MARKET PARTICIPATION, CHANNEL CHOICE AND IMPACTS ON HOUSEHOLD WELFARE: THE CASE OF SMALLHOLDER FARMERS IN TANZANIA

By

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The following publications form part of the research presented in this thesis.

Publication 1 – Chapter 3 of this thesis

Mmbando, F.E., E.Z. Wale, and L.J.S. Baiyegunhi (*in press*). Determinants of smallholder farmers' participation in maize and pigeonpea markets in Tanzania. *Agrekon*.

Publication 2 – Chapter 4 of this thesis

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Publication 4 – Chapter 5 of this thesis

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The data analyses and discussion of empirical results for all the above-listed publications were conducted in their entirety by F.E. Mmbando with technical advice from Prof. Zegeye and Dr. Baiyegunhi. All figures and tables were produced by the same, unless otherwise referenced in the respective publications.

LIST OF CONFERENCE PAPERS

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Mmbando, F.E., E.Z. Wale, and L.J.S. Baiyegunhi. Impact of market channel choice on household welfare: A case study of Tanzania smallholder maize and pigeonpea farmers. Presented at the 9th Africa Farm Management Association (AFMA) Conference, Cape Town, South Africa, 16-20 November 2014.

ABSTRACT

Markets and improved market access plays an important role in improving rural incomes of smallholder farmers in sub-Saharan African countries, particularly in Tanzania. Despite this, participation of smallholder farmers in markets in Tanzania remains low due to a range of constraints. In rural areas, farmers are lacking sufficient means to overcome the costs of entering the market due to high transaction costs. Poor infrastructure and weak institutions raise transaction costs that considerably alter production and market participation decisions. It is widely acknowledged that the involvement of small farmers into markets can contribute to higher productivity and income growth which, in turn, can enhance food security, poverty reduction efforts, and overall economic growth. Following the liberalisation of agricultural markets in Tanzania, smallholder farmers have alternative market channels for selling their agricultural produce, including maize and pigeonpea. These market channels offer different prices and sales services, which determine farmers' choices of the channel and impact on household income and welfare outcome. However, in Tanzania, where smallholder farmers' market access is a constraining factor, quantitative evidence of the relationship between market participation, market channel choice and impacts on household welfare specifically in maize and pigeonpea farmers is scant. The main objective of this study was to determine factors influencing smallholder farmers' market participation decision, channel choice and the impacts of market participation and channel choice on household welfare.

The research focused on four districts: Karatu and Mbulu in the northern zone and Kilosa and Mvomero in the eastern zone of Tanzania. A multi-stage sampling procedure was used to select villages and households, whereby a total of 700 farm households were surveyed. Heckman selection model results showed that fixed transaction costs associated with market information and household characteristics (such as gender and education level of the household head) had a statistically significant influence on maize and pigeonpea market participation. Similarly, distance to market, output prices, farm size, labour force, membership of farmer associations and geographical location of households influenced both market participation and intensity of participation. These results suggest that policies aimed at improving rural road infrastructure, market information systems, smallholder asset accumulation, human capital and promotion of farmer associations could reduce transaction costs and enhance market participation and marketed supply by smallholder farmers.

The multinomial logit results revealed that transaction costs (as a result of distance to markets, quality of road to market, lack of price information, and lack of trust in working relationships with buyers), household wealth, membership in farmer association/group, access to extension services and access to credit significantly influence the choice of profitable market channels by maize and pigeonpea smallholder farmers. The results suggest that policies aimed at reducing transaction costs (such as through increased investment in rural infrastructure, improved market information systems and farm households' access to assets) appear to be important intervention avenues that can affect profitable channel choice in the study area. Promoting farmers' groups/associations (such as producer and marketing groups) is among the efforts that need to be focused to facilitate smallholders' technology and information transfer, bargaining power and trust between farmers and buyers.

This study also examined the impact of market participation and channel choice on household welfare. The propensity score matching and endogenous switching regression results indicated that participation in maize and pigeonpea markets has positive and significant impact on household welfare, measured by consumption expenditure per capita among sample of rural households. The results also showed that the level of market participation has significant positive impact on consumption expenditure per capita. This confirms the role of market participation and level of participation in improving rural household welfare, as higher gain of consumption expenditure from market participation and level of participation also means improved food security and reduced poverty. The empirical results from multinomial endogenous treatment regression showed that market channel choice has positive impact on household welfare. Participation in rural traders and wholesalers market channels has significant positive impact on consumption expenditure per capita relative to brokers channel, for both maize and pigeonpea. The study suggests that policies and programs that support household capacity to produce surplus production and inclusion of smallholder farmers in more profitable markets could increase market participation, improve household welfare and reduce poverty among rural households.

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DEDICATION

I dedicate this thesis to my wife, Sia, and my children, Elvis and Evance.

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LIST OF ACRONYMS

AEU	Adult Equivalent Units
ARC	Agricultural Research Council of South Africa
ATE	Average Treatment Effect
ATT	Average Treatment effect for the Treated
BH	Base Heterogeneity
CIMMYT	Centro Internacional de Mejoramiento de Maízy Trigo (International Maize and Wheat Improvement Center)
CRM	Caliper and Radius Matching
FAO	Food and Agriculture Organization of the United Nations
FIML	Full Information Maximum Likelihood
FSD	Food Security Department
FTC	Fixed transaction costs
GDP	Gross Domestic Product
KBM	Kernel-Based Matching
KSh	Kenyan Shillings
LR	Likelihood Ratio
MAFC	Ministry of Agriculture Food Security and Cooperatives
MNL	Multinomial Logit Model
NGO	Non-Governmental Organization
NIE	New Institutional Economics
NNM	Nearest Neighbor Matching
OLS	Ordinary Least Squares
PC	Principal Component

PCA	Principal Component Analysis
PSM	Propensity Score Matching
PTC	Proportional Transaction Costs
RUM	Random Utility Model
SARI	Selian Agricultural Research Institute
SIM	Stratification and Interval Matching
SIMLESA	Sustainable Intensification of Maize and Legume in East and Southern Africa
SSA	Sub-Saharan Africa
TH	Transitional Heterogeneity
TLU	Tropical Livestock Unit
TSh	Tanzanian Shillings
TT	Treatment on the Treated
TU	Treatment on the Untreated
UKZN	University of KwaZulu-Natal
URT	United Republic of Tanzania
USAID	United States Agency for International Development
US$	United States Dollar
VIF	Variance Inflation Factor

CHAPTER 1. INTRODUCTION

1.1 Background

Agriculture is the largest employer of labour in many sub-Saharan African (SSA) economies, with the greatest potential for enhancing food security and poverty reduction (World Bank, 2008). It employs 62% of the population of SSA (excluding South Africa) and generates 27% of GDP of these countries, with the majority of the poor living in rural areas (FAO, 2006; World Bank, 2008)[1]. In Tanzania, agricultural sector plays a key role in the country's economy - contributing about 43%t to GDP, employing about 70% of the national labour force and generating three quarters of merchandise exports. The sector is characterized by high smallholder participation and represents a source of livelihood to about 80% of the population (World Bank, 2008). Thus, the sector has a considerable impact on rural incomes, poverty reduction and food security. Maize is the most important cereal crop, staple and source of farm income for the smallholder farmers in Tanzania. It is grown in all the agro-ecological zones of the country, and constitutes over 45% and 75% of the total cultivated land and cereal production, respectively (USAID, 2010). About 85% of Tanzania's population depends on maize as an income-generating commodity. Maize accounts for 31% of the total food production and constitutes more than 75% of the cereal consumption in the country. It is estimated that the annual per capita consumption of maize in Tanzania is over 115 kg (Amani, 2004). On the other hand, pigeonpea is an important grain legume grown in the semi-arid regions of Tanzania. The crop constitutes about 5% of the total output of pulses and 4% of the total area under pulses, making it the third most produced pulse after beans and cowpeas in the country (Simtowe *et al.,* 2011). At smallholder level, pigeonpea is used mainly as food, both as dry grain and as a green vegetable, and provides a cheap source of protein. In either form, it makes an important contribution to the diet of resource-poor farmers, especially when the main staple crop fails as a result of drought. Only 35% of the total pigeonpea production is consumed on-farm while about 65% is exported to international markets (Shiferaw *et al*., 2005).

[1] For SSA including South Africa, agriculture employs 59% of the population and generates 17% of GDP.

Considering that agriculture remains a major sector in most economies in sub-Saharan Africa including Tanzania, commercialization of the sector requires improving the ability of smallholder farmers to participate in markets. Markets and improved market access plays an important role in improving rural incomes of smallholder farmers (Ouma, *et al*., 2010). Despite these factors, participation of smallholder farmers in markets in most sub-Saharan Africa countries remains low due to a range of constraints. One of the limiting constraints faced by smallholder farmers is linked to poor market access (Makhura, 2001). In rural areas, farmers lack sufficient means to overcome the costs of entering the market due to high transaction costs (Barrett, 2008; Komarek, 2010). Poor infrastructure and weak institutions cause transaction costs to rise, which considerably alter production and market-participation decisions. The majority of smallholder farmers are located in remote areas with poor transport and market infrastructures, contributing to the high transaction costs they are already facing. In addition, they lack reliable market information as well as information on potential exchange partners (Ouma *et al.,* 2010). Furthermore, in many instances, the poor do not possess the level of assets required to protect themselves from market, natural, political and social shocks (Handley *et al.,* 2009). According to Barret (2008), private asset accumulation, public infrastructure and services are the prerequisites that smallholders need to escape from subsistence production and produce marketable surplus.

On one hand, farmers' choice of market channel is a very important aspect in market participation decision. Following the liberalization of agricultural markets in Tanzania in the early 1990s, smallholder farmers have alternative market channels for selling their agricultural produce, including maize and pigeonpea. These market channels include the informal and formal channels that offer different prices and sales services, which determine farmers' choices of the channel for marketing their produce (USAID, 2010). Informal markets embrace unofficial transactions between farmers and from farmers directly to consumers, such as intermediary (brokers), other farmers, relatives or neighbours. Formal markets (such as traders, wholesalers and cooperatives) have clearly defined grades, quality standards, and safety regulations (Grimsdell, 1996). Smallholder farmers find it difficult to penetrate the formal markets due to high transaction costs, high risks, missing markets, and lack of collective action (Jari and Fraser, 2009). Most farmers in developing countries are fragmented and geographically isolated, and outside the reach of formal market institutions. Research in South Africa has shown that there are few small-scale farmers that are integrated into formal agribusiness value chains either for supermarkets or agri-processors (Sartorius

and Kirsten, 2006). Most small-scale farmers in remote areas still supply to traditional markets such as hawkers and wet/open markets because of high transaction costs (Louw *et al*., 2008).

The issue of welfare gains to smallholder farmers from participation in market and channel choice, specifically in sub-Saharan Africa countries has acquired much significance in recent times (Barrett, 2008; Bellemare and Barrett, 2006; Barrett *et al*., 2012). According to Barret (2008) there is a high potential for smallholder farmers to derive livelihoods from market-oriented agriculture. Increasing participation in agricultural markets is a key factor to lifting rural households out of poverty in African countries (Heltberg and Tarp 2002; Balagtas and Coulibaly, 2007). Similarly, the choice of market channels by smallholder farmers plays an important role in improving rural incomes (USAID, 2010). Rural agricultural households are thus a logical focus for food security and poverty alleviation policies. These policies commonly regard boosting agricultural productivity and increasing rates of market participation and channel choice as key instruments for improving the living standards of agricultural households (Rios *et al*., 2009). Increasing market participation and rural incomes will require some form of transformation out of the semi-subsistence, that currently characterize much of rural households in Tanzania. However, commercialization of the agricultural sector requires improving the ability of smallholder farmers to produce marketable surplus, market participation and choice of profitable markets channels. The next section presents the detailed research problem and justification, followed by objectives of the study in section 1.3. Research hypotheses are presented in section 1.4, and section 1.5 provides an outline of the rest of the thesis.

1.2 Problem statement and justification

Previous studies indicate that smallholders find it difficult to participate in markets because of a range of constraints that reduce the incentives for participation, which may be reflected in hidden costs that make access to markets and productive assets difficult (Makhura *et al*., 2001). In rural areas, farmers are lacking sufficient means to overcome the costs of entering the market, such as assets, access to information (Barrett, 2008; Uchezuba *et al*., 2009). According to Barret (2008), private asset accumulation, public infrastructure and services are the prerequisites for smallholders to escape from subsistence production and produce

marketable surplus. In this regards, commercialisation of the agricultural sector in sub-Saharan Africa, particularly in Tanzania, requires the ability of smallholder farmers to improve, in order for them to produce a marketable surplus and participate in markets. Increasing market participation and rural incomes will require smallholder farmers to understand the factors that influence smallholder market participation and the level of participation. However, very few studies have empirically investigated the factors that influence smallholder farmers' market participation in Tanzania (Rios *et al*., 2009; Asfaw *et al.,* 2012). This study is important from a policy perspective, as little is understood about the factors that influence smallholder market participation, particularly the role of transaction costs and assets in Tanzania. Understanding factors that influence smallholder farmers' market participation and level of participation will assist policy makers to develop strategies required to improve market participation and household income.

High transaction costs are major marketing constraints for smallholder farmers in developing countries specifically in Tanzania. Transaction costs such as distance to market, poor infrastructure, lack of market information, insufficient expertise on and use of grades and standards have under-use of different market channels (Jari and Fraser, 2009). Overcoming these constraints requires understanding factors influencing smallholder famers' choice of marketing channel. These can be a key strategy for increasing access of smallholders to assets, information, services and markets necessary to raise their incomes. However, no empirical study has been carried out to investigate factors influencing the choice of marketing channel by smallholder farmers specifically in maize and pigeonpea markets in Tanzania. No empirical evidence about why producers choose specific market channels and how transaction costs influence market channel choices. A study of this nature is, therefore, important from a policy perspective as it will inform practical interventions required to improve smallholders' market choice and in ultimately increasing their welfare.

A farmer's decision to participate in agricultural markets is one of the most important determinants of household welfare (Smale, 2006; Barrett, 2008; World Bank, 2008). In sub-Saharan Africa specifically in Tanzania, quantitative evidence of the relationship between smallholder market participation and household welfare is scarce (Minten and Barrett 2008). Should participation in markets lead to welfare gains, it offers credible opportunities for smallholder farmers to transform their livelihoods. In more recent study in Zambia, Lubungu (2013) used propensity-score matching to investigate the welfare effects of smallholder

farmers' participation in livestock markets, and concluded that participation in cattle markets raises household income by over 50% on average among cattle selling households. Asfaw *et al.* (2012) found that maize and pigeonpea market participation in northern Tanzania results in higher per capita expenditure.

Other studies on the welfare impact of market participation in developing countries; Bozzoli and Brück (2009) analyses the market participation of farm households in the post-war environment in northern Mozambique and finds that market participation has positive welfare effects. Maertens and Swinnen (2009) found that French beans market participation significantly lower poverty by 14% in Senegal. Similarly, Maertens *et al*. (2011) in Senegal found that market participation in the tomato agro-industry increases household incomes by 47% to 57% on average. Moreover, Smale *et al*. (2012) showed that input market participation in Mali contributes to increased food security. Kamara (2004) found that improvement in market access in Kenya increases productivity hence reduces poverty.

While all these studies have analyzed welfare impact of market participation, there is hardly any work that has examined the impact of level of market participation on household welfare. These studies have documented the welfare effects of market participation for binary treatment (i.e. mean impacts) but failed to examine the effects of level of market participation on household welfare. In this study, this research gap is addressed by analyzing the impacts of market participation and level of participation on household welfare among maize and pigeonpea smallholder farmers in northern and eastern Tanzania. Studying the welfare effects of level of market participation allow to go beyond the simple mean impacts that dominate the literature. Level of market participation is commonly measured as the ratio of percentage value of marketed output to total farm production (Haddad and Bouis, 1990). It involves the transition from subsistence farming to increased market-oriented production (Omiti *et al*., 2006). Analyzing welfare impact of level of market participation plays a critical role in meeting the overall goals for food security, poverty alleviation, and sustainable agriculture, particularly among smallholder farmers in developing countries (Altshul *et al*., 1998). Understanding the impact of level of market participation has potential impact on smallholder farmers' participation in commercial agriculture. This is potential for unlocking suitable opportunity sets necessary for providing better incomes and sustainable livelihoods for smallholder farmers. Commercial orientation of smallholder agriculture 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). These changes improve the welfare of smallholder farmers in two ways: for consumers, low food prices increase the purchasing power for food, while for producers a decline in food prices enables the reallocation of limited household incomes to high-value non-food agribusiness sectors and more profitable non-farm enterprises. Promoting investments in agricultural commercialization among smallholder farmers could reduce poverty (Geda *et al.*, 2001). The potential benefits of higher product prices and lower input prices due to commercialization are effectively transmitted to poor households when market access is guaranteed (IFAD, 2001).

Market participation effects are likely to be heterogeneous, suggesting that all participants may not benefit in the same way from participation. Looking at features of the distribution of impacts other than just the mean provides a more accurate picture on welfare impacts (Kassie *et al*., 2014). However, in sub-Saharan Africa, where smallholder farmers' market access is a constraining factor, quantitative evidence of the heterogeneous impact of market participation on household welfare is scarce (Barrett, 2008). By analyzing impact of market participation and level of participation, this study also aims to fill this gap in the literature by evaluating the heterogeneous impacts of market participation on household welfare.

Unlike other studies (e.g. Maertens and Swinnen, 2009; Maertens *et al*., 2011; Lubungu, 2013), who used per capita income as a measure of household welfare, this study rely on per capita consumption expenditure as a measure of household welfare which is more reliable welfare indicator and less prone to measurement error than total household income. Besides, household income indicates the ability of the household to purchase its basic needs of life while per capita expenditure reflects the effective consumption of households and therefore provides information on food security status of households. Unlike previous study in Tanzania (Asfaw *et al*., 2012) that focused on maize and pigeonpea largely in only northern zone of Tanzania, this study focuses on the northern and eastern zones of Tanzania, making it more representative of maize-legume producing area in the country. Due to the facts that eastern zone is also important in maize and pigeonpea production, this can be representative of the major maize–legume farming systems in the country. Given that poverty is more widespread in rural sub-Saharan Africa especially in Tanzania, new empirical results on links between market participation, level of participation and household welfare are crucial to making policy interventions more effective in improving food security and living standards of rural population.

Recent developments in Africa highlight an increasing trend toward liberalized domestic markets, whereby smallholder farmers have alternative market channels for selling their agricultural produce. These market channels offer different prices and sales services, which determine farmers' choices of the channel and impact on household income and welfare outcome (USAID, 2010). The market channel choice and the price that smallholders receive for their agricultural products have great implications for household welfare and poverty alleviation. In many sub-Saharan African countries, including Tanzania, smallholder farmers typically have a choice between selling their products to brokers, who travel back-and-forth between villages and markets or transporting their products themselves to the nearest market (Fafchamps and Vargas-Hill, 2005). The different market avenues affect the share of the benefit that goes to farmers. Brokers may take advantage of a farmers ignorance of the market price, seeking to extract a rent from them by offering very low prices for their products (Fafchamps and Vargas-Hill, 2005; Mérel *et al*., 2009). Access to better-paying markets for agricultural products is vital in enhancing and diversifying the livelihoods of poor subsistence or semi-subsistence farmers (Kirui *et al*., 2013).

Increased profitability for farmers from marketing decisions may lead them to change their production, investment in productive assets, new agricultural technologies and improve household welfare (Jensen, 2010). However, in sub-Saharan Africa, specifically in Tanzania, where smallholder farmers' market access is a constraining factor, quantitative evidence of the relationship between market channel choice and household welfare is thin (Barrett, 2008). For example, while there are early signs of improving market integration in sub-Saharan Africa, it is unclear how smallholders participate or if they benefit from participating in different market channels (Gomez *et al*., 2011). Moreover, in this study, the possibility of self-selection into market channel choice by the smallholder farmers was explicitly considered and, as such, this represents the study's main contribution to the existing literature on impact of market channel choice among smallholder farmers. In this regard, understanding the link between smallholder market channel choice and household welfare is potentially beneficial to policy makers aimed at improving welfare of rural households. It is also important for supporting the economic inclusion of rural farm households and in ultimately increasing their welfare. The specific objectives of the study are presented in the next section.

1.3 The objectives of the study

In the context of rural Tanzania, the general objective of this study is to generate empirical evidence on smallholder market participation, channel choice decisions and welfare impacts among maize and pigeonpea smallholder farmers.

The specific objectives are to:

i) identify the factors that influence smallholder farmers' decision to participate and explain the intensity of their participation in maize and pigeonpea markets;
ii) examine the factors affecting the choice of marketing channels by smallholder farmers; and
iii) assess the impact of market participation and channel choice on household welfare.

To achieve the above objectives, the study uses quantitative data gathered through household survey in Northern and Eastern zones of Tanzania. Different conceptual and empirical methods have been employed. The empirical results are presented in chapters three to five.

1.4 Hypotheses

Hypothesis (i): Farmers with better access and endowment to assets (wealth) do not participate in the market.

Household asset holdings have been recognized as key determinants of market participation in many empirical studies (Nyoro *et al*., 1999; Cadot *et al*., 2006; Boughton *et al*., 2007) in sub-Saharan Africa. According to Goetz (1992) and Asfaw et al. (2012), access to assets (such as land, livestock, transport and communication assets) enhances smallholder market participation. Livestock ownership is a proxy for wealth and provides a risk diversification benefit and increasing the labour efficiency of the household (Binswanger and McIntire, 1987; Kalinda *et al.,* 2000). Ownership of physical assets such as cart, bicycle and motorized vehicle lower transportation, communication and information costs and subsequently fewer obstacles to entering the market (Boughton *et al*., 2007; Goetz, 1992; Key *et al.,* 2000).

Hypothesis (ii): Transaction costs do not influence smallholder farmers' market participation and channel choice.

Several studies show that transaction costs are significant barriers to market participation by smallholder farmers (Goetz, 1992; Key *et al*., 2000; Makhura *et al*., 2001; Gabre-Madhin *et al*., 2002; Alene *et al*., 2008; Barrett, 2008; Jagwe *et al*., 2010). Transaction costs significantly hinder market participation whereas better market information stimulates it (Alene *et al*., 2008). Access to markets and roads are expected to reduce marketing costs, thus encourage market participation. Distance to market as a proxy for transaction costs has a negative effect on market participation; that is, the greater distance to the market increases transaction costs (Barrett, 2007; Key et al., 2001). Most smallholders do not participate as sellers because they face high transaction costs which limit household's market access (Barrett, 2008). Lack of market information hinder market participation by raising search, screening and bargaining costs (Cadot *et al*., 2006; Alene *et al*., 2008). On the other hand, transaction costs play an important role in market channel choice by smallholder farmers. Payment delay, as a proxy for negotiation costs had a negative influence on market channel choice (Chitika, 2009). Poor infrastructure, lack of market transport, lack of market information, insufficient expertise on and use of grades and standards have led to inefficient use of different market channels (Jari and Fraser, 2009).

Hypothesis (iii): Market participation and channel choice do not influence household welfare.

Market participation and channel choice motivates smallholder farmers to move from subsistence farming to commercial farming (Makhura, 2001; Rao and Qaim, 2011). Commercial farming increases farm's output, hence enabling the farmer to earn more income. Smallholder farmers' market participation and channel choice is very vital for sustaining economic growth, food security and poverty alleviation (Jari and Fraser, 2009; Little, 1994). Most farmers who participated in the market tend to be food secure because the income they derives from the sale of their output has enabled them to purchase the staple food. It is widely acknowledged that the involvement of small farmers into markets can contribute to higher productivity and income growth, which in turn can enhance food security, poverty reduction and overall economic growth (Barrett, 2008).

The next section presents the outline of the thesis.

1.5 Outline of the thesis

This thesis is organized under six chapters, including this introductory chapter. Chapter 2 provides the literature review of the study. Having defines some key concepts and terminologies, it provides an overview of the factors affecting market participation and channel choice by smallholder farmers in developing countries. It also provides the theoretical and empirical evidence on the welfare impact of market participation and channel choice. Chapter 3 assesses the determinants of smallholder farmers' participation in maize and pigeonpea markets in Tanzania. It analyses the factors influencing market participation decisions and the intensity of participation among maize and pigeonpea smallholder farmers. Chapter 4 analyses the factors that influence smallholder farmers' choice of marketing channel in Tanzania. Chapter 5 examines the welfare impacts of market participation and channel choice by maize and pigeonpea smallholder farmers, measured by household expenditures. Finally, chapter 6 presents the conclusions and policy implications of the research findings, and associated recommendations for further research.

CHAPTER 2. LITERATURE REVIEW

2.1 Introduction

This chapter reviews theoretical and empirical literature relating to smallholder market participation, channel choice and impacts on household welfare. The chapter starts by offering some definitional aspects of the terms and concepts of the study, namely, smallholder farmers, market participation, market channel choice and the concept of transaction costs. An exact understanding of these terminologies is important in explaining smallholder farmers' market participation, channel choice and welfare impacts in the study area. The chapter also reviews literature on the determinants of smallholder market participation decision and channel choice in developing countries. This is followed by presentation on the theoretical and empirical evidence on the welfare impacts of market participation and channel choice.

2.2 Concepts and Definitions

2.2.1 Smallholder farmers

Smallholder farmers are defined in various ways depending on context, country and ecological zone. This explains interchangeable use of the term 'smallholder' with 'small-scale', 'resource poor' and 'peasant farmer'. The World Bank's Rural Development Strategy defines smallholders as those with a low asset base, operating less than 2 hectares of cropland and depending on household members for most of the labour (World Bank, 2003). FAO study defines smallholders as farmers with limited resource endowments, relative to other farmers in the sector (Dixon *et al.,* 2003). According to Ellis (1988), smallholder farmers are farm households with access to means of livelihoods in land relying primarily on family labour for farm production to produce for self-subsistence and often for market sale. Todaro (1989) defines smallholder farmers as owning small-based plots of land on which they grow subsistence crops and one or two cash crops relying almost exclusively on family labour. These definitions have a similar theme in the characteristics of smallholder farmers, namely constraints in land and labour. In addition, Dixon *et al.* (2005) suggests that most smallholders have diverse sources of livelihood including significant off-farm income yet are still vulnerable to economic and climatic shocks. Smallholder farmers differ in individual

characteristics, farm sizes, resource distribution between food and cash crops, livestock and off-farm activities, their use of external inputs and hired labour, the proportion of food crops sold and household expenditure patterns. These differences and constraints highlighted above are typical characteristics of smallholder farmers in Tanzania. The next sub-section describes the concept of market participation.

2.2.2 Market participation

Various definitions of market participation have been suggested by different authors. Some studies consider market participation as any market related activity which promotes the sale of produce (Key *et al*., 2000; Holloway and Ehui, 2002; Lapar *et al*., 2003). According to William *et al.* (2008), market participation defined 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. This sales index would be zero for a household that sells nothing, and could be greater than unity for households that add value to their crop production via further processing and/or storage. Improvements in market participation are necessary to link smallholder farmers to markets in order to expand demand for agricultural products as well as set opportunities for income generation (Pingali, 1997).

Goetz (1992) defined market participation using household purchases and sales, whereby volume of produce traded are used to determine market participation. According to Latt and Nieuwoudt (1988) market participation can be referred to as commercialization, which means that increased market participation implies the transition from subsistence farming to a market engagement mode, whereby frequent use of markets is made for the purpose of exchanging products and services. In an agricultural market economy, market participation of commercialization occurs mainly when farmers stop being mostly subsistence and become profit-oriented (Makhura *et al*., 2001). Hazell *et al*. (2007) found out that agricultural commercialization as the degree of participation in the output markets with the focus very much on cash incomes. Increased market participation implies the transition from subsistence farming to a market engagement mode, whereby frequent use of markets is made for the purpose of exchanging products and services. The next sub-section describes the concept of market channel choice.

2.2.3 Marketing channel choice

Marketing channels are defined as downstream part of the value chain consisted of numerous chain actors at different outlets, where final products are available to final consumers (Arinloye, 2012). Coughlan *et al*. (2001) see those chain actors as utility creating parties that offer end-users a combination of attractive products and services. According to Giles (1973), the marketing channels refer to the system of marketing institutions through which goods or services are transferred from the original producers to the ultimate users or consumers. Most frequently a physical product transfer is involved, but sometimes an intermediate marketing institution may take title to goods without actually handling them. Kohls and Uhl (1990) focuses on the marketing of agricultural products, define marketing channels as alternative routes of product flows from producers to consumers. Kotler (2003) also explains marketing channels as a set of interdependent organizations involved in the process of making a product or services available for use or consumption. Most producers do not sell their goods directly to the final users; between them stands a set of intermediaries performing a variety of functions. These intermediaries constitute a marketing channel. According to Stern *et al*. (1996) marketing channels refers as sets of interdependent organisations involved in the process of making a product or service available for use or consumption. The channel follows a vertical structure where products flow from producer to the ultimate consumer and in which actors meet each other at markets. Producers, wholesalers and retailers as well as other channel actors exist in channel arrangements to perform marketing functions (business activities) that contribute to the product flow.

Marketing channel choice is one of the most important farm household decisions and has a great impact on the household income. Before choosing a marketing channel, farmers consider the costs associated with transportation, profits, level of trust among the available channels and familiarity of the markets, among other factors (Makhura, 2001). In other instances, farmers market their produce through channels offering low prices because they either lack market knowledge or have difficulties in accessing markets that are more rewarding. The choice of the channel to use is a fundamental decision for the smallholder farmers where a number of factors have to be considered as a basis for such decision. Farmers need a clear understanding of market characteristics before beginning the selection of channel. The next sub-section presents the concept of transaction costs.

2.2.4 The concept of transaction costs

New Institutional Economics (NIE) defines transaction costs as costs relating to searching and gathering on agents and goods or services. They involve costs of bargaining and negotiating contracts while including costs of monitoring and enforcement (Bromley, 1991). However, Eggertson (1990) defines transaction costs as costs which arise when activities such as information search, bargaining, contracting, monitoring, enforcement and protection of property rights are done. Transactions costs are the embodiment of barriers to market participation by smallholder farmers and have been used as a definitional characteristic of smallholders and as factor responsible for significant market failures in developing countries (de Janvry *et al*., 1991; Sadoulet and de Janvry, 1995). Transaction costs, occasionally referred to as "hidden costs", are the observable and non-observable costs associated with exchange of goods and services (Jagwe *et al*., 2010). These costs arise due to the frictions involved in the exchange process, as it entails transfer and enforcement of property rights.

Transactions costs can explain why some farmers participate in markets while others are simply self-sufficient. Differences in transactions costs, as well as differential access to assets and services to mitigate these transactions costs are possible factors underlying heterogeneous market participation among smallholders (Alene *et al*., 2008). According to Scott (1995), transaction costs include *ex-ante* costs of determining whether an exchange is advantageous, cost of carrying out the exchange such as finding buyers or sellers and cost of transportation, and, where applicable, *ex-post* costs of ensuring that all requirements of the exchange were met. Transaction costs are present every time that there is a trade or a marketing transaction. Transaction costs also imply imperfect knowledge of market opportunities, prices, buyers, quality grades and standards, among others. Together with information asymmetry, these factors increase the cost of information. When transaction costs are large, total costs (the combined sum of production and transaction costs) can exceed total revenue, resulting in "market failure" which means that firms forgo investments that would otherwise be profitable (Jagwe *et al*., 2010).

Key *et al*. (2000) categorized transaction costs into fixed and variable or proportional transaction costs. Fixed transaction costs (FTCs) are invariant to the volume of output traded and affect smallholder farmers' market participation decisions. These costs include the costs of (a) searching for a trading partner; (b) negotiating and bargaining, particularly when there is imperfect information about prices; and (c) enforcing contracts and supervision,

particularly when credit sales are involved, as sellers have to screen buyers for reliability to lower the likelihood of defaults (Fafchamps, 2004). Variable or proportional transaction costs (PTCs), on the other hand, are per unit costs of accessing markets that vary with the volumes traded and may affect the decision to participate in the market, as well as the quantity traded. They include costs associated with the transfer of the output being traded, such as transport costs and time spent delivering the product to the market. These costs are largely unobservable or cannot easily be recorded in a survey. In essence, the variable transaction costs raise the real price of the commodity purchased and lower the real price received for commodity sold (Ouma *et al*., 2010).

Hobbs (1997) applied the transaction cost economics framework to the choice of marketing in agricultural products, and identifies three types of transaction costs in agricultural marketing: information costs, negotiation and bargaining costs, and monitoring and enforcement costs. Information costs (ex-ante transaction costs) are the costs of identifying markets and trading partners, and costs of obtaining price and product information. Negotiation costs are the costs of physically carrying out the transaction, including the costs of physically negotiating, bargaining and formally drawing up the terms of exchange. Monitoring and enforcement costs (ex-post transaction costs) are the costs of ensuring that the trading partners follow the terms of the transaction, such as quality standards or payment arrangements.

According to Sadoulet and de Janvry (1995), transaction costs include costs resulting from distance from markets, poor infrastructure, high marketing margins, imperfect information, supervision and incentive costs. The transaction costs emanate from a number of sources; smallholder farmers are located in remote areas far away from service providers and major consumers of farm products. The distance to the market, together with the poor infrastructure, poor access to assets and information is manifested in high exchange costs. The next section reviews empirical evidence on the factors influencing market participation by smallholder farmers in developing countries.

2.3 Determinants of market participation by smallholder farmers in developing countries

2.3.1 Transaction costs

The key argument in the most of literature on smallholder market participation in developing countries is the effects of transactions costs. Transaction costs hamper market participation because they impose added cost burdens to the efficient conduct of market entry activities. The majority of smallholder farmers in developing countries are located in remote areas with poor infrastructure and they often fail to participate to markets due to the high transaction costs involved (Goetz, 1992; Key, 2000; Makhura, 2001). Several studies show that transaction costs are significant barriers to market participation by smallholder farmers (Goetz, 1992; Key *et al*., 2000; Makhura *et al*., 2001; Gabre-Madhin *et al*., 2002; Obare *et al*., 2003; Cadot *et al*., 2006; Alene *et al*., 2008; Barrett, 2008; Jagwe *et al*., 2010; Asfaw *et al*., 2012).

Goetz (1992), in his pioneering work, estimated a switching regression model of market participation and amount traded to grain market in Senegal; separating the decision of whether or not to participate in markets from the decision of how much to trade. He found that fixed transactions costs significantly hindered, while better information stimulated, smallholder's market participation. Elaborating the works by Goetz (1992), Key *et al*. (2000) develop a model of supply response when transaction costs cause some producers to buy, others to sell, and others not to participate in markets. They consider fixed transaction costs (FTCs) and proportional transaction costs (PTCs). Fixed transaction costs are invariant to the quantity of the good traded, whereas proportional transaction costs increase proportionally in quantity. Thus, PTCs corresponds to constant marginal transaction costs. They estimated the model using data consisting of Mexican corn producers and the results indicate that both types of transactions costs – fixed and proportional – play significant role in explaining household behaviour, with proportional transaction costs being more important in selling decisions.

Alene *et al*. (2008) argue that transaction costs significantly hinder market participation whereas better market information stimulates it. Access to markets and roads are expected to reduce marketing costs, thus encourage market participation. Barrett (2007); Gabre-Madhin

et al. (2002), examined the role of marketing costs in limiting the level of smallholder market participation. Results show that distance to market considered as a proxy for transaction costs and has a negative effect on market participation; that is, the greater distance to the market increases transaction costs.

Barrett (2008) provides a detailed literature review on smallholder market participation in eastern and southern Africa, focusing on staple food-grains markets. He found that the empirical evidence suggests that most smallholders do not participate as sellers because they face two basic classes of barriers to entry; at the micro-level, households have insufficient access to productive assets, financing, and new production technologies; and at the macro-level, especially in remote areas, high transaction costs limit household's market access. 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. Thus, the variable transport costs per unit of distance increases with the potential marketable load size. For farmers in very remote rural areas, geographic isolation through distance creates a wedge between farm gate and market prices.

Asfaw *et al*. (2012); Cadot *et al*. (2006); and Alene *et al*. (2008) found that, the nearer a farmer is to the main market, the greater the likelihood of market participation and marketed surplus. On the other hand, lack of market information hinder market participation by raising search, screening and bargaining costs. Furthermore, poor state of roads as well as inadequate road networks obviously hinders market participation. During rainy season many rural roads are impassable resulting in high transport costs and in cases where buyers provide transport, this further reduces the price that buyers are prepared to pay farmers. Obare *et al*. (2003) revealed that insufficient road infrastructure is associated with poor development of markets through high transaction costs. Thus, the farther a household is away from the town, the higher the transaction costs of obtaining information and market outlet. Furthermore, proximity to towns reflects how far farmers have to travel to reach sources of information (Makhura *et al*., 2001).

Renkow *et al*. (2004) studying Kenyan smallholder households, found that fixed transactions costs, on average is slightly lower in areas with reliable motorized transport service and that are closer to markets. Nevertheless, information costs are often considered to be fixed transaction costs that influence market entry decisions (Omamo, 1998). This means that the

type of information source has a significant effect on the intensity of market participation. Thus, formal sources (for example radio, television and public and private institutional channels) are significant in improving the proportion of output sold. On the other hand, informal sources (mainly friends, neighbours and other non-institutional sources) are more effective for providing relevant market information that increases the intensity of participation.

Studies in Asia also show that transaction costs have significant negative effect on market participation by smallholder farmers. For instance, in Peru, market participation was low among smallholder potato producers because of the high transaction costs and formal markets became inaccessible (Maltsoglou and Tanyeri-Abur, 2005). A case study from the Philippines also shows that high transaction costs played a significant part in decreasing market participation among smallholder livestock producers (Lapar *et al.*, 2003).

2.3.2 Household characteristics

Most previous studies find that household characteristics have significant influence on output markets participation (Key *et al*., 2000; Makhura, 2001; Matungul *et al*., 2001; Lapar *et al*., 2003; Benfica *et al*., 2006; Alene *et al*., 2008; Barrett, 2008; Randela *et al*., 2008; Asfaw *et al*., 2012). While admitting that transaction costs is important in encouraging market participation, Goetz (1992) showed empirical evidence in his study of a significant parabolic relationship between age and market participation. This is also true for the food markets in Tanzania and Ethiopia (Asfaw *et al*., 2011). Age affects supply participation in that older heads of households have more experience and greater contacts allowing for trade opportunities to be discovered at lower costs. Age also indicates increased trust between trading partners through repeated exchange with the same party. The relationship between participation and age is parabolic indicating that beyond a certain age, farmers produce less (they grow older and get past their productive age) and participation in the market reduces (Goetz, 1992).

Age and education not only enhance production, they also mitigate transaction costs as they increase the ability of farmers to obtain market information. Matungul *et al*. (2001), also found that age have significant influence on market participation, as older and more

experienced household heads tend to have more personal contacts, allowing discovery of trading opportunities at low cost. According to Randela *et al*. (2008), a positive and significant relationship was found between household market participation and age of the household heads. Moreover, Makhura (2001) argues that being aged (old) also assists farmers to overcome fixed transaction costs since some experiences about the market have been accumulated overtime.

Education level also play a role in enhancing production and mitigating transaction costs by increasing the ability of farmers to obtain market information. Benfica *et al*. (2006) investigated the determinants of participation of tobacco contract farmers in the Zambezi Valley of Mozambique. He found that education have a positive effect on smallholder farmers participation in markets; due to the fact that educated households are expected to have better skills and better access to information. According to Makhura *et al*. (2001) household head's formal education is posited to increase a household's understanding of market dynamics and therefore improve decisions about the amount of output sold. Asfaw *et al*. (2011) in their study of small holder farmers participation in markets in Tanzania and Ethiopia also found that education level, measured in years of schooling had a positive impact on entry to markets and marketed surplus, suggesting that a higher level of education increases productivity and provides a greater opportunity of producing a marketed surplus. Education also reduces transaction costs and market entry barriers as it enables farmers to obtain and process market information, and gives them better negotiation skills (Makhura *et al*., 2001).

Household size reflecting access to family labours supply for production, and also increases domestic consumption requirements and hence lowers market participation (Makhura *et al*., 2001). Therefore household with large household members are expected to produce more marketable output or store it for household consumption. However, a larger household size also meant that more food was needed to feed the household members (Goetz, 1992). The larger the consumption requirement, the less a household could sell. Lapar *et al*. (2003) revealed that the propensity to participate into the market economy declines with higher numbers of household members. Asfaw *et al*. (2012) also found that household size negatively affects market participation, as larger families consumed much of farm output. This could have also been an indication of the inefficiency of smallholder farm labour.

Literature shows that gender is a significant determinant of market participation, with female-headed households being significantly disadvantaged in terms of both participation and level of participation (Tiruneh *et al.*, 2001). Female-headed households in sub-Saharan Africa are disadvantaged because of unequal distribution of resources as well as cultural barriers (Blackden, 1993; Ongile, 1999; Nyakudya *et al.*, 2006). Female-headed households are more likely to be autarkic than to be net sellers, and are more likely to be net buyers than to be autarkic (Bellemare and Barrett, 2006). Thus, it is highly unlikely that women will participate in a market as sellers but instead it is more common for them to participate as buyers. Cunningham *et al*. (2008) also found that gender plays a role in intensity of market participation. They 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.

2.3.3 Product characteristics

Literature shows that product characteristics such as output prices play a role in market participation. The finding by Alene *et al*. (2008) and Komarek (2010) showed that output prices have positive impact on market participation by maize and banana farmers in Kenya and Uganda, respectively. They argue that output price is an incentive for sellers to supply more in the market. According to van Zyl and Coetzee (1990) farm gate prices are viewed as an incentive to smallholders' participation in agricultural markets. Key *et al.* (2000) predicted that a one percent increase in farm gate price increased the probability that a household would participate in agricultural markets by 0.77%. Madikizela and Groenewald (1998) suggested that farmers would always try to determine where they could get the best price for a given crop in order to sell their products. Enete and Igbokwe (2009) found that price had an important influence on the level of farmers' market participation in cassava markets which is supported by economic theory that price induces increased supply. Omiti *et al*. (2009) also asserted that better output price was a key incentive for increased sales in the market.

2.3.4 Household assets

Household asset holdings have been recognized as key determinants of market participation in many empirical studies (Nyoro *et al*., 1999; Cadot *et al*., 2006; Boughton *et al*., 2007) in sub-Saharan Africa. This is because assets determine the quantity of output produced and

have a strong association with smallholder market entry opportunities, helping farmers overcome market entry barriers and thus increasing market access. Private household assets, especially land, but also livestock, labor and equipment, are strongly positively associated with crop market participation. Previous studies (Asfaw *et al*., 2012; Goetz, 1992) show that households need a minimum asset threshold in order to escape from poverty and participate in the market. Lack of assets may result in the exclusion of producers from new and remunerative market opportunities. Assets enhance the capacity of smallholder farmers to access, and take advantage of market opportunities. Barrett (2007), studying market participation in staple grains in sub-Saharan Africa, found that barriers to participation in markets by smallholders were mainly land, livestock, capital and improved technologies like farm equipment needed to generate a surplus that influenced market participation.

A study by Heierli and Gass (2001) showed that assets empower the rural poor by increasing their incomes and makes a household less vulnerable to shocks and the extent of vulnerability determines household market participation. The larger the size of arable land a household uses, the higher the production levels are likely to be, and the higher the probability of market participation. Farmers owning more livestock will participate more in markets, because livestock ownership tends to serve as a security for risk of market failure on the one hand, and contributing to productive assets on the other hand. They argue that ownership of productive assets (e.g. cattle) can pave the way for a family to participate in economic activities (Heierli and Gass, 2001). Ownership of livestock was a major source of income and an insurance substitute (Binswanger and Mclntire, 1987). According to Binswanger and McIntire (1987) and Kalinda *et al.* (2000), livestock ownership is a proxy for wealth and provides a risk diversification benefit. Apart from increasing the labour efficiency of the household, draught power could be rented and could generate income that was reported to correlate positively with market participation. Pravakar *et al*. (2010) on the other hand found that households with larger land holdings per adult member sold larger volumes of their produce as compared to those with smaller land holdings. The authors further found that households with larger livestock endowments produced and sold more crop produce. They explained that it was because the households used manures from the livestock to enhance crop yields.

Randela *et al*. (2008) studied factors that influence market participation in Mpumalanga, South Africa. They found that ownership of cultivation equipment is associated with timely

planting that can lead to higher production; hence, households with relatively higher production levels have a higher probability of market participation. Gebremedhin *et al*. (2009) found that the size of cultivable land, household labour supply and physical capital to be important factors in inducing smallholder market participation. Farmers with bigger cultivable land were found to participate more because of their ability to produce bigger volumes that ensured marketed surpluses. Enete and Igbokwe (2009) found that the probability of market participation declined with declining farm size for sellers of cassava but increased with farm sizes for buyers though not significant in either case. Jayne *et al*. (2010) stated that most smallholders do not own land and lack other resources to produce a surplus.

Many studies (Boughton *et al*., 2007; Goetz, 1992; Key *et al.,* 2000) have found relationships between household ownership of transportation assets such as cart, bicycle and motorized vehicle, and market participation. The reason is that households that owned these physical assets had lower transportation, communication and information costs and subsequently fewer obstacles to entering the market. Boughton *et al*. (2007) analyzed market participation by rural households in Mozambique using an asset-based approach. They revealed that household ownership of means of transport such as bicycle or motorized vehicle increases market participation and sales volumes conditional on participation. Households with own transport are likely to transport their produce on time to the market, thus higher level of participation. Moreover, the availability of transportation facilities helps reduce long market distance constraint, offering greater depth in marketing choices.

Heltberg and Tarp (2002) estimate reduced form equations for market participation and value of food crops (as a group), cash crops (as a group), and total value of crops sales, using data from a 1996-97 Living Standard Measurement Survey (LSMS) in Mozambique. They found that farm size per household worker and animal traction increases food grains market participation and intensity of participation among smallholder farmers. Explaining variation in the value of sales for food crops or cash crops was much less conclusive, and the authors recognize that aggregation of sales into food or cash crop groups may mask underlying causal mechanisms related to individual crop decisions.

Benfica *et al*. (2006) found that participation in market is driven by factor endowments, asset ownership and alternative income opportunities. Access to liquid assets, such as non-farm income may lead to risk reduction in household decision making and, with it, increased

propensity to undertake higher risk activities, notably selling crops or producing for the market. Masuku *et al.* (2001), in their study to identify factors influencing the decision whether or not to sell maize by smallholder fanners in Swaziland, found that the decision whether or not to sell maize was influenced by income from off-farm activities. Alene *et al*. (2008) also 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. Binswanger and McIntire (1987) found that income transfers from relatives reduced risk-aversion behaviour because it insured against adversity. Therefore, families with employed members had more financial resources and were more likely to participate in agricultural markets. Hlongwane *et al*. (2014) analyzing the factors affecting the market participation of maize farmers in Limpopo province in South Africa, found that credit has a positive impact on market participation.

2.3.5 Social capital

Social capital refers to personal social networks that encourage market participation; such as farmer organizations/associations, farmer groups, cooperatives and extension groups (Sharp and Smith, 2003). It is through these networks that trust is developed, which, in turn, encourages cooperation and regular exchanges. Also, information and production resources can be transmitted through these networks, thus link farmers with markets, and encourage market participation (Jari and Fraser, 2009). It is through networks that information and other resources can be transmitted, and the existence of trust facilitates co-operative behaviour based around these networks (Sharp and Smith, 2003).

Various studies have highlighted the importance of social capital in market participation by smallholder producers in developing countries (Christy, 2001; Darr, 2005; Hellin *et al*., 2007; Holloway *et al*., 1999; Key *et al.,* 2000; Kherallah and Kirsten, 2001; Matungul *et al*., 2001; Poulton *et al.,* 1998). Farmers associations were widely believed to be one of the mechanisms for improving smallholder access to agricultural markets (Christy, 2001); facilitating the collection of farmers' outputs and purchasing and distributing inputs in a liberalised market (Poulton *et al.,* 1998; Matungul *et al*., 2001); reducing information, product collection and marketing costs (Key *et al.,* 2000); and facilitating quality control, packaging and storage of

the products (Matungul *et al*., 2001). Kherallah and Kirsten (2001) argue that overcoming the problem of high transaction costs requires that smallholder producers rely on external rather than internal economies of scale through collective action. Hellin *et al*. (2007) and Darr (2005) suggest that farmer association facilitates easier access to commodity markets, technical skills and market information.

Holloway *et al*. (1999) suggests participatory, farmer-led producer organizations that handle output marketing, usually after some form of bulking to address the problem of market access. Rural producer organizations are the various forms of organizations that perform production and marketing for members (Stockbridge *et al*., 2003). Rural producer organizations enable farmers to have improved access to market for their products at a fairer price (Holloway *et al*, 1999; 2000). They help members by aggregating the volume of produce over the number of producers, finding a trader interested in buying, negotiating the price and quality specifications, assembling the product for the delivery date and quantity agreed, collecting payment, paying farmers and retaining a small margin for the organization to cover its expenses (Grootaert, 1997; Collier, 1998).

Collective action in the form of farmer groups or cooperative associations also increase the market supply participation of households as they improve market access and lower fixed transaction costs by providing information (Fischer and Qaim, 2012). Products of various households can be marketed together, reducing transportation costs. Market discovery costs are reduced because this fixed cost is shared or distributed among all participating households. Stockbridge *et al*. (2003) revealed that there is evidence that farmer groups offer one way for smallholder farmers to participate in the market more effectively. Acting collectively, smallholder farmers may be in a better position to reduce transaction costs of accessing inputs and output, obtain market information, secure access to new technologies and tap into high value markets allowing them to compete with large farmers and agribusiness.

Participation in an agricultural scheme such as farmers' groups, extension groups and contact with extension systems also influences smallholder participation in agricultural markets (Masuku *et al.,* 2001). Government involvement in the provision of public goods related to extension and research stimulate smallholder cultivation and market participation (Delgado, 1999). Extension service is a vital factor in enlightening the farmers about proper marketing

of their produce and disseminating accurate and latest market information. The next section presents empirical evidence on the factors influencing market channel choice by smallholder farmers in developing countries.

2.4 Determinants of market channel choice by smallholder farmers in developing countries

Several studies have been carried out to identify factors influencing farmers' choice of marketing channel in developing countries. These studies have identified factors related to transaction costs, farm household characteristics, product characteristics, access to assets, trust and social capital such as farmer group/association affect farmers' market channel choice.

2.4.1 Transaction costs

The influence of transaction costs on market channel choice by smallholder farmers in sub-Saharan Africa is well documented. Masuku *et al.* (2001), in their study to identify factors influencing the choice of marketing channel by maize smallholder farmers in Swaziland, found that transaction costs such as distance to market and transport costs have impact on market channel choice, as the longer the distance the higher the transport cost and the less likely for the farmer to sell through formal channel. That is, the formal marketing chain is associated with high transportation costs. However, farmers would opt for such a chain since prices are generally stable unlike in the informal chain.

Musemwa *et al*. (2007) regard transaction costs as barriers to the efficient participation of producers in different markets. Thus, farmers will not use a particular channel when the value of using that channel is outweighed by the cost of using it. Ogunleye and Oladeji (2007) analyzed the factors that influence the choice of market channel by cocoa farmers in Nigeria. They found that, the factors associated with the choice of channels are the time of payment, mode of payment, price of product and transportation cost. These shows that transaction costs play an important role in market channel choice by smallholder farmers.

Chirwa (2009) analyzed the determinants of marketing channels among smallholder maize farmers in Malawi. He revealed that distance to day markets was positively associated with the choice of private traders while distance to the tarmac road hinders the choice of private traders. According to Chitika (2009), information costs proxy by quality inspection had a positive influence on informal milk marketing while payment delay, a proxy for negotiation costs had a negative influence on informal milk marketing in Malawi. A recent study in South Africa on strategies to unlock markets access to smallholders showed that factors such as poor infrastructure, lack of market transport, lack of market information, insufficient expertise on and use of grades and standards have led to inefficient use of different market channels (Jari and Fraser, 2009).

Panda *et al*. (2012) studied the factors influencing marketing channel choices of vegetable farmers in India. They found that access to market information has a positive impact on both formal and informal market choices. They also found that there was a positive relationship between formal market channel choice and road infrastructure. Mathye *et al.* (2000) analysed the choice of marketing channels for smallholder farmers producing bananas and mangoes in some areas of the Northern Province in South Africa. They found that transaction costs such as transport costs and searching for markets tend to influence market channel choice. According to Gong *et al*. (2006) there are significant relationships between economic and social variables and marketing channel selection for cattle distribution in China. He argued that transaction cost has a significant impact on marketing channel selection.

Woldie and Nuppenau (2009) studied the market channel choice decision in the Ethiopian banana markets. They found that transaction costs in the form of information costs, negotiation costs as well as monitoring and enforcement costs have significant impact on market channel choice by banana smallholder farmers. Rao and Qaim (2011) show that infrastructure cum transaction costs, for example in road access, are important factors influencing the choice of marketing channel by smallholder farmers in Kenya.

2.4.2 Household characteristics

In addition to transaction costs, household characteristics such as age, education and gender could influence a household's market channel choice by smallholder farmers in sub-Saharan

Africa. For example, Chirwa (2009) and Anteneh *et al*. (2011), points out that level of education of household head have significant influence on market channel choice by smallholder farmers in Malawi and Ethiopia, respectively. Chirwa (2009) analyzed the determinants of marketing channels among smallholder maize farmers in Malawi; he revealed that education was positively associated with the choice of private traders. Anteneh *et al*. (2011) found that education level of household head have impact on market outlet choice by smallholder coffee farmers in Ethiopia. According to Zivenge and Karavina (2012) farmers who have more education tend to be good negotiators and are risk averse. They can gather and understand production and marketing information so that they can adjust their production and marketing systems according to the different market demands.

Shiimi *et al*. (2012) analyzed the determinants of marketing channels among cattle farmers in Namibia. They revealed that age was positively associated with the decision to sell or not to sell through formal market channel. According to them, as age increases, cattle producers lose interest in negotiating with buyers in the informal market as it takes time to secure a buyer in the informal market. Girma and Abebaw (2012) in their study on the determinants of livestock farmers' choice of marketing channels in Ethiopia found that education and gender of household head determined the choice of market channels. According to them, as education level increases, livestock farmers choose the final consumers as their market destination in the nearby local markets compared to traders. Educations of household head increase the ability of farmers to gather and analyse relevant market information for their products and choose the market for better price. They also found that gender of the farmer was an important determinant of market channel choice to choose between the consumers (farm gate buyers) and market traders. The result shows that male household heads tend to prefer market traders over consumers compared to female household heads. Literature shows that many societies in the rural areas in sub-Saharan Africa do not allow women to associate equally with their male counterparts (Blackden, 1993; Ongile, 1999; Nyakudya *et al.*, 2006). This hinders women participation further downstream in the supply chain, and reduces overall earnings from their production activities.

2.4.3 Product characteristics

Product characteristics such as output price and perishability of products have an influence on the choice of marketing channel. A higher price provides an incentive to the selling point. Martey *et al*. (2012) found that output price determined the choice of market channels by smallholder farmers in Ghana. They revealed that output price determined the choice of rural market relative to urban market. Perishable goods, such as, vegetables, milk, fruits etc. can employ shorter channels to minimize the risk of damage. Non-perishable goods such as cereals, beans can be stored for quite a long time when properly treated in terms of moisture content and storage conditions, and can employ longer channels with many intermediaries (Pride and Ferrell, 2010).

2.4.4 Household assets

Anteneh *et al*. (2011) found out that factors such as farm size, proportion of off-farm income to total income, and credit access affected market channel choice among smallholder coffee farmers in Ethiopia. Masuku *et al.* (2001), in their study to identify factors influencing the choice of marketing channel by maize smallholder farmers in Swaziland, found that farm size has positive effect on the decision to sell maize through formal channel. This implies that the size of the farm increases the market risk pushing farmers to look for a secured market for their produce. Panda *et al*. (2012) in their study on the factors influencing marketing channel choices of vegetable farmers in India, found that there was a positive relationship between formal market channel and transport ownership. This is because the farmers' own vehicles allow them freely without relying on others to participate in formal markets, which are marketing centres located far off.

Alemu *et al*. (2012) analyzed the determinants of farmers' participation in contracts or cooperatives channel in Ethiopia, indicated that the wealth of the household has positive contribution to contracts channel. Farmers with relatively higher wealth or assets may have a lower degree of risk aversion, and with less risk aversion, may be more willing to adopt new market channel opportunities. They also find that an increase in land size increases the probability of contract. As the size of the land increases, they start to retreat from contracting once they built their capacity to cope with all the barriers they face due to their wealth.

Woldie and Nuppenau (2009) studied the market channel choice decision in the Ethiopian banana markets. They found that farm size allocated to banana has significant impact on the proportion of banana sold to wholesale traders. This is due to the fact that large farm sizes mean more bargaining power to farmers in dealing with wholesale traders. Zivenge and Karavina (2012) in their study on factors influencing market channel access by horticulture farmers in Chinamora District in Zimbabwe also show that farm size has positive effect on the decision to sell through formal channel. Neven *et al*. (2009) and Rao and Qaim (2011) in their studies in Kenya, found that the larger the farm size, the greater the probability of participation in the local supermarket channel in Kenya. They also found that farmers with limited access to transportation and credit are less likely to participate in supermarket channel.

2.4.5 Social capital

There is increasing evidence from both research and practice that one way for smallholder farmers to overcome market failures and maintain their market position is through organizing into producer groups or associations (Markelova *et al*., 2009). The importance of farmer groups or associations is that they help farmers to negotiate or bargain as a group rather than as individuals. Stringfellow *et al*. (1997) and Stockbridge *et al*. (2003) argue that smallholder associations are important for developing negotiation skills, power and political representation which are critical for smallholder farmers to participate in the improvement of their institutional environment. Information availability also increases, as once a member of the group gets hold of information quickly pass it on to others and it is used for marketing decisions. Farmer groups/association also gives high bargaining power to suppliers of a commodity. This prevents exploitation by traders and other agents in the supply chain. Bienabe *et al*. (2004) also confirmed that farmer groups in terms of collective action better positions smallholder farmers to reduce transaction costs for their market exchanges, obtain necessary market information, secure access to new technologies, and tap into high-value markets, allowing them to compete more effectively with large farmers and agribusinesses.

According to Narayan and Pritchett (1999) and Grootaert (1999), rural producer associations can facilitate low cost access to information, thereby stimulating technology adoption and enhancing contract enforcement. Rural producer associations lower the transaction costs of

marketing produce by eliminating some of the intermediaries and also enable farmers to capture the economies of scale of joint marketing. Jari and Fraser (2009) pointed out that an increase in social capital such as producer association results in households shifting from non-participation to formal and informal market participation. This suggests there is a higher probability of shifting to formal and informal marketing with an increase in social capital. Therefore, it can be concluded that social networks are important in produce marketing, regardless of the choice of market being used. Their results also shown that farmers' group participation have significant influence for both formal and informal market choices. Thus, group participation encourages market penetration among smallholder farmers who find it difficult individually to gain market access.

2.4.6 Trust

Trust is an important factor in shaping the effective and efficient supply chain of crop produce. Trust may be defined as a set of expectations that managers of firms adopt about the future behavior of their exchange partners (Rademakers, 2000). The presence of trust can reduce the specification and monitoring of contracts (Hill, 1990), thus resulting in reduction of transaction cost. Trust may also lead to enhanced revenues for alliance partner firms' resources (Barney and Hansen, 1994; Dyer, 1997; Hansen *et al*., 2002). Trust has been theorized to reduce opportunistic behaviour, and hence mitigates transaction costs in business practice. For example trust, is much more important, especially in the African context where collective action is more prominent. It follows, thus, that interventions which enhance trust among members in a group, including laws of engagement and operational democracy, are likely to contribute to successful collective action. Whenever trust is present, farmers can lower their guard and economize on transaction costs.

Trust minimizes search costs, and facilitates the enforcement of contracts (Woldie and Nuppenau, 2009). Therefore trust enables farmers to place and take orders with less risk and less conflict, provide exchange credit, and offer warranty. Trust also encourages farmers and buyers to make relationship-specific investments, which in turn enhances productivity in the exchange relationship without fear of opportunism (Dyer, 1997). Previous studies (Tsourgiannis *et al*., 2008; Woldie and Nuppenau, 2009) found that trust have a significant influence on marketing channel selection. According to them, farmers' degree of trust

towards buyers is an important variable affecting transaction costs, since higher levels of trust reduce the perception of risk and hence transaction costs in an exchange relationship. The next section reviews theoretical literature on welfare impacts of market participation and channel choice in smallholder farming.

2.5 Theoretical consideration of the welfare impacts in smallholder farming

2.5.1 Welfare impacts of market participation

The welfare of an agricultural household can be defined as the utility derived by the household given its income and the prices it faces. It is generally accepted that marketing decisions can be analyzed within the utility maximization framework. According to Norris and Batie (1987), the decision of a farmer (or economic agent) whether or not to participate in markets are generally assumed to be derived from the maximization of expected profit or utility theories. Smallholder farmers will make their decisions by choosing the alternative that maximizes their perceived utility (Fernandez-Cornejo *et al*., 1994). An alternative view of utility-based market participation is that farm households make a decision to participate in particular markets when the utility derived from returns earned from participating in one market, is greater than that derived from returns realized due to allocating resources to an alternative enterprise (Baid-Forson *et al.,* 1997).

However, the features that lead to utility maximization, and induce market participation, such as the welfare gains that result from choosing market-oriented production and exchange, emerge not just from welfare effects of trade (according to comparative advantage), but also even more from the opportunities that emerge from dynamic technological change effects associated with increased flow of ideas due to regular trade-based interactions. In this framework, incentives to trade result from many different aspects. That is, just ‘‘getting prices right” is unlikely to induce market participation; rather, farm households must also have access to productive technologies and adequate private and public goods in order to produce a marketable surplus (Barrett, 2008).

According to Pryanishnikov and Katarina (2003), households seek to maximize utility through the consumption of various agricultural commodities, for which it may produce some to consume, or trade in order to obtain those it cannot produce. Therefore farm households

may engage in a supplier side type of market participation, by selling of surplus that remains after consumption. But also, they may choose to participate on the demand side, in which case they would largely purchase commodities that they cannot produce.

Barret (2008) used what he called a stylized model, in which different consumption requirements are accounted for and restricted within a set, constituting the various food commodities which farmers produce themselves. That is, farm households seek to maximize utility by consuming a combination of commodities that yield the most utility, and each farmer is taken to be both a consumer and a producer of some of the commodities. Producers are sellers and/or buyers of the commodities they produce, and supply side participation only occurs when net sales are greater than one. Lapar *et al*. (2003) took up this approach to investigate market participation and supply decisions. The decision rule was to participate when the utility derived from returns realized from investing in one enterprise was greater than the utility derived from returns realized from investing in an alternative enterprise, using the same resources.

Most studies on market participation employed the theoretical models, where the household, as both producer and consumer, decides upon market participation as a means to maximize utility (for example Barret, 2008; Heltberg and Tarp, 2002; Goetz, 1992; Key *et al*., 2000). According to them, various trade related costs will work to distort prices on the market, and, consequently, some farmers will opt not to participate. This is a key mechanism of market participation in developing countries. It is in the light of these costs, together with assets, skills and endowments that households decide upon the perceived profitability of entering the market. According to Barrett (2008) there are two main arguments for why market participation of farm households is so important to improving household welfare in rural areas; it allows farmers to focus on producing the goods at which they are skilled (i.e., have a comparative advantage); and to trade their surplus for other goods and services they desire but for which they do not have a comparative advantage in producing. Improvements of market participation by smallholder farmers not only help to meet future food demand, but also improve food security and nutrition in rural and urban areas. In addition, it increases opportunities for linkages with the rural non-farm economy, as smallholders are likely to use most of their additional income to purchase locally produced goods and services (Wickramasighe and Weinberger, 2013).

Omamo (1998) in his study on the effect of transaction costs in market participation, he revealed that increased incomes, urbanisation and population growth is expected to lead in increasing demand of goods and services in the developing world, which can in turn improve incomes of smallholder farmers. Furthermore, as households' disposable income increases, so does demand for variety in goods and services, thereby increasing demand-side market participation, which further increased the demand for cash and thus supply-side market participation. The standard process of rural transformation therefore involves households' transition from a model of subsistence, in which most inputs are provided for and most outputs consumed internally, to a market engagement mode, with inputs and products increasingly purchased and sold off the farm (Timmer, 1988; Staatz, 1994).

The theory of market participation has developed many different perspectives, including asset-based approaches and agricultural developmental theory approaches. Boughton *et al*. (2007) viewed market participation as both a cause and a consequence of economic development. Markets offer households the opportunity to specialize according to comparative advantage and thereby enjoy welfare gains from trade. Recognition of the potential of markets as engines of economic development and structural transformation gave rise to a market-led paradigm of agricultural development during the 1980's (Reardon and Timmer, 2006) in which market liberalization policy agendas were widely promoted in sub-Saharan Africa (SSA) and other low-income regions. According to Omiti *et al*. (2009), as the market share of agricultural output increases, input utilization decisions and output combinations are progressively guided by profit maximization objectives. This process leads to the systematic substitution of non-traded inputs with purchased inputs, the gradual decline of integrated farming systems, and the emergence of specialized high-value farm enterprises.

Enhancing market participation of smallholder farmers is considered as an important way to reduce poverty in developing countries (World Bank, 2008). Therefore, greater market access for smallholders can be a route for them to raise farm productivity, incomes and escape poverty. If smallholder producers increase their participation in staple food crop markets by selling more through increases in productivity and market efficiencies, cash incomes will increase. Productivity and increased incomes lead to reinvestment and release of other resources from food crop production. These resources can move into higher value production, be it agriculture, manufacturing, or services. Thus, growth in agriculture directly reduces

poverty and food insecurity by augmenting farm incomes through increased production and marketing of agricultural produce (Barrett, 2008; Jayne, 2010).

Market participation has motivated the farmers to move from subsistence farming to commercial farming (Makhura, 2001). Commercial farming increases farm's output, hence enabling the farmer to earn more income. Jari and Fraser (2009) noted that smallholder farmers' market participation is very vital for sustaining economic growth, food security and poverty alleviation. Most farmers who participated in the market tend to be food secure because the income they derives from the sale of their output has enabled them to purchase the staple food. Altman *et al*. (2009) also noted that, access to input and output markets can be important contributors to food security. It is widely acknowledged that the involvement of small farmers into markets can contribute to higher productivity and income growth, which in turn can enhance food security, poverty reduction efforts, and overall economic growth (Barrett, 2008; Bernard and Spielman, 2009). In summary, marketing plays a crucial role in meeting the overall goal of food security, poverty alleviation and sustainable agriculture, especially among smallholder farmers in developing countries (Jari and Fraser, 2009).

Markets are necessary to boost productivity and availability. Improved access to agricultural input markets—such as seed and fertilizer—is crucial for productivity growth. Moreover, farmers will only increase production if they have access to viable markets for their agricultural outputs (IFPRI, 2002). Markets also play a crucial role in achieving food security by increasing access to food. In regions like sub-Saharan Africa, where 70% of the population relies on agriculture for their livelihood, and 80% of all the farms are less than 2 hectares in size, poor smallholder farmers can turn their surpluses into income only if they have access to markets. Increased incomes, in turn, increase food security and help to alleviate poverty (IFPRI, 2002). The next sub-section presents theoretical literature on the welfare impacts of market channel choice in smallholder farming.

2.5.2 Welfare impacts of market channel choice

A stronger growth in agriculture would lead to higher income for farmers, generate more employment opportunities and reduce poverty. However, this requires an adequate presence of channels to buy their produce and ensure competitive price (Ritson, 1997)**.** Marketing

channel choices have a great impact on the farm household decisions and welfare outcome. Most importantly, marketing channels play a significant role as a major source of rural income and in facilitating social interaction, general communication and information about the market and technology. The development of the marketing channels is, consequently, of paramount importance in agriculture and affects farms in regard to several issues, namely:

i) crop mix: market conditions inform farmers on the products in demand and prompt him to decide what, when and how much to produce
ii) farm income: agriculture, as the farm's chief economic activity, is the main source of income for the farm
iii) food security: production of agricultural products for consumption and for the market affects farm food availability and household consumption and nutrition
iv) farm resource allocation: market channel news have, inevitably, impact on changes in use of the farm factors of production land, labour and capital
v) farm sustainability: marketing channels have ultimately effects on the use of the farm natural resources, and, hence, on sustainability.

Farmers' market channel choice could be perceived as one of the available income strategies, whereby a farmer will choose a given channel if the utility obtained from it exceeds that of the alternatives. The decision to participate in a particular marketing channel is based on the maximization of an underlying utility function, and a farmer selects the marketing channel that maximizes his/her utility (McFadden, 1986). Thus, a farmer is likely to choose the option that gives a higher utility among the alternatives (Pryanishnikov and Katarina, 2003). According to Rao and Qaim (2011), household income is determined by various socioeconomic factors. For farm households, income is usually influenced by returns from agricultural production, which depend on asset ownership and capacity to produce and market efficiently. Hence, participation in certain market channels may directly influence household income. Narayanan (2012) applied the utility theory to assess the welfare impacts of participation in contract farming schemes in southern India. He noted that marketing channels offer different prices and sales services, thus are very important on smallholders welfare gains.

Improved market access plays an important role in channel choice and improving rural incomes of smallholder farmers. The choice of different channels is vital to reduce transaction costs and avoid market risks of rational decision-making behaviour (Swinnen,

2007). The marketing channels are an important aspect of agricultural marketing affecting the prices paid by consumers and shares of them received by the producer. The market channel choice and the price that smallholders receive for their agricultural products have great implications for household welfare and poverty alleviation. Increased profitability for farmers from marketing decisions may lead them to change their production, investment in productive assets, new agricultural technologies and improve household welfare (Jensen, 2010). According to Osborne (2005) imperfect competition among traders in grain markets inflates their profits and drives down prices paid to farmers. If imperfect competition in rural markets is widespread, then competition policy may be an important tool of government to improve price transmission and the appeal of market participation for smallholders. One response to imperfect competition in the marketing channel is to organize farmers so as to gain bargaining power so as to extract better terms of trade from downstream purchasers. The empirical evidence of the welfare impacts of market participation and channel choice by smallholder farmers in developing countries is discussed in the next section.

2.6 Empirical evidence of welfare impacts of market participation and channel choice

2.6.1 Welfare impacts of market participation

Several studies on the impact of market participation by smallholder farmers have been done in the agricultural sector of developing countries. Empirical results indicates that commercialization of smallholder farmers has the potential to enhance incomes and welfare outcomes and take smallholder farmers out of poverty if constraining factors such as lack of capital, high transaction costs, lack of infrastructure, lack of information and lack of education could be eliminated (Lerman, 2004). Study by von Braun and Kennedy (1994) revealed that market participation plays a significant role in increasing incomes, and in most cases, these increased incomes have led to increased food consumption. According to Gebreselassie and Sharp (2007), smallholder farmers with high degree of market engagements have better potential of enjoying better standards of welfare. Similarly Sharp *et al*. (2007) noted that enhancing the degree of commercialization of smallholder farmers can have more impact on reducing poverty than promoting few large ventures.

Asfaw *et al*. (2012) study smallholder market participation and rural poverty in Tanzania, and found that there is a statistically significant impact of maize and pigeonpea market

participation in improving household welfare and poverty reduction in Tanzania. Similarly, Asfaw *et al*. (2012) examines the impact of pigeonpea market participation in Kenya. Results show that, market participants have significantly higher food security status than non-participants.

Heltberg and Tarp (2002) examine agricultural supply response and poverty in Mozambique, and they found that the probability of participation in food markets increases with household expenditure. In other hand, lack of sufficient assets, like land and livestock is emphasized as a constraint on household welfare. Assets like livestock may reduce the risk of food insecurity since it can be sold in order to buy food (Boughton *et al*., 2007). A study on the effects of smallholder commercialization on rural Kenyan food production and welfare in South Nyanza District, found that farmers participating in the sugarcane scheme enjoyed significantly higher agricultural incomes than their neighbours who did not participate (Kennedy and Cogill, 1987).

Pender and Dawit (2007), and Escobal and Toreto (2006) revealed that market participation plays a significant role in increasing household incomes, and in most cases, these increased incomes have led to increased food consumption. Bozzoli and Brück (2009) analyses the market participation of farm households in the post-war environment in Northern Mozambique and finds that market participation has positive welfare effects. Other studies on the welfare effects of market participation (Maertens and Swinnen, 2009; Maertens *et al*., 2011) have shown that market participation significantly increases smallholder household income for French beans and on tomato in Senegal.

Market participation as commercialization of smallholder agriculture is often viewed as an opportunity for economic growth and development for less-developed countries whose economies depend on agriculture to a large extent (von Braun and Kennedy, 1994; Pingali, 2007). A study by Pingali and Rosegrant (1995) in some developing countries found that commercialisation of agriculture benefits the poor by offering direct income benefits. These changes result from a combination of increased productivity and increased cash sales. Similarly, Sharp *et al*. (2007) and Fafchamps (2004) noted that enhancing the degree of commercialization of the smallholders can have more impact on food security and reducing poverty than promotion of few large ventures. According to Barrett (2008),

commercialization of output from small-scale farming is closely linked to higher productivity, greater specialization, and higher income.

Furthermore, in a world of efficient markets, commercialization leads to the separation of household production decisions from consumption decisions, supporting food diversity and overall stability. At the macro level, commercialization increases food security (Fafchamps, 2004). Samuel and Sharp (2007) pointed out that agricultural commercialization is a bridge through which smallholder farmers are able to achieve welfare goals. They also note that greater engagement in output markets would result in higher agricultural productivity which can facilitate the achievement of the welfare goals of smallholder farmers. The next sub-section discusses empirical evidence of the welfare impacts of market channel choice by smallholder farmers in developing countries.

2.6.2 Welfare impacts of market channel choice

In terms of studies on impact of market channel choice on household welfare; Saigenji and Manfred (2009) have evaluated the impact of contract farming participation on income by applying Propensity Score Matching in north western Vietnam. They found that there is a significant effect of contract participation on income. Bernard *et al*. (2008) examined the impact of co-operatives on smallholder commercialization of cereals, using detailed household data from rural Ethiopia. They found that cooperatives channel obtain higher prices for their members, and is associated with a significant increase in the overall share of cereal production sold by their members.

Warning and Key (2002) determined the impact of contract farming for peanut growers in Senegal. They found that contract participation had an impact on farmers' income, compared to those who did not participate. Similarly, Miyata *et al*. (2009) examined the impact of contract participation on household income of apple and green onion farmers in China, and found that contract market participation has a significant income to farmers in both apple and green onion. In the study of channel choice, Katchova (2008) applied propensity score matching to correct farmer's selling to contractor (contract farming) depending on whether the contracted group has alternative marketing choice or not. He revealed the absence of price distortion in six different agricultural commodity markets of contract farming where there

were no marketing options. Ruben *et al*. (2009) investigated the impact of fair trade involvement on farmers' income and the overall welfare indicators of banana farmers and found a significant impact on income.

A study by Little (1994) in sub-Saharan Africa, reveals that contract farming increased incomes from a moderate (30-40%) to a high (50-60%) proportion of participants. Other studies show similar results (von Braun, 1995; Glover, 1987). Minot (1986) finds that farmers generally benefit from contract farming because it provides them with inputs on credit, technical assistance, and (often) a guaranteed price, allowing them to produce a higher-value commodity than would otherwise be possible. In almost all the African case studies conducted by von Braun (1995) on contract farming, total per capita income was found, *ceteris paribus,* to be higher among the participants.

Minten *et al*. (2009) used representative household survey data and informant interviews to examine the income and perceived benefits for smallholders producing vegetables under supermarket supply contracts in Madagascar. They found that income from contract crops represented on average 50% of household income and that smallholders participating in supply contracts perceived higher income stability than non-participating farmers.

Several studies showed that participation in supermarket channels can cause significant income gains (Reardon and Berdegué, 2002; Hernández *et al*., 2007; Rao and Qaim, 2011). Higher incomes improve household welfare, which may result in poverty reduction. Rao and Qaim (2011) analysed the impacts of supermarket channel participation in Kenya, and found that supermarket participation is associated with a 48% gain in average household income, which also contributes to poverty reduction.

Other studies provide more direct evidence in the form of income or gross margin comparisons. For example, Birthal *et al*. (2005) compare the gross margins of vegetable contract farmers with independent farmers producing the same commodities. The gross margin for contract vegetable growers was almost double that of independent farmers, largely because contract growers had lower production and marketing costs. Although they do not use regression analysis to control for other factors, they show that contract farmers had higher gross margins for small-, medium-, and large-scale farmers.

2.7 Summary

In this chapter some of the key concepts of the study, namely smallholder farmers, market participation, marketing channel and transaction costs are defined. A review of some empirical literature on determinants of market participation and channel choice by smallholder farmers in developing countries are also presented. This chapter also review some theoretical and empirical literature on welfare impacts of market participation and channel choice. The literature has shown that in general, commercialization of smallholder agriculture remains one of the major challenges in most of the developing countries, specifically sub-Saharan Africa. Several studies show that transaction costs have significant negative effect on market participation and market channel choice by smallholder farmers. Majority of these literatures also identifies other factors affecting market participation and channel choice such as household assets, household characteristics, social capital and trust. It should be noted that household characteristics as well as access to assets are important in market participation decisions because not only do they determine the nature and structure of the market at producer level but they also impact on the occurrence of transaction costs incurred by the household. The chapter also concludes that market participation and channel choice have a significant impact on household welfare. Empirical evidence shows that there is a statistically significant impact of smallholders' market participation in improving household welfare and poverty reduction in developing countries. Similarly, enhancing the degree of commercialization of the smallholders can have more impact on reducing poverty in developing countries, especially sub-Saharan Africa. The following chapters (three to five) comprise empirical methods and research results presented in accordance with the tree specific objectives of the study. The next chapter discusses the factors that influence market participation by maize and pigeonpea smallholder farmers in Tanzania.

CHAPTER 3. THE DETERMINANTS OF SMALLHOLDER FARMERS' PARTICIPATION IN MAIZE AND PIGEONPEA MARKETS IN TANZANIA[2]

3.1 Introduction

This chapter presents and discusses empirical findings on the determinants of smallholder farmers' participation in maize and pigeonpea markets. The remainder of the chapter is structured as follows. The next section presents the conceptual framework of market participation, followed by econometric estimation in section 3.3. Section 3.4 presents data and description of variables, followed by a presentation of results and discussions in section 3.5. Section 3.6 concludes the chapter with a summary of the findings.

3.2 Conceptual framework

The theoretical model that guides the empirical analysis rests on the agricultural household model framework that incorporates transaction costs, in line with Key *et al*. (2000). To incorporate transaction costs into an agricultural household model framework, market participation is conveniently specified as a choice variable. In addition to deciding how much of each good (i) to consume (c_i), produce (q_i) and use as input (x_i), the household also decides how much of each good (i) to sell (m_i). When the household sells the goods it produces, m_i assumes a positive sign. However, when the household purchases such goods, m_i assumes a negative sign. Supposing there were no transaction costs, the household's problem would be to maximise the utility function (3.1), subject to conditions (3.2) to (3.5):

$u(c; z_u)$ the utility function, (3.1)

$\sum_{i=1}^{N} p_i^m m_i + T = 0$ the cash constraint, (3.2)

$q_i - x_i + A_i - m_i - c_i = 0$ the resource balance (where $i = 1,..., N$), (3.3)

$G(q, x; z_q) = 0$ the production technology, and (3.4)

$c_i, q_i, x_i \geq 0$ the non-negativity condition, (3.5)

[2] This chapter gave rise to the following publication: Mmbando, F.E., E.Z. Wale, and L.J.S. Baiyegunhi. (*in press*). Determinants of smallholder farmers' participation in maize and pigeonpea markets in Tanzania. *Agrekon*.

where p_i^m = the market price of good *i*;

A_i = the endowment in good *i*;

T = exogenous transfers and other incomes;

z_u and z_q = exogenous shifters in utility and production, respectively; and

G represents the production technology.

The cash constraint (3.2) states that expenditures on all purchases must not exceed revenues from all sales and transfers. The resource balance (3.3) states that, for each of the N goods, the amount consumed, used as input and sold is equal to what is produced and bought, plus the quantity of the goods that the household owns. The production technology (3.4) relates the inputs (e.g. land, labour) to the outputs.

PTCs raise the price paid by a buyer and lower the price received by a seller. These costs may include transport and marketing costs (Key *et al*., 2000). However, FTCs are invariant to the quantity transacted. Hence, they are generally unobservable, though factors z_t^s and z_t^b with coefficients δ_i^s and δ_i^b, respectively, can explain these costs. When both the FTCs and PTCs are incorporated into the cash constraint, Equation 3.2 is rewritten as Equation 3.6, where the household pays the fixed cost t_{fi}^s if it sells good *i* and pays t_{fi}^b if it buys good *i*:

$$\sum_{i=1}^{N}[(p_i^m - t_{pi}^s(z_t^s))\delta_i^s - (p_i^m + t_{pi}^b(z_t^b))\delta_i^b]m_i - t_{fi}^s(z_t^s)\delta_i^s - t_{fi}^b(z_t^b)\delta_i^b + T = 0 \qquad (3.6)$$

To solve the household problem, a Lagrange multiplier expression can be derived and first order conditions for the consumption goods obtained from Equation 3.1 to 3.6. The decision price (p_i) is thus defined as:

$p_i^m - t_{pi}^s$ if $m_i > 0$, for selling household,

$p_i^m + t_{pi}^b$ if $m_i < 0$, for the buying household, and

$\tilde{p}_i = \dfrac{\mu_i}{\lambda}$ if $m_i = 0$ for self-sufficient households.

The econometric estimation used to study the determinants of market participation and intensity of participation is discussed in the following section.

3.3 Econometric estimation

The econometric specification of the preceding model consists of market participation decision equations and maize/pigeonpea supply equations, estimated separately. The focus of the analysis is on the selling decision. Equation 3.6 shows that market participation depends on both FTCs and PTCs, while the supply decision, conditional on market participation, only depends on PTCs.

For empirical analysis, mostly focusing on selling households, a linear expression is assumed for the supply functions and the PTCs, as follows:

$q(p, z_q) = p\beta + z_q\beta_q$ and $t_p^s = -z_t^s\beta_p^s$, whereas $t_p^b = -z_t^b\beta_p^b$

This leads to linear expressions for supply by sellers as follows:

$$q^{s^*} = p^m\beta_m + z_t^s\beta_t^s + z_q\beta_q$$

The linear expressions for the production threshold levels are thus

$$\underline{q}^s = z_t^s\alpha_t^s + z_q\alpha_q^s + z_c\alpha_c^s$$

where z_t = exogenous characteristics that affect transaction costs when selling;

z_q = production shifters;

z_c = consumption shifters;

α_q, α_c = their coefficients, respectively; and

β_t^s, β_q^s = coefficients of z_t and z_q , respectively.

The econometric specification can thus be obtained by adding an error term as follows:

$$q^{s^*} = p^m\beta_m + z_t^s\beta_t^s + z_q\beta_q^s + u \qquad (3.7)$$

where q^{s*} is the latent supply if a household is a seller, and it is observed when it is higher than the threshold for market participation ($\underline{q}^s$)

$$q^s > \underline{q}^s \equiv \Pr ob(Y = 1) = X_i\beta_i + u$$

Thus, if $q^{s^*} > \underline{q}^s$, then the household is participating in the market as a seller.

Equation 3.8 therefore allows for the identification of parameters β_i , using the probit analysis.

The factors that affect a smallholder farmer's decision to participate in maize/pigeonpea markets can be determined on the basis that:

$$q^{s^*} > \underline{q}^s \equiv \Pr ob(Y = 1) = X_i\beta_i + u \quad (3.8)$$

The estimation of coefficients $\beta_m, \beta_t^s, \beta_q^s$ shown in Equation 7 caters for the aspect of the intensity of participation of smallholder farmers.

For a household to be a seller,

$$\varphi(\beta X_i) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{\beta X_i} e^{\frac{-t^2}{2}} dt \quad (3.9)$$

The continual decision made by smallholder farmers with regards to the intensity of participation is captured by the factors that affect the amount of commodity traded (m_i). We assume an expression to link back to Equation 6, and this is given as:

$$m_i = f(p^\alpha, p\sigma, t_{fi}^b z_t^b, t_{fi}^s z_t^b, t_{pi}^s z_t^b, K, L) \quad (3.10)$$

where m_i = quantities of maize/pigeonpea sold;

the *z*'s = the factors capturing the transaction costs incurred in the buying and selling of the commodity;

K = other costs; and

L = other factors.

An econometric form is adopted as shown in Equation 3.11. The estimates (β_i) for the vector of variables capturing the factors which determine m_i and include transaction-related factors (i.e. access to information, transport, distance to market), are obtained as follows:

$$m_i = \sum_{i=1}^{i=n} (X_i\beta + u_{1i}), i = 1,...,n \quad (3.11)$$

where m_i = the intensity of market participation (the log value of maize/pigeonpea sales);

X_i = independent variables that affect maize/pigeonpea sales and include those capturing transaction costs for the *j* observations;

β = coefficient estimates of the independent variables; and

u_{1j} = the error term for the regression equation.

The dependent variable for observation (*i*), is observed only if the selection expression is

$(z_i\gamma + u_{2i}) > 0$, which implies $m_i > 0$ (3.12)

where z_i = the independent variables which determine whether a household was engaged in the selling of maize/pigeonpea during 2008/09 or not (including those capturing transaction costs);

γ = the coefficient estimates of the independent variables of z_i; and

u_{2i} = the error term for the selection equation.

For both Expressions 3.11 and 3.12,

$u_1 \approx N(0, \sigma)$

$u_2 \approx N(0,1)$

$corr(u_1, u_2) = \rho$

where ρ = the correlation coefficient for the error terms u_1 and u_2.

When $\rho \neq 0$, standard regression techniques such as OLS would yield biased estimates when applied to Equation 3.11, since they do not take into account the process that generates the observed maize/pigeonpea sales of households. A Heckman-Lee two-step type process has therefore been applied to correct the possibility of bias due to sample selection (Lee and Wang, 2003; Maddala, 1983). The model is estimated by using an extension of the Heckman two-step procedure. The first step involves the estimation of the relationship between Equations 3.8 and 3.12, by using a probit model. The result provides an estimate of probability of market participation. This estimate is then used to calculate the inverse Mills ratio (λ), which is then added to the market supply function in Equation 3.11. This process yields the following Equation 3.13, which can be estimated by OLS, free of selection bias (Greene, 2003):

$$m_i = X_i\beta + \theta\lambda_i + u_{1i} \qquad u_{1i} \approx N(0, \sigma) \tag{3.13}$$

where $\lambda_i = \dfrac{\phi(z_i\gamma)}{\Phi(z_i\gamma)}$;

ϕ and Φ = the density and distribution functions, respectively; and

θ = the associated parameter to be estimated.

Marginal effects

According to Huang *et al*. (1991), there are four different responses of marketing behaviour to changes in explanatory variables in selectivity models. These are: (i) the change in the probability of market participation as derived from the selection equation; (ii) the change in desired marketed quantities (for the full sample) that can be derived directly from the estimated parameters in the quantity equation; (iii) the conditional marginal effects (i.e. the

change in actual quantities conditionally transacted on market participation), using information only for those already in the market; and (iv) the unconditional marginal effects (i.e. the total change in quantities unconditionally transacted on market participation).

The change in the probability in market participation per unit change in the i^{th} explanatory variable (z_{ki}) can be calculated as

$$\left(\frac{\partial \Phi(z_k \gamma_k)}{\partial z_{ki}}\right) = \gamma_k \phi(z_k \gamma_k) \tag{3.14}$$

The change in desired (or potential) quantities transacted is simply the coefficient associated with the variable in the output marketed supply equation. The parameter β thus represents the marginal effects on potential maize/pigeonpea supply.

The unconditional marginal effect, which is of particular interest for this study, captures the joint impact of a variable on the changes in the rate of market participation and the quantities transacted. As shown in Huang *et al.* (1991), the unconditional marginal effects on actual quantities transacted (Q_t) per unit change in the i^{th} variable (X_{ki}) can be calculated as

$$\frac{\partial E(Q_t)}{\partial X_{ki}} = \beta_{ki} \Phi(z_k \gamma_k) + \gamma_{ki} \phi(z_k \gamma_k)[(X_k \beta_k) + \theta_k (z_k \gamma_k)] \tag{3.15}$$

$$= \beta_{ki} \cdot psel + \gamma_{ki} \cdot \phi(xbsel) \cdot ycond$$

Where $\Phi(\cdot)$ and $\phi(\cdot)$ = the standard normal distribution and density functions, respectively; and

β_{ki} and γ_{ki} = the estimated parameters for variable (X_{ki}) in the quantity and selection equation of the model, respectively.

The first part of Equation 3.15 represents the change in quantity in response to a change in X_{ki} (β_{ki}), weighted by the probability of being in the market (*psel* in *Stata* language); and the second part represents the change in the probability of being on the market [$\gamma_{ki}\phi(xbsel)$], weighted by the expected value traded if on the market (*ycond* in *Stata* terminology). All continuous variables have been transformed into natural logarithm and hence, double log forms of maize and pigeonpea supply equations were estimated. These estimations facilitated the analysis and interpretation of the marginal effects on quantities transacted in terms of unit-free elasticities, especially with respect to responses to output prices (Hoffmann and Kassouf, 2007). The next section presents the data collection procedure.

3.4 Data collection

The data used in this study were collected from a household survey of 700 households conducted in two maize-legume-based farming systems, in the northern and eastern zones of Tanzania. The survey was part of a "Sustainable Intensification of Maize and Legume in East and Southern Africa (SIMLESA)" program that assesses the maize-legume cropping systems in Tanzania. The survey was conducted by the Selian Agricultural Research Institute (SARI) in collaboration with the International Maize and Wheat Improvement Centre (CIMMYT) between October and December 2010. A multi-stage sampling procedure was used to select wards and villages from each district, and households from each village. In the first stage, four districts from two zones were purposively selected based on their maize-legume production potential: Karatu and Mbulu, from the northern zone; and Mvomero and Kilosa, from the eastern zone (see Appendix 3.1 for a map). Each of the two zones was assigned an equal number of sample households. The households within a zone were distributed within the two respective districts according to district household size (proportionate sampling). In the second stage, a proportionate random sampling, were used to select 5–13 wards in each district, 1–4 villages in each ward, and 2–30 farm households in each village. A total of 700 farm households in four districts were surveyed using a structured questionnaire. The questionnaire was administrated through trained enumerators. Data were collected on a wide range of factors including household composition and characteristics, land and non-land farm assets, household membership in different rural institutions, indicators of access to infrastructure and transaction costs. The questionnaires also captured household crop production and marketing, marketing channels, household income sources and food and non-food consumption expenditure. The questionnaires used in this study are presented in Appendix 3.2. The following section discusses the variables used in the empirical model.

3.5 Definition of variables

Dependent variables

The dependent variable in the participation equation is equal to one if the household sold maize/pigeonpea during 2008/09 cropping season, or equal to zero otherwise. The dependent variable in the supply equation is the natural log of the value of maize/pigeonpea sold in 2008/09 cropping season.

Explanatory variables

The explanatory variables hypothesized to explain maize and pigeonpea market participation and level of participation were identified based on the theoretical framework and on past empirical work on market participation. The explanatory variables were classified into six categories: household characteristics; output price; private assets; public assets and services; transaction costs-related variables; and location-specific variables. The explanatory variables are discussed below and summarized in Table 3.1.

Table 3.1. Description of variables used to analyse the determinants of market participation and intensity of participation

Variable name	Description
Dependent variables	
MKTP	Market participation (=1 if household sold maize/pigeonpea in the reference period, 0 otherwise)
SALES	Natural log of the value of maize/pigeonpea sold in the reference period
Household characteristics	
AGE	Age of the household head (years)
GENDER	Gender of the head (1= male, 0 otherwise)
EDUC	Education of the head (years)
LABOR	Household labor force (AEU)
Output price	
PRICE	Mean village price (TSh)[a]-lagged
Private assets	
FSIZE	Farm size per capita (ha)
TLU	Livestock herd size (TLU)[b]
PAI	Productive assets Index (PC score)
Public assets and services	
EXT	Extension contact (days/year)
FASS	Member in farmer association/group (1=yes; 0 otherwise)
CREDIT	Credit access (1=yes; 0 otherwise)
Transaction costs variables	
DIST	Distance to nearest market (km)
TRANS	Ownership of transport assets (1=yes; 0 otherwise)
COMM	Access to communication assets (1=yes; 0 otherwise)
Location dummies	
KARATU	Household is located in Karatu district (1=yes; 0 otherwise)
MBULU	Household is located in Mbulu district (1=yes; 0 otherwise)
MVOM	Household is located in Mvomero district (1=yes; 0 otherwise)
KILOSA	Household is located in Kilosa district (1=yes; 0 otherwise)

Notes: [a]The exchange rate at the time of the survey was about 1US$ = 1,500 TSh.
[b]Tropical Livestock Units (TLU) estimated using FAO conversion factors.

Household characteristics:

The household characteristics are constructed by four variables, that are, the age (AGE), gender (GENDER) and education (EDUC) of the household head, and household labour force (LABOR) (in Adult Equivalent Units)[3]. Age is expected to have positive association with participation in agricultural market since older farmers may be more experienced in marketing management and tend to have stronger networks and more credibility, thus facing lower transaction costs (Bahta and Bauer, 2012). Male-headed households have access to productive assets such as land, labour and capital which increases their production capabilities and hence, a positive relationship is expected with market participation. Advancement in education increases ability to obtain and process market information (Makhura, 2001) and thus, a positive relationship with market participation. The household labour force was included as a proxy for labour supply for production and for transporting crops to the nearest market. A positive relationship is expected between labour supply and market participation.

Output price:

Output prices are expected to have a positive influence on market participation and marketed surplus, as hypothesised by Key *et al*. (2000) and Alene *et al*. (2008). Price variation is potentially endogenous, as a price depends on the place and time of sale, and is thus observed only for those farmers who actually sold maize and pigeonpea during the period of the survey. To mitigate the potential endogeneity problem, lagged and average village-level maize and pigeonpea prices are used in the analysis (Alene *et al*., 2008; Asfaw *et al*., 2012).

Public assets and services:

Contact with extension officers (EXT), membership in farmer association/group (FASS) and access to credit (CREDIT) are included to capture the effect of public assets and services. Contact with extension officers and membership of farmer association provide technical assistance and information on improved technologies and marketing (Bahta and Bauer, 2012). It is expected that the more visits the extension service provider pays to the farmers, the more likely the farmer would sell his/her produce and at the same time increase sales.

[3] Labour force in Adult Equivalent Units (AEU) per household was estimated using recommended levels of energy intake by transforming each family member into a fraction of an AEU based on age group and sex and those values are then summed to compute the total Adult Equivalent Units for the particular household. The 1973 FAO/ WHO-recommended calorie requirements were used as the basis for the transformation. See Schofield (1985) for details.

According to Poulton *et al*. (2006) farmer groups empower farmers to bargain and negotiate for better trading terms. Farmer groups are also important platforms for information exchange among farmers, especially in places with weak physical infrastructure. Access to credit is production-enhancing assets, which facilitate productivity. A positive relationship between these three variables and market participation is, therefore expected.

Private assets:

Farm size per capita (FSIZE), livestock ownership (TLU) and index of productive assets (PAI)[4] are included in the model to capture the effect of household private assets. These variables are critical in production that enables households to produce a surplus for the market (Alene *et al.,* 2008). A positive relationship is expected between these three variables and market participation.

Transaction costs variables:

Following Alene *et al*. (2008), transaction costs are captured through three proxy variables: distance to nearest market (DIST), access to communication assets (COMM) e.g. radio, cell-phone, TV; and ownership of transport assets (TRANS) e.g. bicycle, motorcycle and cart. Distance to market is a proxy for PTCs, and included to the analysis to capture the extent of isolation of farming households and level of access to marketing infrastructure. The variable is associated with the per-unit costs of accessing markets (Key *et al*., 2000) and, hence, expected to have a negative relationship with market participation. Access to communication assets and ownership of transport assets are proxies for FTCs. The variables reduce the costs associated with communication and are, therefore, expected to positively influence market participation (Key *et al*., 2000). In this study access to communication assets and ownership of transport assets capture the FTCs associated with information access, are the exclusion restriction variables. These two variables are used to identify the Heckman model, such that they enter the selection regression but not the underlying regression (Heckman, 1979).

[4] In order to reduce the high number of explanatory variables and remedy multicollinearity, an index of productive assets was developed using PCA. Key assets included are plough, cart, oxen, sprayer, spade/shovel/rake, axe, water pump and wheelbarrow. The first principal component (PC_1) was used in constructing the index for sample households for both maize and pigeonpea producers because it explained about 38% and 39% of the total variance in the nine indicators for maize and pigeonpea households, respectively.

Location dummies:

The unobserved location-specific effects were controlled using district dummy variables. The variables included in the model to capture differences in the general economic and social conditions of the different locations, refer to infrastructure, remoteness, resource endowment, production potential and farming conditions across districts. The relationships revealed by the results are to be explained by the specific attributes of each of the location. The dummy for Karatu district (KARATU) was used as a reference and was left out of the model to avoid the dummy variable trap. The next section presents empirical results and discussions.

3.6 Empirical results and discussions

3.6.1 Descriptive statistics

Summary statistics for all variables included in the regressions, as well as the significance level of tests of difference between means for each variable for market participants (sellers) and non-participants (non-sellers) are presented in Table 3.2. About 56% and 75% of maize and pigeonpea households participated in the market as sellers. The differences in age of the household head between maize sellers and non-sellers were statistically significant at the 10% level. On average, more male-headed households participated in markets as sellers for both maize and pigeonpea, and they also more educated than non-participants. It is also found that maize and pigeonpea sellers have a larger labour force and farm size than non-sellers. Maize and pigeonpea sellers had a significantly larger farm size per capita than non-sellers.

The differences in livestock unit between maize sellers and non-sellers were statistically significant at the 10% level. The index of productive assets was significantly higher for pigeonpea sellers as compared to non-sellers. The share of households having a membership of farmer association and access to credit was significantly higher for maize and pigeonpea sellers than non-sellers. In general, a higher percentage of maize and pigeonpea non-sellers were located farther away from the nearest market than sellers were. Not surprisingly, maize and pigeonpea sellers owned more transport and communication assets than non-sellers.

Table 3.2. Summary statistics of the variables used in the analysis

Variable	Maize			Pigeonpea		
	Non-participants (N=291)	Participants (N=372)	MT[b]	Non-participants (N=63)	Participants (N=190)	MT[b]
AGE	46.90	45.00	*	49.65	46.69	
GENDER	0.81	0.91	***	0.81	0.91	*
EDUC	4.52	5.28	***	4.78	5.20	
LABOR	4.34	4.49		3.62	4.78	***
PRICE	260.53	267.92	**	639.62	761.15	***
FSIZE	1.76	2.54	***	1.51	1.94	**
TLU	2.29	2.00	*	2.38	2.19	
PAI	-0.01	0.01		-0.20	0.07	*
EXT	2.24	2.73		1.71	2.31	
FASS	0.20	0.30	**	0.16	0.32	**
CREDIT	0.05	0.10	**	0.06	0.09	
DIST	6.40	4.71	***	6.84	4.92	*
TRANS	0.38	0.67	***	0.24	0.39	**
COMM	0.27	0.45	***	0.22	0.36	**
KARATU	0.23	0.21		0.32	0.47	**
MBULU	0.35	0.22	***	0.02	0.01	
MVOM	0.20	0.19		0.33	0.18	**
KILOSA	0.22	0.38	***	0.33	0.34	

Source: SIMLESA project survey data (2010).
Notes: MT[a] = Test of difference between means of sellers and non-sellers: * significant at 10%; ** significant at 5%; *** significant at 1%.

Over 67% of maize sellers and 39% of pigeonpea sellers had their own transport assets for regular access to nearby towns. Similarly, over 45% of maize sellers and 36% of pigeonpea sellers had access to communication assets. The next sub-section presents the empirical results and discussion of the factors influencing market participation decisions by maize and pigeonpea smallholder farmers.

3.6.2 Determinants of market participation decision

Prior to estimating the selection model, the model was checked for possible multicollinearity problems by using the Variance Inflation Factor (VIF) and correlation matrix. The VIF was less than the critical value of 10 (Gujarati and Porter, 2009), for both maize and pigeonpea, confirming that multicollinearity was not a problem. The correlation coefficient results show

that these coefficients are globally less than 0.5 for both maize and pigeonpea samples, indicating weak correlations. These correlations suggest that the variables are sufficiently independent to be modelled together without multicollinearity concerns.

The coefficient estimates as well as the marginal effects of the probit model are presented in Table 3.3. The model fits the data well, whereby about 71% and 77% of the participation outcomes in maize and pigeonpea, respectively, are correctly predicted. The Wald test of the hypothesis that all regression coefficients are jointly equal to zero is rejected at the 1% significance level in both maize and pigeonpea. This test result shows that, jointly, the independent variables included in the probit regression model explain the variations in a household's probability to sell maize and pigeonpea. The result further suggests that male-headed households are more likely to participate in maize markets than female-headed households. The reason is probably because female-headed households are resource-constrained, lacking access to productive assets (land, labour and capital) which limits their production capabilities.

The education level had a significantly positive impact on the probability of maize market participation, but an insignificant impact on pigeonpea market participation. From this result, it is clear that advancement in education increases the ability to obtain and process market information. This finding is in contrast with Ouma *et al*. (2010) who found that education levels had a significantly negative impact on banana market participation in Rwanda and Burundi.

Labour force in adult equivalent units had a significantly positive effect on pigeonpea market participation, but an insignificant impact on maize market participation. Households with more labour supply had about a 5% higher probability of pigeonpea market participation. Considering the labour demand of crop production, labour can have an impact on the amount of pigeonpea produced in a household, and this can also affect market participation. Bahta and Bauer (2012) found a similar result in their study in South Africa. Output prices had a significantly positive effect on market participation for both maize and pigeonpea. This finding has also been observed in maize markets by Alene *et al*. (2008) and in banana markets by Komarek (2010).

Table 3.3. Factors influencing maize and pigeonpea market participation: Probit results

Variable	Maize		Pigeonpea	
	Coefficient	Marginal effects	Coefficient	Marginal effects
AGE	-0.006	-0.002	-0.011	-0.003
	(-1.42)		(-1.53)	
GENDER	0.480***	0.190***	0.262	0.077
	(3.00)		(0.93)	
EDUC	0.043**	0.017**	-0.007	-0.002
	(2.35)		(-0.25)	
LABOR	0.016	0.006	0.180***	0.049***
	(0.63)		(3.10)	
PRICE	0.003**	0.001**	0.001**	0.001**
	(2.36)		(2.27)	
FSIZE	0.024*	0.010*	0.041	0.011
	(1.92)		(1.27)	
TLU	-0.004	-0.002	-0.081	-0.022
	(-0.14)		(-1.61)	
PAI	0.033	0.013	0.135	0.037
	(0.67)		(1.37)	
EXT	0.010	0.004	0.025	0.007
	(0.98)		(1.07)	
FASS	0.227*	0.088*	0.091	0.024
	(1.91)		(0.34)	
CREDIT	0.327	0.123	-0.024	0.006
	(1.58)		(0.12)	
DIST	-0.019**	-0.008**	-0.020*	-0.005*
	(-2.42)		(-1.70)	
TRANS	0.633***	0.245***	0.441**	0.112**
	(5.94)		(1.98)	
COMM	0.398***	0.153***	0.287	0.074
	(3.53)		(1.31)	
KARATU (reference)				
MBULU	-0.305*	-0.120*	-0.144	-0.037
	(-1.87)		(-0.35)	
MVOM	-0.161	-0.064	-0.141	-0.040
	(-0.98)		(-0.41)	
KILOSA	0.401**	0.154**	-0.184	-0.051
	(2.61)		(-0.68)	
Constant	1.716***		-0.714	
	(3.70)		(-0.89)	
Number of observations	663		253	
Wald χ^2 (17)	121.38***		49.33***	
Pseudo R^2	0.160		0.175	
Log pseudo-likelihood	-381.777		-115.936	
Outcomes correctly predicted	71%		77%	

Source: SIMLESA project survey data (2010)
Notes: Robust *z*- statistics in parentheses
*, ** and *** represent significance at 10%, 5%, and 1% level, respectively.

Unlike pigeonpea market participation, farm size per capita had a significantly positive effect on market participation for maize. The larger the farm size, the more it allowed the household to have a surplus production above the subsistence needs and surplus to sell. This result is consistent with Azam *et al*. (2012) who found that Cambodian farmers with larger land per worker are more likely to participate in markets.

The coefficient for the membership of farmer association had a positive and statistically significant impact on maize market participation. Belonging to a farmer association increased the probability of maize market participation by 9%. As expected, farmer associations can be good platforms for exchanging information, enabling farmers to link to buyers at a lower cost and thereby lowering the FTCs of market participation.

The coefficient of distance to nearest market is statistically significant and negatively related to market participation for both maize and pigeonpea farmers. Farmers located far from markets are less likely to participate in markets, probably because of the restricted market access costs. This result conforms to findings by Ouma *et al.* (2010) in Rwanda and Burundi, where the probability of banana market participation decreases for farmers located far away from markets. As expected, ownership of a transport asset has a statistically significant positive effect on market participation for both maize and pigeonpea. This finding implies that households with access to transport are 25% and 11% more likely to participate in maize and pigeonpea markets, respectively. Heltber and Tarp (2002), Boughton *et al*. (2007) and Alene *et al*. (2008) also found that household ownership of transport asset increases market participation. Similarly, ownership of communication assets increases the probability of market participation for maize by 15%, suggesting that better access to information is likely to result in increased agricultural output and improved market participation.

With regard to the location of households, the coefficient for the variable referring to the households in Mbulu district is statistically significant and negatively related to maize market participation as compared to Karatu District (reference district), reducing the likelihood of households' market participation by 12%. Mbulu district is characterised by poor infrastructure and relative remoteness as compared to Karatu district, which is characterised by relatively good physical infrastructure (implying low transaction costs). Conversely, households in Kilosa district are more likely to participate in the maize market compared to those in Karatu district, possibly because of greater access to neighbouring markets such as

Kibaigwa maize market. A household located in Kilosa raises the probability of maize market participation by 15%. Although there is no statistically significant variation in pigeonpea market participation across the districts, the results of this study show that farmers in Mbulu, Mvomero and Kilosa Districts have lower pigeonpea market participation than farmers in the Karatu District. The empirical results and discussion of the factors influencing intensity of market participation by maize and pigeonpea smallholder farmers are presented in the next sub-section.

3.6.3 Determinants of the intensity of market participation

The coefficient estimates for the second-stage Heckman selection estimation of the intensity of market participation are presented in Table 3.4. The model was tested for heteroscedasticity by using the Breusch–Pagan/Cook–Weisberg test. The result indicated no heteroscedasticity, since the calculated χ^2 value for both maize (0.48) and pigeonpea (0.81) was smaller than the tabulated χ^2 value (3.841) at the 5% significance level and one degree of freedom. Because the double-log specification is used, the coefficients in Table 3.4 are elasticities conditional on participation. The coefficient of inverse Mills ratio λ, is significantly different from zero for both the maize ($p < 0.1$) and pigeonpea ($p < 0.05$) market supply equations, indicating that sample selection bias would have resulted if the maize and pigeonpea supply equations had been estimated without consideration of the market participation decision.

The results show that the coefficients for mean village price are statistically significant and have a positive impact on marketed supply for pigeonpea, while the price is insignificant for maize. This finding means that for pigeonpea, marketed supply increases with price once participation decisions are made. The conditional price elasticity of marketable supply for pigeonpea and maize are 1.5% and 0.4%, respectively, showing that pigeonpea is more responsive to price changes compared to maize; and a 1% increase in pigeonpea prices increases pigeonpea supply by 1.5% among sellers. The high conditional elasticity of pigeonpea suggests that the pigeonpea price is an effective policy instrument to increase marketed surplus among sellers.

Table 3.4. Factors influencing the intensity of maize and pigeonpea sales

Variable	Maize		Pigeonpea	
	Coefficient	***t*-statistics**	**Coefficient**	***t*-statistics**
AGE	-0.464	-1.15	1.012	1.49
	(0.405)		(0.681)	
GENDER	-0.517	-1.21	-1.014	-1.32
	(0.429)		(0.768)	
EDUC	0.102	0.23	-0.106	-0.19
	(0.442)		(0.566)	
LABOR	-0.214	-0.84	1.211**	3.28
	(0.255)		(0.369)	
PRICE	0.374	0.51	1.455**	1.93
	(0.736)		(0.754)	
FSIZE	0.296**	2.21	0.302	1.27
	(0.134)		(0.238)	
TLU	-0.070	-0.28	-0.091	-0.45
	(0.250)		(0.203)	
PAI	0.197**	2.47	0.053	0.30
	(0.080)		(0.179)	
EXT	-0.098	-0.88	0.409	1.31
	(0.111)		(0.312)	
FASS	0.221	0.79	1.290***	4.18
	(0.279)		(0.309)	
CREDIT	0.517	1.12	0.792*	1.95
	(0.460)		(0.406)	
DIST	-0.187**	-2.06	0.099	0.69
	(0.091)		(0.144)	
KARATU (reference)				
MBULU	-1.040**	-2.81	-1.303	-1.77
	(0.370)		(0.736)	
MVOMERO	-1.482***	-3.13	-1.103	-1.40
	(0.474)		(0.789)	
KILOSA	-1.698***	-4.32	-1.027**	-2.48
	(0.393)		(0.415)	
Lambda (Inverse Mills	-0.517*	-1.93	-2.150**	-2.38
Ratio)	(0.268)		(0.903)	
Constant	12.540**	2.87	-2.504	-0.46
	(4.362)		(5.486)	
Breusch–Pagan/Cook–Weisberg test for heteroscedasticity				
χ^2 (1)	0.48		0.81	
Prob>χ^2	0.4893		0.3684	

Source: SIMLESA project survey data (2010).
Notes: Robust standard error in parentheses.
*, ** and *** represent significance at 10%, 5%, and 1% level, respectively.

The coefficient of labour force in adult equivalent units is statistically significant and has a positive impact on marketed supply for pigeonpea, but not for maize. Since the agricultural activities are labour intensive, households with a larger labour force can cultivate larger areas of land and produce more surpluses to market. The coefficient of farm size per capita is statistically significant and is positively associated with marketed supply for maize, but not for pigeonpea, indicating that relatively well-endowed farmers (with larger farm size per capita) produce more surpluses to the market. Similar results were also reported in Kenya and Mozambique by Alene *et al*. (2008) and Boughton *et al*. (2007), respectively.

The coefficient for index of productive assets is statistically significant and has a positive effect on marketed supply for maize, but not for pigeonpea, suggesting that productive assets facilitate productivity that, in turn, increase marketed surplus. The coefficient for membership of farmer association/group was positive and significant for the pigeonpea marketed supply, a result that conforms to expectations that membership of farmer association/group provides relevant information for increased returns to crop production and marketed supply. Farmer association/group can improve market access, lower transaction costs and increase the profits of smallholder farmers by offsetting diseconomies of scale (Hill *et al*., 2008; World Bank, 2008).

Distance to nearest market had a negative and significant influence on sales volume for maize, but an insignificant influence for pigeonpea. This finding means that there is a decline in volume of maize sold, while there is an increase in distance to reach the market. The results show that the supply of maize by farmers located one kilometre further from the nearest market is reduced by 19%, compared with those living closer to these markets. Ouma *et al*. (2010) found that transacted quantities of farmers located far from the market in Rwanda and Burundi is reduced by 17%.

In explaining maize marketed supply, the coefficients for geographical location of households are significant. The results reveal that maize supply is significantly lower for farmers in the Mbulu, Mvomero and Kilosa Districts compared to the reference district, Karatu. Similarly, pigeonpea supply is significantly lower for farmers in the Kilosa District as compared to Karatu District. Karatu District is characterised by high potential and relatively good physical infrastructure that can lower transaction costs.

The unconditional marginal effects calculated at the mean are presented in Table 3.5, separately reporting the effect on unconditional marketed supply that is due to change in participation and in marketed supply. Because of the double-log specification of the model, the marginal effects essentially represent elasticities. For maize, the largest marginal effect emerges from ownership of communication assets and transport assets, with elasticities of supply of 0.42 and 0.36, respectively, and over 60% being due to the effect on marketed supply. As in the case of critical in maize production, farm size per capita and productive assets index have the third- and fourth-largest total elasticities of supply of 0.26 and 0.19, respectively. The marginal effect of gender and education level of household heads increases maize supply by 10% and 2.6%, respectively, with all the effects displayed in terms of increased market participation. This finding suggests a potential of improved human capital and an increased targeting of women, in order to increase market participation.

Table 3.5. Unconditional marginal effects (Heckman sample selection model)

Variable	Total expected change in sales (%)	Marginal impact via participation (%)	Marginal impact via intensity (%)
Maize			
GENDER	0.099	0.099	NS
EDUC	0.026	0.026	NS
PRICE	0.001	0.001	NS
FSIZE	0.262	0.007	0.255
FASS	0.069	0.069	NS
PAI	0.194	0.020	0.174
COMM	0.42	0.152	0.268
TRANS	0.363	0.120	0.243
DIST	-0.013	-0.001	-0.012
Pigeonpea			
PRICE	1.287	0.001	1.286
LABOR	0.535	0.167	0.368
FASS	0.866	NS	0.866
CREDIT	0.394	NS	0.394
TRANS	0.243	0.060	0.183
DIST	-0.014	-0.014	NS

Source: SIMLESA project survey data (2010).
Notes: Only significant total elasticities and decompositions are reported.
Marginal effects are not reported for district dummies.
NS = not significant.

Membership of farmer association, coming about through increased participation, increases maize supply by 7%. Distance to nearest market reduces supply by 1.3%, with all the effects being in terms of reduced marketed supply. For pigeonpea, the largest effects on commercialisation come from price, with an elasticity of 1.3, and almost all of the entire impact deriving through increased marketed supply. Membership of farmer association has the second-largest total elasticities of pigeonpea supply of 0.87, with all of the impact deriving through increased marketed supply. As in the case of critical inputs in pigeonpea production, labour force in adult equivalent units has elasticities of supply of 0.54, and this comes about through both increased participation (31%) and increased supply (68%). Access to credit increases supply by 39%, with all the effects displayed in terms of increased marketed supply. Ownership of transport assets has elasticities of pigeonpea supply of 0.24. Distance to nearest market reduces supply by 1.4%, with all the effects displayed in terms of reduced market participation.

3.7 Summary

In this chapter, the factors that influence smallholder farmers' participation in maize and pigeonpea markets were determined by estimating a probit model in step 1 of Heckman's procedure. The probit model was also used to estimate the inverse Mills ratio, which was incorporated into the second step of the procedure to estimate the market supply equation. The result reveals that distance to nearest market, mean village prices, farm size, labour force, membership of farmer associations and geographic locations of household have significant effects on both market participation and intensity of participation. Distance to nearest market influences participation and marketed supply negatively, whereas other factors influence participation and marketed supply positively. These results highlight the importance of proportional transaction cost, output price, private and public assets, and locations in determining market participation and marketed surplus. Furthermore, gender, education of the household head, access to communication assets and ownership of transport assets have significantly positive effects on market participation decision. The results suggest that policies aimed at improving rural road infrastructure, market information systems, smallholder asset accumulation, human capital and promotion of farmer association could reduce transaction costs and enhance market participation and marketed supply by smallholder farmers. Having identified the determinants of market participation, the next

chapter presents the empirical results and discussion on the factors influencing the choice of marketing channels by smallholder farmers.

CHAPTER 4. THE CHOICE OF MARKETING CHANNEL BY MAIZE AND PIGEONPEA SMALLHOLDER FARMERS: EVIDENCE FROM NORTHERN AND EASTERN ZONES OF TANZANIA[5]

4.1 Introduction

This chapter presents and discusses empirical findings on the factors that influence smallholder farmers' choice of marketing channel with a particular focus on maize and pigeonpea. The rest of the chapter is organized as follows: Section 4.2 outlines the data and methodology, which constitutes the data collection and sampling methods, conceptual and empirical models and definition of variables. Section 4.3 presents the empirical results and discussion, while section 4.4 concludes the chapter with a summary of the results.

4.2 Conceptual framework

A producer's choice of market channel can be conceptualized using a Random Utility Model (RUM). The focus is to model a smallholder farmer's market decision making process based on utility maximization theory. The model assumes that the decision to participate in a particular marketing channel is based on the maximization of an underlying utility function, and a farmer selects his/her market channels based on his/her expected utility (McFadden, 1986). A farmer's decision to participate or not in a given market channel is made by evaluating gains in expected utility, taking into account the related investments, benefits and costs. If this expected utility is positive and higher – as compared to alternative options –this market will be selected by a farmer.

Following Balsevich *et al.* (2006), let farmer i observe $N(3)$ market channels; say traders, wholesalers or brokers. The farmer's utility from participating in market channel j is represented by U_{ij}. The farmer makes a marginal benefit-marginal cost calculation based on

[5] This chapter gave rise to the following publication: Mmbando, F.E., E.Z. Wale, L.J.S. Baiyegunhi, and M.A.G. Darroch. The choice of marketing channel by maize and pigeonpea smallholder farmers: Evidence from Northern and Eastern zones of Tanzania. Revised and resubmitted to *Agrekon*.

the utilities achieved by selling to a market channel or to another. The utility U_{ij} for each individual farmer choosing a particular alternative is specified as a linear function of the vector of channel-specific parameters (β_j) and the attributes of that alternative (X_{ij}) and a stochastic error component (e_{ij}):

$$U_{i(j=k)} = \beta_{j=k} X_{ij} + e_{ij} \qquad \forall j \in N \tag{4.1}$$

The utilities (the difference between benefit and cost) cannot be observed directly but the choice made by the farmer reveals which one provides the greater utility (Greene, 2003).

The farmer will choose to market his/her crops through a specific channel if the expected utility gained by selling through this channel is greater than all the other channels. The probability of choosing an alternative is equal to the probability that the utility of that particular alternative is greater than or equal to the utilities of all other alternatives in the choice set. The household selects market channel $j = k$ if

$$U_{i(j=k)} > U_{i(j\neq k)} \forall k \neq j \tag{4.2}$$

where U_{ij} denotes a random utility associated with the market channel $j = k$, and $\beta_{j=k} X_{ij}$ is an index function denoting the producer's average utility associated with this alternative. The second term e_{ij} denotes a random error which is specific to a producer's utility preference. The empirical model used to study the factors influencing marketing channel choice by smallholder farmers is presented in the following section.

4.3 Multinomial logit model

Given that sampled farmers in the study areas have more than two alternative channel choices, the Multinomial Logit (MNL) model was applied to estimate factors affecting their choice of marketing channel. The model is widely used in studies involving multiple choices that define the dependent variable (Gujarati and Porter, 2009). The independent variables can be either dichotomous (i.e., binary) or continuous (i.e., interval or ratio in scale). Like binary logistic regression, multinomial logistic regression uses maximum likelihood estimation to evaluate the probability of categorical membership (Schwab, 2002).

Following Greene (2003), assuming that the probability that the i^{th} farmer chooses the j^{th} of 3 channels is P_{ij}, the probability that a smallholder farmer chooses alternative j can be explained by a MNL as

$$P_{ij} = \frac{\exp(\beta_j x_i)}{1+\sum_{j=1}^{3}\exp(\beta_j x_i)} \qquad \text{for j=1,2,3} \qquad (4.4)$$

where x_i is a vector of contextual socio-economic characteristics of the i^{th} farmer,

β_j is a vector of regression parameter estimates associated with alternative j, and

3 is the number of market channels in the choice set.

The coefficients of explanatory variables on the omitted or base category are assumed to be zero. The probability that a base category will be chosen is calculated as

$$P_i(j=1 \mid x_i) = \frac{1}{1+\sum_{j=1}^{3}\exp(\beta_j x_i)} \qquad (4.5)$$

The probabilities of the i^{th} farmer being in the other two categories (j = 2 or 3) can be estimated as:

$$P_i(j=m \mid x_i) = \frac{\exp(\beta_j x_i)}{1+\sum_{j=2}^{3}\exp(\beta_j x_i)} \qquad \text{for m>1} \qquad (4.6)$$

By differentiating equation (4.4) with respect to the covariates, the marginal effects of the individual characteristics on the probabilities can be estimated as:

$$\frac{\partial P_j}{\partial X_i} = P_j[\beta_j - \sum_{j=0}^{3} P_j\beta_j] = P_j[\beta_j - \overline{\beta}] \qquad (4.7)$$

where P_j is the probability of the farmer choosing market channel j, and

β_j is a vector of regression parameter estimates associated with alternative j (Greene, 2003).

The main explicit assumption of MNL is that the variables do not have to be multivariate normally distributed. The MNL can, therefore, be estimated using continuous, dichotomous and ordinal explanatory variables (Aldrich and Nelson, 1984). This is a much less restrictive assumption than the multinomial probit that assumes that the specified variables are all

normally distributed. The MNL results are also relatively easy to interpret compared to the multinomial probit model. The next section presents the data collection procedure.

Although the MNL is relatively easy to estimate and interpret, its major disadvantage is the inherent assumption of the independence of irrelevant alternatives (IIA) (Amemiya, 1985). This assumption requires that the inclusion or exclusion of any category (e.g., use of brokers) does not affect the relative risks associated with the regressors in the remaining categories (use of traders and wholesalers). The Hausman test (Hausman and McFadden, 1984) was performed to check whether or not the IIA assumption was violated in this study. The process involves estimating a full model that includes all *j* categories and a restricted model where one category is eliminated. A statistically significant difference between the two models' estimates would indicate a violation of the IIA assumption. The Hausman test showed that the null hypothesis of independence for both maize and pigeonpea could not be rejected. All tests (see Appendix 4.1) concluded that the IIA could not be rejected by the data, suggesting that the use of MNL was appropriate.

4.4 Data collection

The analysis conducted in this chapter used the same dataset used in chapter three. However, given the aim of understanding the choice of marketing channels made by maize and pigeonpea farmers, the dataset in this chapter analyses only those sampled households that participated in the market. Out of the total 700 sample households, only a sub-sample of 562 selling transactions made by 372 households that participated in the market were included in the final analysis. The next section presents the definition of variables used in the empirical model.

4.5 Definition of the variables

Dependent variable

In this study, there are four channels through which farmers sold their maize and pigeonpea during 2008/09 cropping season, namely: (i) consumers; (ii) brokers; (iii) rural traders; and (iv) wholesalers/exporters. This can be depicted as:

Maize

Channel I: Producer→consumer;

Channel II: Producer→ broker →rural trader→wholesaler→retailer→consumer

Channel III: Producer→rural trader→wholesale →retailer→consumer

Channel IV: producer→wholesaler→retailer→consumer

Pigeonpea

Channel I: Producer→consumer;

Channel II: Producer→broker →rural trader→wholesaler/exporter →foreign markets

Channel III: Producer→rural trader→wholesaler/exporter→foreign markets

Channel IV: Producer→wholesaler/exporter→foreign markets

Analysis indicated that 54% and 66% of farmers sold their maize and pigeonpea through brokers at the farm gate, respectively. About 30% and 21% of farmers sold their maize and pigeonpea through traders at the market, whereas 13% and 12%, respectively, were sold through wholesalers at the market. Only 3% and 1% of farmers sold their maize and pigeonpea through consumers at the farm gate, respectively. Considering the above observations, three marketing channels were found prominent for both maize and pigeonpea, and these were brokers, rural traders and wholesalers. Therefore, farmers have three major channels to sell maize/pigeonpea, and the alternatives j = 1, 2, 3 represent sales to brokers, rural traders or wholesalers. The estimated MNL predicts the relative probability that a producer would choose one of the three categories based on the nature of the explanatory variables. For this analysis, the marketing channel broker is used as the comparison, base or reference category because this channel was chosen by most of the farmers to trade their maize and pigeonpea. The MNL was estimated using Stata (StataCorp, 2009) software.

The empirical MNL for factors affecting the choice of marketing channel in the four areas was specified as:

$$P_{ij} = \ln(P_j / P_1) = \beta_0 + \beta_1 AGE + \beta_2 EDUC + \beta_3 EXPER + \beta_4 FORG + \beta_5 EXT + \beta_6 CREDIT + \beta_7 WINDEX + \beta_8 MKINF + \beta_9 DISTMK + \beta_{10} RDQ + \beta_{11} TRUST + \mu_i$$

where

β_0.....β_{11} = the parameters to be estimated,

P_{ij} is the probability of marketing channel j being chosen by farmer i, and $j = 1$ for sales to brokers, $j = 2$ for sales to rural traders, and $j = 3$ for sales to wholesalers.

The explanatory variables and their expected relationship with dependent variable are described in Table 4.1. A positive sign for estimated coefficients indicates a higher likelihood of choosing the alternative channel over the base category as that explanatory variable increases.

Household characteristics:

Age of household head (AGE): Older farmers are more likely to sell through closer markets (Amaya and Alwayng, 2011). However, when older farmers own cell phones, they are more likely to go to farther markets. Thus, AGE (in years) is expected to increase the likelihood of using brokers.

Education of household head (EDUC): The level of formal education attained is used as a proxy for the farmer's ability to acquire, process/synthesize and effectively use information gathered from different sources (Strauss *et al.,* 1991). The household head's years of formal education, is expected to increase the likelihood of selling to more complex markets (i.e. using alternatives to brokers).

Farming experience (EXPER): More experienced farmers may be better connected with traders (i.e. have developed social capital) and may have more marketing experience. According to Renos *et al.* (2003), experience also reflects the ability to better negotiate. Therefore, the number of years of farming experience of household head is expected to increase the likelihood of using traders or wholesalers relative to brokers.

Social capital:

Membership of a farmers association (FORG): Household membership in a farmer association or group may increase access to information critical to production and marketing decisions (Olwande and Mathenge, 2012). Membership in a farmer association or group can also contribute towards reduced transaction costs and strengthen farmers' bargaining power. Therefore membership in a farmer association or group is expected to increase the likelihood of using wholesalers relative to brokers, and was set as a dummy variable (1 if the farmer was a member and 0 otherwise).

Table 4.1. Description of the explanatory variables and expected signs

Variable	Description	Expected sign
AGE	Age of household head (years)	-
EDUC	Education of household head (years)	+
EXPER	Farming experience of the household head (years)	+
EXT	Farmers have access to extension (1=yes; 0 otherwise)	+
CREDIT	Farmers have access to credit (1=yes; 0 otherwise)	+
FORG	Membership in farmers' association/group (1=yes; 0 otherwise)	+/-
MKINF	Farmer uses market price information before decision to sell (1=yes; 0 otherwise)	+
DISTMK	Distance to the main market in km	-
RDQ	Quality of road to the main market (1-5) [a]	+
TRUST	Farmers' level of perceived trust in buyers (1-6) [b]	+
WINDEX	Household wealth index (PC score)	+

[a] 1=very poor, 2=poor, 3=average, 4=good, 5=very good
[b] 1=strongly disagree, 2=disagree, 3=slightly disagree, 4=slightly agree, 5=agree, 6=strongly agree

Institutional factors:

Access to extension services (EXT): Agricultural extension services are expected to improve access to production and marketing information and technical skills of smallholders. Extension services are also expected to facilitate smallholder linkages with input and output markets (Gebremedhin *et al.,* 2009). Therefore, access to extension services may thus be associated with higher market participation and the likelihood of choosing wholesalers relative to brokers. EXT was captured as a dummy variable (1 if the farmer has access to extension services and 0 otherwise).

Access to credit (CREDIT): Farmers who have access to credit may produce more output and hence be able to sell in bulk. Therefore, increased marketable surplus expected to increase the likelihood of using wholesaler relative to brokers. Access to credit was set as a dummy variable (1 if the farmer accessed credit and 0 otherwise).

Household wealth:

Wealth index (WINDEX): Farmers with relatively higher wealth may have a lower degree of risk aversion, and with less risk aversion, may be more willing to adopt new market channel opportunities (Alemu *et al.*, 2012). In order to reduce the high number of explanatory variables and remedy multicollinearity, the study developed a wealth index (WINDEX) for asset ownership using PCA. Key assets included total farm size, total livestock units, ownership of mobile phones, radio, bicycle, television sets or ox-plough, and house with iron sheet roof or brick wall. The first principal component (PC_1) was used in constructing WINDEX for sample households for both maize and pigeonpea producers because it explained about 27.14% and 30.05% of the total variance in the nine indicators for maize and pigeonpea households, respectively (Appendix 4.2). All of the estimated coefficients (eigenvectors) had positive signs, implying that as the size of the estimated coefficients increases, the WINDEX of the i^{th} household also increases. Therefore, the higher the WINDEX increases the likelihood of selling to wholesalers relative to brokers, because wealthy farmers are more capable to transport their produce to more distant markets instead of selling to brokers at the farm gate.

Transaction cost factors:

Price knowledge (MKINF): Prior to selling to various markets, farmers spend time and resources on finding relevant markets and price information. Broader information on prices at different market channels can improve farmers' bargaining position, reducing search costs and creating an opportunity to choose the best options (Zanello *et al.,* 2012). In this study, the MKINF indicates whether farmers used market price information before they decided to sell their maize and pigeonpea and is set as dummy variable (1 if the farmer used price information and 0 otherwise). MKINF is expected to increase the likelihood of using wholesalers or traders relative to brokers.

Distance to main market (DISTMK): This variable was measured by kilometres from the production area to the market. Farmers located farther from the market are expected to face high search costs. The further the production area is from the market, the less likely would the farmer be to participate in that market since it implies higher transportation charges and less access to market information (Omamo, 1998). Therefore, it was hypothesized that the higher the distance to the market the more the likelihood of selling to brokers at farm-gate.

Quality of road to the main market (RDQ): Transportation cost increases with poorer road conditions to market, and so farmers will prefer to sell at nearby market. The RDQ variable was set as a continuous variable ranging from 1 to 5 (low to high). The availability of good road to the main market is expected to increase the likelihood of using wholesalers or traders relative to brokers.

Trustworthiness of buyers (TRUST): Farmers' degree of trust towards buyers is an important variable affecting transaction costs, since higher levels of trust reduce the perception of risk and hence transaction costs in an exchange relationship (Woldie and Nuppenau, 2009). This variable should positively influence farmers' channel choice, and included as a continuous variable ranging from 1 to 6 (low to high) to reflect farmers' perceptions of the trustworthiness of buyers. The next section presents the empirical results and discussions.

4.6 Empirical results and discussions

4.6.1 Descriptive statistics

4.6.1.1 Maize statistics

Descriptive statistics of the maize producing households presented in Table 4.2 indicate that most of these households (210 of 372 or 56.5%) used the brokers market channel. Nearly 30.1% sold to traders and the rest (13.4%) sold to rural wholesalers. On average, the head of household is about 45 years old with five years of formal education. The education level distinguishes between those who succeed in selling to more complex markets, and those who do not. The producers selling to wholesalers have, on average, about two more years of formal schooling than those selling their maize to traders and brokers. Farmers that sell to wholesalers had relatively more farming experience (22.4 years), implying that they may have more ability to negotiate. Most of the households (66.0%) are not a member of a farmers' association. On average, about 31% and 20.0% of sample households have access to extension services and credit facilities, respectively.

Table 4.2. Descriptive statistics for variables used in the MNL for maize

Variable	Marketing channel						Total (N=372)	
	Traders (N=112)		Wholesalers (N=50)		Brokers (N=210)			
	Mean	St.dev	Mean	St.dev	Mean	St.dev	Mean	St.dev
AGE	45.22	13.04	45.78	14.92	44.73	13.20	45.02	13.36
EDUC	5.12	2.78	7.14	1.01	4.69	2.89	5.15	2.79
EXPER	21.48	12.23	22.44	10.53	20.46	10.33	21.03	10.96
FORG	0.56	0.50	0.28	0.45	0.23	0.42	0.34	0.47
EXT	0.54	0.50	0.18	0.39	0.22	0.41	0.31	0.46
CREDIT	0.19	0.39	0.52	0.50	0.13	0.34	0.20	0.40
WINDEX	0.35	1.65	0.53	1.34	-0.23	1.54	0.05	1.58
MKINF	0.55	0.50	0.40	0.49	0.24	0.43	0.35	0.48
DISTMK	16.60	9.19	17.05	9.25	18.02	7.02	17.46	8.05
RDQ	3.12	0.94	3.76	0.77	2.87	1.02	3.06	1.01
TRUST	4.03	0.84	4.74	0.44	3.90	1.03	4.05	0.96

Source: SIMLESA project survey data (2010).

Farmers that sell to wholesalers are wealthier (WINDEX of 0.53) than those who supplied to traders (WINDEX of 0.35) and brokers (WINDEX of -0.23). This implies that farmers who supplied to wholesalers have access to more assets than traders and brokers. Ex-ante information on price in the market in which farmers are selling varies from 55.0% (for suppliers to traders) to 40.0% and 24.0% for those using wholesalers and brokers. Distance to main market is longer for farmers using brokers (18.0 km) as compared to farmers supplying to traders (16.6 km) and wholesalers (17.1 km). The overall road quality mean score for maize farmers was 3.1 and the mean score for farmers' trustworthiness of buyers was 4.1. Farmers seem to have more trust in wholesalers than in traders and brokers.

4.6.1.2 Pigeonpea statistics

Table 4.3 provides some basic descriptive statistics of pigeonpea sample households in the study area. Most pigeonpea growing households (126 of 190 or 66.3%) used the brokers' market channel. Nearly 21.6% sold to traders and the rest (12.1%) sold to wholesalers. On average, the head of household is about 47.1 years old with five years of formal education. Farmers that sell to brokers have more farming experience (19.6 years) compared with those that sell in other channels, implying that they may have more ability to negotiate.

Table 4.3. Descriptive statistics for variables used in the MNL for pigeonpea

Variable	Marketing channel						Total (N=190)	
	Traders (N=41)		Wholesalers (N=23)		Brokers (N=126)			
	Mean	St.dev	Mean	St.dev	Mean	St.dev	Mean	St.dev
AGE	47.24	14.13	46.48	17.06	47.17	13.30	47.10	13.90
EDUC	5.17	2.79	6.22	3.03	4.79	3.18	5.04	3.10
EXPER	18.56	12.61	15.26	9.23	19.55	12.24	18.82	12.02
FORG	0.76	0.43	0.22	0.42	0.29	0.45	0.38	0.49
EXT	0.17	0.38	0.39	0.50	0.10	0.29	0.15	0.36
CREDIT	0.32	0.47	0.39	0.50	0.10	0.29	0.18	0.38
WINDEX	0.12	1.61	1.97	1.97	-0.22	1.57	0.12	1.77
MKINF	0.76	0.43	0.39	0.50	0.37	0.49	0.46	0.50
DISTMK	18.15	8.52	10.57	6.15	20.46	8.96	18.76	9.11
RDQ	2.73	0.90	3.09	0.79	2.94	1.08	2.91	1.01
TRUST	4.10	1.00	4.48	0.51	3.85	0.96	3.98	0.94

Source: SIMLESA project survey data (2010).

Most of the farmers who supplied to traders (76.0%) participate in a farmers' association/group compared to farmers supplied to brokers (29.0%) and wholesalers (22.0%). On average, about 15.0% and 18.0% of sample pigeonpea households have access to extension services and credit, respectively. Farmers that sell to wholesalers are relatively wealthier (WINDEX of 1.9) than those who supplied to traders and brokers. About 76.0% of farmers who supplied to traders used market price information before they decided to sell their produce, as compared to those using wholesalers (39.0%) and brokers (37.0%). Distance to main market was higher for broker users (20.5 km) than for traders (18.2 km) and wholesalers (10.6 km). The mean score for farmers' perceived trustworthiness of buyers was 3.9, and those who supplied to wholesalers trust buyers more as compared to those who supplied to traders and brokers. Descriptive statistics show that distance to main market was higher for maize growers (17.5 km) as compared to pigeonpea growers (18.8 km). About 38% of pigeonpea growers have membership in farmer association/group as compared to 34% of maize growers. Result also showed that pigeonpea producers (wealth index of 0.12) are wealthier than maize producers (wealth index of 0.05). In both maize and pigeonpea producers, most of the transactions occurred in a situation where seller positively trusted the buyer. Econometric results are presented in the next sub-section.

4.6.2 Econometric results

The empirical MNL models were corrected for possible multicollinearity problems after testing for multicollinearity using the Variance Inflation Factor (VIF) and correlation matrix. The VIF was less than 10, for both maize and pigeonpea, confirming that multicollinearity was not a problem (Gujarati and Porter, 2009). In addition, correlation matrix show that these coefficients are globally less than 0.37 for both maize and pigeonpea samples, indicating weak correlations, which suggest that the variables are sufficiently independent to be modeled together without multicollinearity concerns.

4.6.2.1 Maize MNL results

The estimated results from the MNL for maize channel choice are presented in Table 4.4. The estimated Deviance χ^2 of 457.60 with 720 degrees of freedom (df) show statistical significance at well above the 5% level, suggesting that the MNL adequately fits the data. The estimated Likelihood ratio test (χ^2 of 252.13 with 22 df; p=0.000) is statistically significant at well below the 5% level, implying that the full MNL improves the data fit and hence outperforms, the null model. The overall classification accuracy of the model is relatively good at 75%, with broker channel users classified very well (85.70%) and users of traders and wholesalers classified well (61.60% and 60.00%, respectively).

Estimated coefficients and marginal effects all have the a *priori* expected signs and show that EDUC, FORG, EXT, CREDIT, MKINF, RDQ and TRUST all influence market channel choices made by maize growers, but have different impacts depending on the market channel. Education level of household head (EDUC) positively increased the likelihood that maize producers will sell to wholesalers relative to brokers. The probability of a household head using wholesalers relative to brokers increases by 1.6% ($p<0.01$) for every additional year of education of the household head. Study reported by Hobbs (1997) found the same impact of education level on channel choice.

Farmer membership of a farmer association/group (FORG) significantly ($p<0.01$) and positively increased the likelihood that a maize producer will sell to traders relative to brokers. Being a member of a farmer's association/group increases the likelihood that a maize farmer will sell to traders by about 37%.

Table 4.4. Estimated coefficients and marginal effects of the variables in the MNL model for maize, Northern and Eastern Tanzania, 2010

Variables [a]	$\ln(P_2/P_1)$ Traders vs Brokers contrast			$\ln(P_3/P_1)$ Wholesalers vs Brokers contrast		
	Estimated coefficients	Marginal effects dy/dx	z-value	Estimated coefficients	Marginal effects dy/dx	z-value
Constant	-4.2261 (1.1215)			-17.6035 (2.6076)		
AGE	-0.0031 (0.0116)	-0.0007 (0.0024)	-0.27	0.0085 (0.0169)	0.0002 (0.0004)	0.51
EDUC	0.0662 (0.0528)	0.0087 (0.0110)	1.26	0.7076*** (0.1984)	0.0163 (0.0052)	3.57
EXPER	0.0216 (0.0138)	0.0043 (0.0029)	1.56	0.0213 (0.0196)	0.0004 (0.0005)	1.08
FORG[b]	1.6801*** (0.3016)	0.3695 (0.0626)	5.57	-0.0659 (0.4830)	-0.0139 (0.0102)	-0.14
EXT	1.6909*** (0.3008)	0.3770 (0.0629)	5.62	-0.2908 (0.5238)	0.0181 (0.0109)	-0.56
CREDIT[b]	0.3677 (0.3885)	0.0420 (0.0805)	0.95	2.2218*** (0.4878)	0.1017 (0.0484)	4.55
WINDEX	0.1709 (0.0922)	0.0343 (0.0190)	1.85	0.1809 (0.1460)	0.0031 (0.0036)	1.24
MKINF[b]	1.4890*** (0.2987)	0.3220 (0.0633)	4.98	0.3568 (0.4809)	-0.0038 (0.0098)	0.74
DISTMK	-0.0216 (0.0188)	-0.0045 (0.0039)	-1.15	-0.0013 (0.0281)	0.0001 (0.0006)	-0.05
RDQ	0.2416 (0.1533)	0.0430 (0.0318)	1.58	1.0257*** (0.2425)	0.0225 (0.0102)	4.23
TRUST	0.1669 (0.1579)	0.0238 (0.0329)	1.06	1.5346*** (0.3405)	0.0351 (0.0147)	4.51
No. of observation	372					
Log likelihood	-229.5251					
Pseudo R^2	0.3532					

Deviance χ^2 (720) = 457.60 (significance level =1.00)

Likelihood ratio test χ^2 (22) = 252.13 (significant level =0.00)

Classification accuracy (correctly predicted):

Brokers = 85.70%; traders = 61.60%; wholesalers = 60.00%; overall model = 75.00%

Source: SIMLESA project survey data (2010).

Notes: Base category is brokers (P_1)

P_2 and P_3 represent the probability that a household selects traders and wholesalers channels, respectively.

[a] Definitions for variables are given in Table 4.1.

[b] *dy/dx* is for discrete change of dummy variable from 0 to 1.

Standard errors are in parentheses.

***= significant at 1% level; **= significant at 5% level; *= significant at 10% level.

Access to extension service (EXT) significantly increased the likelihood that a maize producer will sell to traders relative to brokers. Access to extension services increases the probability of selling maize to traders relative to brokers by 37.7% ($p<0.01$). Access to extension services is expected to increase the ability of farmers to acquire relevant market price information and related production information which, in turn, increases a farmer's ability to choose the distant market channel. Alemu *et al.* (2012) also reported that access to extension services significantly increased the probability that a small-scale farmer in Ethiopia will choose the contract market relative to the spot market.

Access to credit (CREDIT) significantly increased the likelihood that a maize producer will sell to wholesalers relative to brokers and increased the probability that a farmer will sell to wholesalers relative to brokers by 10.2% ($p<0.01$). The price knowledge proxy MKINF also significantly increased the likelihood that a maize producer will sell to traders relative to brokers, increasing the probability by 32.2% ($p<0.01$).

Quality of road to main market (RDQ) again significantly influenced the probability of choosing wholesalers relative to brokers, with improved quality of road to main market increasing the probability of selling to wholesalers by 2.3% ($p<0.01$). Jari and Fraser (2009) reported that the availability of good road infrastructure significantly increased the likelihood of households marketing their produce through informal channels in South Africa.
Perceived trust in buyers (TRUST) also significantly increased the probability of choosing wholesalers relative to brokers. Households who perceived higher trust in the buyer relationship are more likely to sell to wholesalers relative to brokers. This implies that there is a 3.5% ($p<0.01$) increase in the probability of selling maize to wholesalers for these households. Higher levels of trust reduce screening costs and the risk of default in the business relationship.

4.6.2.2 Pigeonpea MNL results

The results of the MNL estimated for pigeonpea market channel choice are presented in Table 4.5. The goodness-of-fit of the model is quite good. The estimated Deviance χ^2 of 193.79 with 356 df, shows statistical significance at well above the 5% level, suggesting that the MNL adequately fits the data and that the data are consistent with the MNL assumptions.

The estimated Likelihood ratio test (χ^2 of 132.59 with 22 df; p=0.000) is statistically significant at well below the 5% level, implying that the full MNL outperforms the null model. The overall classification accuracy is again relatively good at 80.0%, with users of brokers classified very well (91.3%), and users of wholesalers and traders less well classified (60.9% and 56.1%, respectively). Estimated coefficients and marginal effects all have the expected a *priori* signs. Membership in farmer association/group (FORG), EXT, CREDIT, WINDEX, MKINF, DISTMK and TRUST all influence market channel choices made by pigeonpea producers, but have different impacts depending on the market channel.

FORG significantly increased the likelihood that a pigeonpea producer will sell to traders relative to brokers, and increased the probability that a pigeonpea farmer will sell to traders relative to brokers by 37.7% ($p<0.01$). Access to extension services (EXT) significantly influenced the likelihood that a pigeonpea farmer will sell to a wholesaler channel relative to brokers. Such access increases the probability of selling pigeonpea to wholesalers relative to brokers by an estimated 10.2% ($p<0.01$). Access to credit (CREDIT) also increased the likelihood that a pigeonpea producer will sell to wholesalers relative to brokers by some 6.8% ($p<0.05$).

The wealth index (WINDEX) has significantly increase the probability of selling to wholesalers relative to brokers by about 1.5% ($p<0.01$) per unit increase in the index. In contrast with maize market channel choice, WINDEX did not significantly influence farmers' choice of market channel for maize producers. Wealthy farmers are more capable of owning vehicles that can be used to transport their produce to more distant markets instead of selling to brokers at the farm gate. This finding is consistent with Fafchamps and Vargas-Hill (2005), who all established a positive relationship between wealth and market choice. According to them, wealthier farmers are less likely to sell at the farm gate as quantity sold increases, and more likely to travel to market in order to sell.

Table 4.5. Estimated coefficients and marginal effects of the variables in the MNL model for pigeonpea, Northern and Eastern Tanzania, 2010

Variables [a]	$\ln(P_2/P_1)$ Traders vs Brokers contrast			$\ln(P_3/P_1)$ Wholesalers vs Brokers contrast		
	Estimated coefficients	Marginal effects *dy / dx*	z-value	Estimated coefficients	Marginal effects *dy / dx*	z-value
Constant	-5.0568 (1.9477)			-4.5035 (3.2318)		
AGE	-0.0005 (0.0179)	0.0001 (0.0023)	-0.03	-0.0212 (0.0278)	-0.0004 (0.0006)	-0.76
EDUC	0.0878 (0.0791)	0.0110 (0.0102)	1.11	0.1426 (0.1300)	0.0026 (0.0029)	1.1
EXPER	-0.0183 (0.0192)	-0.0023 (0.0025)	-0.95	-0.0142 (0.0284)	-0.0002 (0.0006)	-0.5
FORG[b]	2.3264*** (0.4957)	0.3676 (0.0765)	4.69	-0.6813 (0.8241)	-0.0197 (0.0152)	-0.83
EXT	0.5925 (0.6967)	0.0646 (0.1085)	0.85	2.2957*** (0.8390)	0.1023 (0.0737)	2.74
CREDIT[b]	0.8752 (0.5555)	0.1182 (0.0960)	1.58	1.9777** (0.7815)	0.0678 (0.0515)	2.53
WINDEX	-0.0216 (0.1475)	-0.0051 (0.0190)	-0.15	0.7321*** (0.2270)	0.0146 (0.0082)	3.22
MKINF[b]	2.0549*** (0.5093)	0.2888 (0.0713)	4.03	0.3146 (0.7454)	-0.0012 (0.0135)	0.42
DISTMK	-0.0414 (0.0273)	-0.0048 (0.0036)	-1.52	-0.1865*** (0.0628)	-0.0036 (0.0019)	-2.97
RDQ	0.0069 (0.2396)	0.0006 (0.0310)	0.03	0.0944 (0.3529)	0.0018 (0.0072)	0.27
TRUST	0.5012* (0.2818)	0.0621 (0.0369)	1.78	0.9801* (0.5634)	0.0179 (0.0135)	1.74
No. of observation	190					
Log likelihood	-96.8939					
Pseudo R^2	0.4063					

Deviance χ^2 (356) = 193.79 (significance level =1.00)

Likelihood ratio test χ^2 (22) = 132.59 (significance level =0.00)

Classification accuracy (correctly predicted):

broker = 91.30%; traders = 56.10%; wholesalers = 60.90%; overall model = 80.00%

Source: SIMLESA project survey data (2010).

Notes: Base category is brokers (P_1)

P_2 and P_3 represent the probability that a household selects traders and wholesaler channels, respectively.

[a] Definitions for variables are given in Table 1.

[b] *dy/dx* is for discrete change of dummy variable from 0 to 1.

Standard errors are in parentheses.

***= significant at 1% level; **= significant at 5% level; *= significant at 10% level.

Price knowledge (MKINF) significantly increased the likelihood that a pigeonpea producer will sell to traders relative to brokers, and results suggest that price information knowledge increased the probability that a farmer will sell to traders by about 28.9% ($p<0.01$). Intuitively, households with no access to price information are less likely to travel to market to sell their produce to traders; they are more likely to sell to brokers at farm gate.

Distance to market (DISTMK) significantly reduced the likelihood that a pigeonpea producer will sell to wholesalers rather than to brokers. A one kilometre increase in distance to market increases the probability that the farmer will sell to brokers by about 0.4% ($p<0.01$). Farmers who are located farther away from markets face higher transaction costs and so may opt for brokers at farm-gate, in their villages or in nearby villages, rather than selling to wholesalers in more distant market that increase transaction costs. This result is consistent with Alemu *et al.* (2012) who found that Ethiopian farmers located far from markets faced higher transaction costs, and so opted for cooperatives.

Finally, TRUST significantly increased the likelihood that a pigeonpea producer will sell to traders and wholesalers relative to brokers. A unit increase in TRUST scores generates a 6.2% ($p<0.1$) and 1.8% ($p<0.1$) increase in the probability of selling to traders and wholesalers, respectively. Similar to the MNL for maize market channel choice, higher levels of trust may reduce transaction costs for screening and the risk of contract default.

4.7 Summary

This chapter studied the factors that influence smallholder farmers' choice of marketing channels by maize and pigeonpea smallholder farmers in Tanzania, using multinomial logit model. The results indicate that transaction costs (such as distance to market, quality of road to market, price knowledge, trust in working relationships with buyers), and household wealth, membership of farmer association/group, access to extension services and access to credit significantly influence the choice of marketing channels. This suggests that policies aimed at reducing transaction costs such as increased investment in rural infrastructure, improved market information systems and farm households' access to assets appear to be an important intervention area that can affect choice of profitable channels. Promoting farmers' groups/associations such as producer and marketing groups could facilitate smallholders'

technology and information transfer, bargaining power and trust between farmers and buyers. The next chapter examines the impacts of market participation and channel choice on household welfare by maize and pigeonpea smallholder farmers.

CHAPTER 5. WELFARE IMPACTS OF MARKET PARTICIPATION AND CHANNEL CHOICE BY MAIZE AND PIGEONPEA SMALLHOLDER FARMERS IN TANZANIA[6]

5.1 Introduction

This chapter presents and discusses empirical findings on the impacts of market participation, and channel choice on household welfare by maize and pigeonpea smallholder farmers. The rest of this chapter is organized as follows. Section 5.2 presents the welfare impacts of market participation, which constitutes the conceptual framework, econometric techniques, data, sampling technique and description of variables, and empirical results and discussion. Section 5.3 presents the welfare impacts of market channel choice, which comprises the conceptual framework, econometric estimation, data and description of variables and empirical results and discussion. Section 5.4 concludes the chapter with a summary of the results.

5.2 Welfare impacts of market participation

5.2.1 Conceptual Framework

The extent to which smallholder market participation contributes to household welfare can be modeled in a random utility framework (Lubungu, 2013; Baltas and Doyle, 2001). The model assumes that an individual will choose to participate in maize and pigeonpea markets based on utility maximization. Thus, the objective of the decision marker is to maximize utility and an individual will always choose the alternative for which utility is maximal (Baltas and Doyle, 2001). Suppose total utility as a function of household consumption expenditure per capita, the utility function can be expressed as;

$$U_{ji} = \alpha(Y_{ji}) + \varphi' z_{ji} + e_{ji} \quad (5.1)$$

[6] This chapter gave rise to the following publications: Mmbando, F.E., E.Z. Wale, and L.J.S. Baiyegunhi. Welfare impacts of smallholder farmers' participation in maize and pigeonpea markets in Tanzania. Revised and resubmitted to *Food Security*.
Mmbando, F.E., E.Z. Wale, and L.J.S. Baiyegunhi. Welfare impacts of market channel choice by smallholder farmers in Tanzania: A multinomial endogenous treatment approach. Submitted to the *International Food and Agribusiness Management Review.*

where U_{ij} is the farmer's utility from participating or not in market, Y_{ji} is the household consumption expenditure per capita, z_i are observed factors that affect total utility, α and φ are the coefficient estimates, e_{ji} is a random component capturing the unobserved factors, i denotes an individual while j is an index (1, 0) representing the decision whether to participate or not, respectively. Individuals compare utilities associated with each decision, in this case participation (U_{1i}) and non-participation (U_{2i}) in maize/pigeonpea markets, before the choice is made. Let V be the difference in the utilities of the participation and non-participation decisions,

$$V_i = U_{1i} - U_{2i} = \alpha(Y_{1i} - Y_{2i}) + \varphi' z_{ji} + e_{ji} \quad (5.2)$$

where Y_{1i} and Y_{2i} are household consumption expenditure per capita associated with participation and non-participation in maize/pigeonpea markets, respectively; U_{1i} is the farmers utility from participation; U_{2i} is the farmers utility from non-participation. The difference in utilities is, however, not observed and only the decision that the individual takes is observed such that;

$$J_i \in j = \begin{cases} 1 \; if \; V > 0 \\ 0 \; otherwise \end{cases} \quad (5.3)$$

The individual is assumed to select the alternative that provides the greatest utility. The utility derived from participation will motivate the individual to participate in maize/pigeonpea markets only if it is greater than that derived from the other alternative, non-participation. Therefore, the gain from participation can be expressed as follows;

$$ATE = E(Y_{1i} - Y_{2i}) \quad (5.4)$$

where Y_{1i} is the expected consumption expenditure per capita if household i participates in maize/pigeonpea markets and Y_{2i} is the expected consumption expenditure per capita of household i if it chooses not to participate. Equation 4 estimates the expected value of the difference (impact) between consumption expenditure per capita attained by households participating in maize/pigeonpea markets and that which they would have attained had they not participated (Ravallion, 2006). The difference in consumption expenditure per capita is referred to average treatment effect (ATE). However, a bias will arise if there are systematic differences between participants and non-participants that affect the household's decision of whether to participate or not (Dehejia and Webha, 2002).

This bias (b) is given by: $b = E(Y_{2i} \mid D_i = 1) - E(Y_{2i} \mid D_i = 0)$ (5.5)

where, Y_{1i} is the expected consumption expenditure per capita if household i participates in markets, D is dummy for market participation (=1 if a household participates and 0 otherwise). In the impact evaluation literature, b is termed as selection bias. Rosenbaum and Rubin (1983) suggest that standardized bias can be large if the absolute estimate is larger than 20. This bias could be corrected if $E(Y_{2i} \mid D_i = 1)$ were known. Unfortunately, participants' household consumption expenditure per capita had they not participated cannot be observed. The next sub-section discusses the impact econometric challenges and estimation techniques.

5.2.2 Econometric estimation challenges and techniques

5.2.2.1 Econometric estimation challenges

Estimation of the impact of market participation on household welfare outcome based on non-experimental observations is a major methodological challenge because of two specific related problems, namely, the selection bias problem, and the problem of missing data for the counterfactual (Wooldridge, 2003). Selection bias is related to the problem of identifying the appropriate counterfactual—the benchmark against which to compare the impact of market participation between participants and non-participants. In either case, the sample of market participants is not assigned randomly. Then, the direct comparison of consumption expenditure per capita between participants and non-participants may be biased. There is a problem of missing data because it is not possible to measure the impact on the same individuals as at each moment in time each individual is either under the intervention being evaluated or not and thus he or she cannot be in both. This implies that we cannot observe the outcome variable of interest for the targeted individuals had they not participated at the same time. Outcomes are only observed in one state (participation or non-participation); the counterfactual is unobservable. Unobservable characteristics of farmers and their farms may affect both the participation decision and the welfare outcome, resulting in inconsistent estimates of the effect of market participation on household welfare. Farmers who participated may have systematically different characteristics from the farmers who did not participate, and they may have decided to participate based on information they have (Smale *et al*., 2012). Thus, possible self-selection occur if unobserved factors influence both the error

term of the participation equation and the error term of the outcome equation, thus resulting the correlation of the error terms. The implication of this is that the use of standard regression techniques (ordinary least square (OLS)) to estimate the parameters of the equation would result in biased and inconsistent estimates.

Some authors have employed the Heckman two-step method or similar approaches to address selection bias. However, the two-step procedures are completely dependent on the strong assumption that unobserved variables are normally distributed. Another way of controlling for selection bias is to employ instrumental variable approach (IV). A limitation of IV regression assumes that welfare function would differ only by constant term (i.e., unobservable factors) between the participating and non-participating households; it is also difficult in finding and identifying instruments in the estimation. According to Heckman *et al*. (1997), it is likely that the differences between participants and non-participant may be more systematic even after conditioning on unobservable or observable factors. Moreover, both OLS and IV procedures tend to impose a linear functional form assumption implying that the coefficients on the control variables are similar for participants and non-participants.

Unlike the parametric methods mentioned above, propensity score-matching (PSM) requires no assumption about the functional form in specifying the relationship between outcomes and predictors of outcome. However, PSM assumed that the welfare function differ only by observable factors. The implication of this is that when welfare function differs by unobservable factors, then the result of the PSM may give biased estimates. In view of this development, switching regression model takes into account the limitation of IV regression and PSM by taking into account both observable and unobservable factors. Therefore, this study uses both PSM and endogenous switching regression to address the above econometric challenges in evaluating the welfare effects of maize and pigeonpea market participation and to ensure robustness of findings. For the welfare effects of level of market participation, a Tobit selection equation was used in the first stage to estimate the level of market participation, and the predicted level of market participation variable was used in the second stage to estimate household welfare.

5.2.2.2 Econometric techniques

a) Propensity score matching technique (PSM)

As noted above, in the absence of experimental data, the propensity score-matching model (PSM) can be employed to account for sample selection bias (Dehejia and Wahba, 2002). To create the conditions of a randomized experiment, the PSM employs the un-confoundedness assumption also known as conditional independence assumption (CIA), which implies that once covariates *X* is controlled for, market participation is random and uncorrelated with the outcome variables. The PSM can be expressed as,

$$p(X) = Pr(D_i = 1|X) = E(D_i|X) \quad (5.6)$$

where D_i =(0,1) is the dummy for market participation and *X* is the vector of household characteristics. The conditional distribution of *X*, given the propensity score *p(X),* is similar in both groups of market participants and non-participants.

After estimating the propensity scores, the average treatment effect for the treated (ATT) can then be estimated as

$$ATT = E(Y_{1i} - Y_{2i}|D_i = 1)$$
$$ATT = E[E(Y_{1i} - Y_{2i}|D_i = 1, P(X))]$$
$$ATT = E[E\big(Y_{1i}|D_i = 1, P(X)\big) - E\big(Y_{2i}|D_i = 0, P(X)\big)] \quad (5.7)$$

where Y_{1i} is the expected consumption expenditure per capita if household *i* participates in markets; Y_{2i} is the expected consumption expenditure per capita of household *i* if it chooses not to participate; D_i =(0,1) is the dummy for market participation and *X* is the vector of household characteristics.

Several matching methods have been developed to match participants with non-participants of similar propensity scores. Asymptotically, all matching methods should yield the same results. However, in practice, there are tradeoffs in terms of bias and efficiency with each method (Caliendo and Kopeinig, 2008). In this study, the two most frequently used matching methods, namely, the nearest neighbour matching (NNM) and kernel based matching (KBM) methods were used to match treated and control units and to check if the results are robust with respect to different matching methods, which gain more precision in estimates. Unlike the NNM algorithm that ensures only a few observations from the comparison group are used

to construct the counterfactual outcome of a treated individual, KBM is a non-parametric matching estimator that uses weighted averages of all individuals in the control group to construct the counterfactual outcome. KBM is therefore associated with lower variance because more information is used (Caliendo and Kopeinig, 2005).

It is important to note that the main purpose of the propensity score estimation is to balance the observed distribution of covariates across the groups of participants and non-participants. The balancing test is normally required after matching to ascertain whether the differences in covariates in the two groups in the matched sample have been eliminated, in which case the matched comparison group can be considered as a plausible counterfactual (Caliendo and Kopeinig, 2008). Although several versions of balancing tests exist in the literature, the most widely used is the standardized mean difference between treatment and control sample suggested by Rosenbaum and Rubin (1985), whereby the quality of matches is assessed by comparing the situation before and after matching to check if there remain any differences after conditioning on the propensity score. They recommend that a standardized difference of greater than 20% should be considered too large and thus an indicator of failure of the matching process. Additionally, Sianesi (2004) propose a comparison of the pseudo R^2 and the P-values of the likelihood ratio tests obtained from the logit analysis before and after matching the samples. After matching, there should be no systematic differences in the distribution of covariates between the groups. As a result, the pseudo R^2 should be lower and the joint significance of covariates should be rejected (or the P-values of the likelihood ratio should be insignificant).

b) Endogenous switching regression model of household welfare

Endogenous switching regression model that accounts for both endogeneity and sample selection was used following Maddala and Nelson (1975) and Di Falco *et al*. (2011). The model uses a probit model in the first stage to determine the relationship between market participation and a number of household and farm characteristics. In the second stage, separate regression equations are used to model consumption expenditure per capita conditional on a specified criterion function. To clarify the method, consider a situation where a farmer could participate to market or not. Let D_i^* be a latent variable capturing the expected net benefits from market participation. We specify the probit model of market participation as

$$D_i^* = \alpha' Z_i + u_i \quad \text{with} \quad D_i = \begin{cases} 1 \ \ if \ \ D_i^* > 1 \\ 0 \ \ otherwise \end{cases} \tag{5.8}$$

where D_i^* is the unobservable or latent variable for market participation; D_i is its observable counterpart (i.e. the dependent variable market participation equals 1, if the farmer has sold any quantity of specific crop produced in the market, and zero otherwise); Z_i is a vector of observed farm and non-farm characteristics determining market participation; α is the coefficient estimates and u_i is random disturbances associated with the market participation.

The two welfare regression equations where farmers face the regimes of participation or not to participate to the market are defined as follows:

$$Regime\ 1\text{:}\ Y_{1i} = \beta_1 X_{1i} + \varepsilon_{1i} \ \ if\ D_i = 1 \tag{5.9a}$$

$$Regime\ 2\text{:}\ Y_{2i} = \beta_2 X_{2i} + \varepsilon_{2i} \ \ if\ D_i = 0 \tag{5.9b}$$

where, Y_i is household consumption expenditure per capita in regimes 1 and 2, X_i is a vector of exogenous variables of household *i*, expected to influence consumption expenditure; β is the coefficient vector; *D* is dummy for market participation, and ε_i, the residuals.

The error terms are assumed to have a trivariate normal distribution with zero mean and non-singular covariance matrix specified as

$$cov(\varepsilon_{1i,}\, \varepsilon_{2i,} u_i) = \begin{bmatrix} \sigma_{\varepsilon 2}^2 & \cdot & \sigma_{\varepsilon 2u} \\ \cdot & \sigma_{\varepsilon 1}^2 & \sigma_{\varepsilon 1u} \\ \cdot & \cdot & \sigma_u^2 \end{bmatrix} \tag{5.10}$$

where, σ_u^2 is the variance of the error term in the selection equation; $\sigma_{\varepsilon 1}^2$ and $\sigma_{\varepsilon 2}^2$ are the variances of the error terms in the welfare outcome functions; $\sigma_{\varepsilon 1u}$ is the covariance of u_i and ε_{1i} ; and $\sigma_{\varepsilon 2u}$ is the covariance of u_i and ε_{2i}. Since Y_{1i} and Y_{2i} are not observed simultaneously, the covariance between ε_{1i} and ε_{2i} is not defined (Maddala, 1983). An important implication of the error structure is that because the error term of the selection equation u_i is correlated with the error terms of the welfare outcome functions, ε_{1i} and ε_{2i}, the expected values of ε_{1i} and ε_{2i} conditional on the sample selection are non-zero and are defined as:

$$E[\varepsilon_{1i}/D_i = 1] = \sigma_{\varepsilon 1u} \frac{\emptyset(\alpha Z_i)}{(\alpha Z_i)} = \sigma_{\varepsilon 1u} \lambda_{1i} \ \ and \ \ E[\varepsilon_{2i}/D_i = 0] = -\sigma_{\varepsilon 2u} \frac{\emptyset(\alpha Z_i)}{1-\Phi(\alpha Z_i)} = \sigma_{\varepsilon 2u} \lambda_{2i}$$

where $\emptyset(.)$ is the standard normal probability density function, $\Phi(.)$ the standard normal cumulative density function, and $\lambda_{1i} = \frac{\emptyset(\alpha Z_i)}{\Phi(\alpha Z_i)}$ and, $\lambda_{2i} = \frac{\emptyset(\alpha Z_i)}{1-\Phi(\alpha Z_i)}$. If the estimated covariances $\sigma_{\varepsilon 1u}$ and $\sigma_{\varepsilon 2u}$ are statistically significant, then the decision to participate and the welfare outcome variables are correlated; that is we find evidence of endogenous switching and reject the null hypothesis of absence of sample selectivity bias (Lokshin and Sajaia, 2004).

A more efficient method of estimating endogenous switching regression models is full information maximum likelihood (FIML) method. The FIML method simultaneously estimates the probit criterion or selection equation and the regression equations to yield consistent standard errors. Given the assumption of trivariate normal distribution for the error terms, the logarithmic likelihood function for the system of equations (5.8) and (5.9a & 5.9b) can be given as:

$$lnL_i = \sum_{i-1}^{N} D_i \left[ln\phi \left\{ \frac{\varepsilon_{1i}}{\sigma_{\varepsilon 1}} \right\} - ln\sigma_{\varepsilon 1} + ln\Phi(\phi_{1i}) \right] + (1 - D_i) \left[ln\phi \left\{ \frac{\varepsilon_{2i}}{\sigma_{\varepsilon 2}} \right\} - ln\sigma_{\varepsilon 2} + ln\big(1 - \Phi(\phi_{2i})\big) \right] \quad (5.11)$$

where $\phi_{ji} = \frac{(\alpha Z_i + \gamma_j \varepsilon_{ji}/\sigma_j)}{\sqrt{1-\gamma_j^2}}, j_i = 1,2,\ with\ \sigma_j$ denoting the correlation coefficient between the error term u_i of the selection equation (5.8) and the error term ε_{ij} of equation (5.9a) and (5.9b), respectively. The FIML estimates of the parameters of the endogenous switching regression model obtained using the *movestay* command in Stata (Lokshin and Sajaia, 2004).

Conditional expectations, treatment and heterogeneity effects

Following Di Falco et al. (2011), the endogenous switching regression model can be used to compare the expected consumption expenditure outcome of households that participated (a) with respect to households that did not participate (b), and to investigate the expected consumption expenditure outcome in the counterfactual hypothetical cases (c) that the participated households did not participate, and (d) that the non-participant households participated. The conditional expectations for our outcome variables in the four cases are presented in Table 5.1 and defined as follows:

$$E(Y_{1i}/D_i = 1) = \beta_1 X_{1i} + \sigma_{\varepsilon 1u}\lambda_{1i} \quad (5.12a)$$

$$E(Y_{2i}/D_i = 0) = \beta_2 X_{2i} + \sigma_{\varepsilon 2u}\lambda_{2i} \quad (5.12b)$$

$$E(Y_{2i}/D_i = 1) = \beta_2 X_{1i} + \sigma_{\varepsilon 2u}\lambda_{1i} \quad (5.12c)$$

$$E(Y_{1i}/D_i = 0) = \beta_1 X_{2i} + \sigma_{\varepsilon 1u}\lambda_{2i} \quad (5.12d)$$

Cases (a) and (b) along the diagonal of Table 5.1 represent the actual expectations observed in the sample. Cases (c) and (d) represent the counterfactual expected outcomes. In addition, following Heckman et al. (2001), the effect of market participation on consumption expenditure outcome of the households that actually participated in the market is calculated as the difference between (a) and (c),

$$TT = E(Y_{1i}/D_i = 1) - E(Y_{2i}/D_i = 1) = X_{1i}(\beta_1 - \beta_2) + \lambda_{1i}(\sigma_{\varepsilon 1u} - \sigma_{\varepsilon 2u}) \quad (5.13)$$

Similarly, the effect of the treatment on the untreated (TU) for households that actually did not participate in the market is calculated as the difference between (d) and (b),

$$TU = E(Y_{1i}/D_i = 0) - E(Y_{2i}/D_i = 0) = X_{2i}(\beta_1 - \beta_2) + \lambda_{2i}(\sigma_{\varepsilon 1u} - \sigma_{\varepsilon 2u}) \quad (5.14)$$

The effect of base heterogeneity" for the group of farm households that decided to participate is defined as the difference between (a) and (d),

$$BH_1 = E(Y_{1i}/D_i = 1) - E(Y_{1i}/D_i = 0) = \beta_{1i}(X_{1i} - X_{2i}) + \sigma_{\varepsilon 1u}(\lambda_{1i} - \lambda_{2i}) \quad (5.15)$$

Similarly, for the group of farm households that decided not to participate, "the effect of base heterogeneity" is the difference between (c) and (b)

$$BH_2 = E(Y_{2i}/D_i = 1) - E(Y_{2i}/D_i = 0) = \beta_{2i}(X_{1i} - X_{2i}) + \sigma_{\varepsilon 2u}(\lambda_{1i} - \lambda_{2i}) \quad (5.16)$$

Finally, the difference between TT and TU can be estimated. This effect called "transitional heterogeneity" (TH), estimates whether the effect of market participation is larger or smaller for households that participated in the market or for the household that did not participate in the counterfactual case that they did participate.

Table 5.1. Conditional expectations, treatment and heterogeneity effects

Sub-samples	Decision stage		Treatment
	To participate	Not to participate	Effects
Households that participated	(a) $E(Y_{1i}/D_i = 1)$	(c) $E(Y_{2i}/D_i = 1)$	TT
Households that did not participated	(d) $E(Y_{1i}/D_i = 0)$	(b) $E(Y_{2i}/D_i = 0)$	TU
Heterogeneity effects	BH_1	BH_2	TH

Notes: (a) and (b) represent observed expected consumption expenditures outcome; (c) and (d) represent counterfactual expected consumption expenditures outcome.
$D_i = 1$ if households participated in the market; $D_i = 0$ if farm households did not participate
Y_{1i} = consumption expenditures outcome if households participated
Y_{2i} = consumption expenditures outcome if households did not participate
TT = the effect of the treatment (i.e. market participation) on the treated (i.e. households that participated)
TU = the effect of the treatment (i.e. market participation) on the untreated (i.e. households that did not participate)
BH = the effect of base heterogeneity for households that participated ($i = 1$), and did not participate ($i = 2$)
TH = (TT-TU), i.e. transitional heterogeneity

Alongside typical farm, household, and contextual characteristics, it is hypothesize that institutional support through NGO market linkage programs influences farmers' market participation. Therefore, farmers' participation in the NGO market linkage programs was included as an additional explanatory variable—defined as a dummy. Yet, participation in those programs might potentially be endogenous, which would lead to a bias in the coefficient estimate. Endogeneity of the NGO market linkage programs dummy was tested by employing a two-stage approach as detailed in Wooldridge (2003). In the first stage, a probit regression with the NGO market linkage programs dummy as dependent variable was run, using membership in a farmer group as an instrument. As NGO prefers to work with farmer groups, group membership is correlated with the NGO market linkage programs dummy[7]. In the second stage, a probit with market participation as dependent variable, including predicted residuals from the first-stage probit as an additional explanatory variable was run. The *t*-statistics for the coefficient of this residual term provides a valid test for the null hypothesis that the NGO market linkage programs variable is exogenous (Wooldridge, 2003). The test fails to reject the null hypothesis (Appendix 5.1 for detail).

[7] The correlation coefficient between group membership and NGO market linkage programs is $\rho = 0.515$ ($p = 0.000$), for maize; and $\rho = 0.\ 0.379$ ($p = 0.000$), for pigeonpea; while between group membership and market participation it is $\rho = 0.045$ ($p = 0.250$), for maize; and $\rho = 0.095$ ($p = 0.131$), for pigeonpea.

For the model to be identified it is important to use as exclusion restrictions, thus as selection instruments, not only those automatically generated by the nonlinearity of the selection model of market participation but also other variables that directly affect the selection variable but not the outcome variable. In this study, the variables related to the information sources (e.g., extension services and mobile phone) were used as selection instruments. Farmers access to market information via extension services and mobile phone increases market participation. Secondly, it is assumed that farmers access to market information via extension services and mobile phone affects the welfare outcome indicators only through market participation (i.e., the mere access to market information without participating to markets it does not affect the welfare outcome indicators of a farmer). The validity of the selection instruments was tested following Di Falco *et al*. (2011). If a variable is a valid selection instrument, it will affect the market participation decision but it will not affect the consumption expenditure per capita among farm households that did not participate. The test of the validity of instruments (Appendix 5.2) show that the identification variables in both maize and pigeonpea specifications are jointly statistically significant determinants of the decision of whether or not to participate in market (χ^2 = 125.59, p= 0.00, for maize; and χ^2 = 49.19; p = 0.00, for pigeonpea) but not the consumption expenditure per capita by households that did not participate: (F-stat. = 1.29, p = 0.215, for maize; and F-stat. = 1.61, p = 0.110, for pigeonpea). The results are quite robust, and the sets of instruments are successful at enabling identification.

c) Impact of level of market participation on household welfare

Level of market participation can potentially be endogenous variable in the model for consumption expenditure/household welfare. To solve endogeneity problems a two-stage approach was used, which involves the use of predicted values of the potentially endogenous variables as instrumental variables in the estimation of the truly endogenous variables (Kassie *et al*., 2014; Wooldridge 2003). In this study, a Tobit model for the level of market participation was specified in the first stage, and use the predicted value of the level of market participation obtained from this model in the second stage, welfare function. Multicollinearity was checked using a simple correlation coefficient matrix and Variation Inflation Factor (VIF), and found no evidence of serious multicollinearity problem as correlation matrix and VIF results show less than 0.5 and less than 10, respectively. The next

sub-section presents the data collection procedure and description of variables used in the analysis.

5.2.3 Data collection and description of the variables

The analysis for this chapter relied on the same dataset of 700 households used in chapter three.

Outcome variable

The consumption expenditure adjusted by the number of adult equivalents (hereafter referred to as consumption expenditure per capita) was used as a proxy for household welfare indicator. The consumption expenditure data was collected for the preceding year covering a period of 12 months. This was collected using purchased items and the amount spent during each month and then aggregated to the annual level. The standard per capita consumption indicator of household welfare is based on food (household's own consumption of home produced food + purchased food + aid or gift food) and non-food expenditure adjusted to adult equivalent.

Dependent variables

The dependent variable in the PSM and switching regression was binary market participation equals 1, if the farmer has sold any quantity of maize/pigeonpea produced in the market, and zero otherwise. For the level of market participation model, the dependent variable was the proportion of maize/pigeonpea sold, ranging between 0 and 100 percent.

Independent variables

The explanatory variables included to the estimations are summarized in Table 5.2. The explanatory variables include various proxies for household characteristics (such as age, gender, level of education, and labor force in AEU. Household labour force was included to capture labour supply for production and for transporting crops to the nearest market. Farm size, value of farm assets, and access to off-farm income are included to capture the effect of household wealth. These variables are critical in production that enables households to produce surplus for the market (Alene *et al.,* 2008). Transaction costs are captured through three proxy variables: distance to nearest market is a proxy for proportional transaction costs, and sources of information (such as extension services and mobile phone) are proxies for

fixed transaction cost. Farmers' participation in the NGO market linkage programs/trainings is included as a proxy for institutional support. The unobserved location-specific effects were controlled using district dummy variables. These variables were included in the model to capture differences in the household welfare conditions that might have arisen due to infrastructure, remoteness, resource endowment, production potential and farming conditions across districts. The dummy for Karatu district was made as a reference and was left out of the model to avoid the dummy variable trap. The next sub-section presents the empirical results and discussions.

5.2.4 The empirical results and discussions

5.2.4.1 Descriptive statistics

Summary statistics and statistical significance tests on equality of means for continuous variables and equality of proportions for binary variables for market participants and non-participants are presented in Table 5.2. In this study, market participants are farmers who sold any quantity of maize/pigeonpea in the market during 2008/09 cropping season, and non-participants are those who did not sale. About 56% and 75% of sampled households participated in maize and pigeonpea market, respectively. There are significant differences between participants and non-participants with respect to the average consumption expenditure per capita for both maize and pigeonpea.

Market participants are consuming more expenditure per capita by about 3% and 14% compared to nonparticipants for both maize and pigeonpea, respectively. The proportion of maize and pigeonpea sold was 32% and 51%, respectively. On average, a higher proportion of market participants are male-headed households and they also have more farm size for both maize and pigeonpea. There are statistically significant differences in education level of household head; maize market participants are better educated than their non-participating counterparts. Educated households may have more access to information and be able to participate in the market. There are also statistically significant differences between participants and non-participants with respect to value of farm assets for both maize and pigeonpea. On average, a higher proportion of maize (23%) and pigeonpea (31%) market participants participated in the NGO market linkage programs/trainings. This shows the role of institutional support in smallholder market participation.

Table 5.2. Summary statistics of variables used to analyse welfare impacts of market participation and level of participation

Variable	Maize			Pigeonpea		
	Participants (N=372)	Non-participants (N=291)	MT[a]	Participants (N=190)	Non-participants (N=63)	MT[a]
Outcome and dependent variable						
Consumption expenditure per capita ('000Tsh)	381.45	368.52	**	430.47	371.82	***
Proportion of crop sold (ranging between 0-100)	32.33	-		50.74	-	
Independent variables						
Household characteristics						
Age of the household head (years)	45.00	46.90	*	46.69	49.65	
Gender of the head (1= male)	0.91	0.81	***	0.91	0.81	*
Education of the head (years)	5.28	4.52	***	5.20	4.78	
Labor force (AEU)	4.49	4.34		4.78	3.62	***
Household wealth variables						
Farm size per capita (ha)	2.54	1.76	***	1.94	1.51	***
Value of farm asset per capita ('000TSh)[b]	456.61	286.89	***	566.19	439.76	***
Access to off-farm (1=yes)	0.17	0.22		0.09	0.06	
Institutional support						
NGO market linkage programs (1= yes)	0.23	0.14	***	0.31	0.16	**
Proportional transaction cost						
Distance to market (km)	4.71	6.40	***	4.92	6.84	*
Information sources						
Extension service (1=yes)	0.43	0.34	***	0.31	0.18	***
Mobile phone (1=yes)	0.47	0.22	***	0.42	0.37	**
Location variables						
Karatu (1= yes) - reference	0.21	0.23		0.40	0.31	**
Mbulu (1= yes)	0.22	0.35	***	0.10	0.11	
Kilosa (1= yes)	0.38	0.22	***	0.32	0.28	
Mvomero (1= yes)	0.19	0.20		0.18	0.31	**

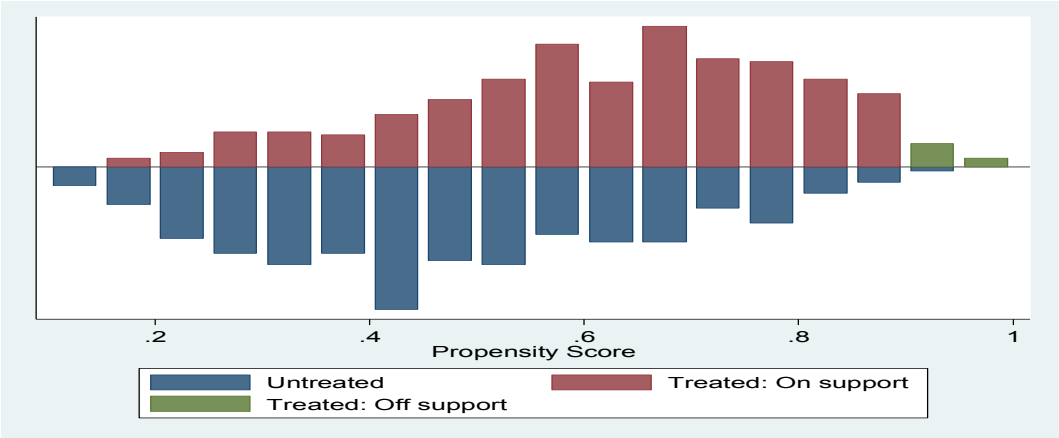
Source: SIMLESA project survey data (2010).
Notes: MT[a] = Test of difference between means of participants and non-participants: *, ** and *** denote significance at 10%, 5% and 1% level, respectively.
[b]The exchange rate at the time of the survey was about 1US$ = 1,500 TSh.

Nonparticipants are located far from output markets compared to participants for both maize and pigeonpea. The summary statistics show that the main source of information is mobile phone for both maize and pigeonpea. About 47% and 42% of maize and pigeonpea market

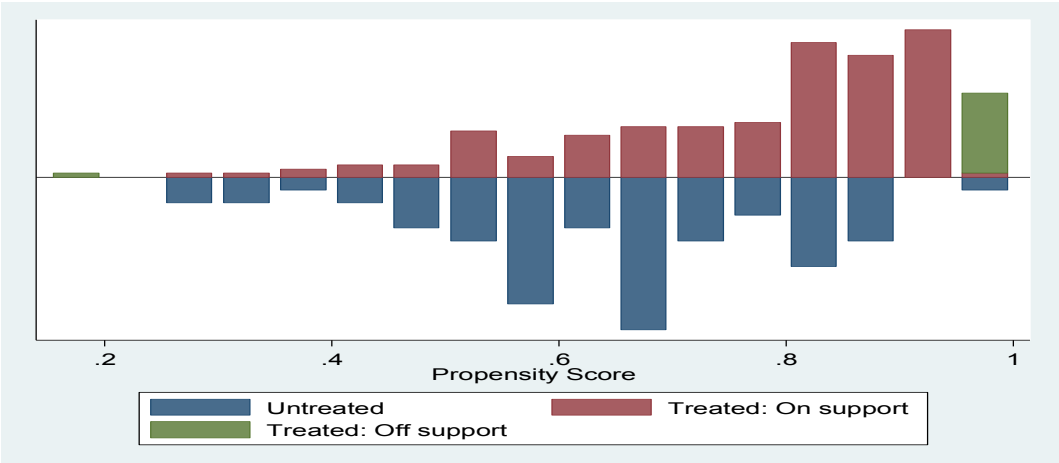
participants indicate obtaining market information via mobile phones compared to 43% and 31% who indicate their market information source to be extension services, respectively.

5.2.4.2 Propensity score matching estimation results

Prior to non-parametrically estimating the market participation impact, the propensity scores for treatment variable were estimated using a logit model. After estimating the propensity scores for the participant and non-participant groups the quality of the matching process was checked. Matching is impossible when there is no sufficient overlap between the treated and control groups (Caliendo and Kopeinig, 2008). Figure 5.1 gives the histograms of the estimated propensity scores for participants and non-participants for both maize and pigeonpea markets.



(i) Maize market participation



(ii) Pigeonpea market participation

Figure 5.1. Propensity score distribution and common support for propensity score estimation
Source: SIMLESA project survey data (2010).
Notes: ‘‘Treated: on support’’ indicates the observations in the market participation group that have a suitable comparison. ‘‘Treated: off support’’ indicates the observations in the market participation group that do not have a suitable comparison.

A visual inspection of the density distributions of the estimated propensity scores for the two groups indicates that the common support condition is satisfied, as there is substantial overlap in the distribution of the propensity scores of both participant and non-participant groups, for both maize and pigeonpea. The bottom half of the graph shows the propensity scores distribution for the non-participants and the upper half refers to the participants. The densities of the scores are on the y-axis.

As noted earlier, it is important to assess matching quality by checking the balance of distribution of relevant variables in the treated and the control groups. Table 5.3 below presents the results from covariate balancing tests before and after matching. The standardized mean difference for overall covariates used in the propensity score is reduced to about 6% and 4% after matching for both maize and pigeonpea, respectively. This substantially reduces total bias of 77% and 80% through matching for both maize and pigeonpea, respectively. The p-values of the likelihood ratio tests indicate that the joint significance of covariates was always rejected after matching, whereas it was never rejected before matching. The pseudo-R^2 also dropped significantly after matching. The low pseudo-R^2, low mean standardized bias, high total bias reduction, and the insignificant p-values of the likelihood ratio test support the hypothesis that both groups have the same distribution in covariates x after matching. Rosenbaum and Rubin (1983) suggested that a remaining standardized bias of 20% would be advisable. These results suggest that the proposed specification of the propensity score is fairly successful in terms of balancing the distribution of covariates between the two groups. We therefore used these results to evaluate the effect of market participation among groups of households having similar observed characteristics. This allowed us to compare observed outcomes for participants with those of a comparison group sharing a common support.

Table 5.3. Matching quality indicators before and after matching for Kernel-based estimation

Crop	Pseudo R^2 before matching	Pseudo R^2 after matching	LR x^2 (p-value) before matching	LR x^2 (p-value) after matching	Mean standardized bias before matching	Mean standardized bias after matching	Total % |bias| reduction
Maize	0.1705	0.022	155.05 (p=0.000)	29.40 (p=0.210)	24.87	5.54	77.74
Pigeonpea	0.1471	0.094	41.77 (p=0.000)	24.26 (p=0.316)	18.33	3.64	80.14

Source: SIMLESA project survey data (2010).

Table 5.4 reports the estimates of the average impact estimated by nearest neighbor matching (NNM) and Kernel-based matching (KBM) methods. Both matching methods were used in-order to check the robustness of the results. The results show that maize and pigeonpea market participation increases the proportion of consumption expenditure in the range of 19.2-20.4% and 28.3-29.4% on average, respectively. This result is consistent with the previous findings indicating a positive relationship between market participation and higher levels of farm household welfare using PSM. Asfaw *et al*. (2012) in their study in the northern part of Tanzania showed that maize and pigeonpea market participation increases the proportion of consumption expenditure by 25% and 32% on average, respectively. Lubungu (2013) show that participation in cattle markets in Zambia raises per capita household income by about 52-64% on average. This show the role of market participation in improving the rural household welfare, whereby the resulting increase in farm income from market participation may facilitate the purchase of more farm inputs to intensify production and improve food security and poverty reduction among smallholder farmers.

Table 5.4. The impact of market participation on consumption expenditure per capita using PSM methods

Outcome variable	Matching algorithm	Mean outcome variable based on matched observations		
		Participants	Non-participants	Difference (ATT)
Log consumption expenditure per capita				
Maize	NNM	12.533	12.329	0.204 (2.89)***
	KBM	12.522	12.329	0.192 (2.84)***
Pigeonpea	NNM	12.518	12.235	0.283 (2.41)***
	KBM	12.489	12.194	0.294 (2.91)***

Source: SIMLESA project survey data (2010).
Notes: *** denote significance at 1% level.
The number in brackets show bootstrapped t-value with 100 replication samples.
NNM = single nearest neighbor matching with replacement and common support.
KBM = kernel based matching with band width 0.06 and common support.

5.2.4.3 Endogenous switching regression estimation results

The coefficient estimates from the second stage of endogenous switching regression model (the consumption expenditure equation) for both maize and pigeonpea are presented in Table 5.5. The first and second column presents the consumption expenditure functions for farm

households that did and did not participate in the market for the respective crop. The last rows give the estimates of the coefficients of correlation between the random errors in the system of equations. The estimated coefficient of correlation between the market participation equations and the consumption expenditure functions (ρ_j) are negative and significantly different from zero, for both maize and pigeonpea. This suggests that both observed and unobserved factors influence the decision to participate in market and welfare outcomes given the participation decision. The significance of the coefficient of correlation between the participation equation and the consumption expenditure of participants indicates that self-selection occurred in the maize and pigeonpea market participation decision. The result allows estimation with endogenous switching to control for the predicted probability of market participation in order to correct for a possible selection effect associated with unobserved factors that might simultaneously affect the participation and outcome decision. The results indicate that the differences in the consumption expenditure equation coefficients between the farm households that participated and that did not participate in the maize and pigeonpea market, illustrate the presence of heterogeneity in the sample. The consumption expenditure function of farm households that participated in the maize and pigeonpea markets are significantly different (at the 1% level) from the consumption expenditure function of the farm household that did not participate.

Value of farm assets has a positive and significant influence on household consumption expenditure for both participants and non-participants households, in both maize and pigeonpea, but the effects are much bigger among participants. For maize, the elasticity coefficient reveals that a 1% increase in value of farm assets per AEU increases consumption expenditure per capita by 0.19% for market participants as compared to 0.11% for non-participants. Similarly, for pigeonpea, a 1% increase in value of farm assets per AEU increases consumption expenditure per capita by 0.15% for market participants as compared to 0.07% for non-participants. The results demonstrate the critical role of assets holding in household welfare among smallholders.

Table 5.5. Endogenous switching regression parameter estimates for household welfare

Variables	FIML endogenous switching regression			
	Maize		Pigeonpea	
	Participation = 1 (Participants)	Participation = 0 (non-participants)	Participation =1 (Participants)	Participation = 0 (Non-participants)
Age	0.130	0.002	0.008**	0.014**
	(0.106)	(0.004)	(0.004)	(0.006)
Gender	0.011	-0.341**	0.061	-0.196
	(0.136)	(0.148)	(0.175)	(0.185)
Education	0.026*	0.015	0.011	0.073***
	(0.014)	(0.017)	(0.015)	(0.021)
Labor	0.008	-0.015	-0.011	0.088*
	(0.018)	(0.027)	(0.028)	(0.048)
Farm size per AEU	0.030**	0.022	-0.024	- 0.154**
	(0.013)	(0.028)	(0.025)	(0.067)
Log value of farm assets	0.190***	0.112***	0.150***	0.068**
per AEU	(0.025)	(0.034)	(0.046)	(0.028)
Access to off-farm	0.014	0.009**	-0.229	0.562**
	(0.025)	(0.011)	(0.178)	(0.266)
Distance to market	-0.001**	0.011	-0.009	-0.015*
	(0.006)	(0.008)	(0.007)	(0.008)
Karatu - reference				
Mbulu	-0.291**	0.320**	2.051***	-0.526
	(0.124)	(0.160)	(0.492)	(0.531)
Mvomero	0.094	0.503***	0.268*	-0.295
	(0.119)	(0.167)	(0.149)	(0.179)
Kilosa	0.186*	0.343***	0.301**	0.060
	(0.111)	(0.160)	(0.115)	(0.169)
Constant	9.846***	10.357***	11.244***	9.296***
	(0.423)	(0.479)	(0.460)	(0.811)
Sigma (σ_{ei})	-0.368***	0.009	-0.402***	-0.642***
	(0.040)	(0.069)	(0.053)	(0.181)
rho (ρ_j)	-0.120	-1.176***	0.099	-0.723*
	(0.256)	(0.181)	(0.382)	(0.412)

Source: SIMLESA project survey data (2010).
Notes: *, ** and *** denote significance at 10%, 5% and 1% level, respectively.
Robust standard errors in parentheses
Dependent variable: log consumption expenditure per capita.

Age of the household head is significantly associated with an increase in the consumption expenditure per capita for pigeonpea market participants and non-participants. Caglayan and Astar (2012) also find that age of the household head raises the consumption expenditure in Turkey. Education significantly affects the consumption expenditure of the farm households that participated in the maize market and those that did not participate in the pigeonpea

market. The result is consistent with the findings of Ogundari and Aromolaran (2013) in Nigeria, who found that an extra year of primary, secondary, tertiary, and postgraduate education of household head increases household consumption expenditure per capita by about 2.5%, 0.27%, 4.24%, and 0.19%, respectively.

Farm size is significantly associated with an increase in the consumption expenditure per capita of the farm households that participated in the maize market and decrease in the consumption expenditure per capita of the farm households that did not participated in pigeonpea market. Similar results were also reported by Bozzoli and Brück (2009) in Mozambique, who found that a 10% increase in farm size leads to an almost 7% increase in household income per capita. This suggests that the increase in farm size may be associated with high maize and pigeonpea production and marketable surplus, hence improved household welfare.

Moreover, access to off-farm income activities raises consumption expenditure per capita of the households that did not participate, in both maize and pigeonpea. Distance to market has a negative impact on consumption expenditure of the farm households that participated in the maize market and those that did not participate in the pigeonpea market. With regards to location-specific variables, and in comparison to households located in Karatu district, the households located in Mbulu district district had significantly less consumption expenditure per capita for households that participated in the maize market and increase in the consumption expenditure per capita for households that did not participated in maize market. The households in Kilosa district are significantly associated with an increase in the consumption expenditure per capita of the farm households that participated in the maize and pigeonpea market and non-maize market participants.

Table 5.6 presents the expected household welfare outcome (i.e. consumption expenditure per capita) under actual and counterfactual conditions for maize and pigeonpea. The predicted consumption expenditure per capita from endogenous switching regression model was used to determine the mean consumption expenditure gap between participants and if they had not participated. The results indicate that the mean value of consumption expenditure per capita for maize and pigeonpea market participants is statistically higher than had they not been participants, which is consistent with the result from propensity score matching. The results show that maize and pigeonpea market participation increases consumption expenditure per

capita by about 23% and 26%, respectively. For non-participants, the mean consumption expenditure per capita would have been increased by 14% had they participated in maize market and by 23% had they participated in pigeonpea market. It is also important to note that pigeonpea, which is a cash crop has higher impact than maize which is staple crop. Study by Asfaw *et al*. (2012) indicated that under actual and counterfactual conditions, maize and pigeonpea market participation increases consumption expenditure per capita by about 20% and 27%, respectively. These results imply that maize and pigeonpea market participation increased household welfare measured in terms of consumption expenditure per capita. The transitional heterogeneity effect of consumption expenditure in both maize and pigeonpea is positive implying that the effect is bigger for the farm household that did participate with respect to one that did not participate.

Table 5.6. Average expected log consumption expenditure per capita; treatment and heterogeneity effects

Sub-samples	Decision stage		Treatment effects
	To participate	Not to participate	
(i) *Maize*			
Households that participated	(a) 12.460	(c) 12.232	TT = 0.228 (6.25)***
Households that didn't participate	(d) 12.625	(b) 12.487	TU = 0.138 (4.54)***
Heterogeneity effects	BH_1 = -0.165	BH_2 = -0.055	TH = 0.090
(ii) *Pigeonpea*			
Households that participated	(a) 12.561	(c) 12.304	TT = 0.257 (2.02)***
Households that didn't participate	(d) 12.478	(b) 12.244	TU = 0.234 (3.91)***
Heterogeneity effects	BH_1 = 0.083	BH_2 = 0.06	TH = 0.023

Source: SIMLESA project survey data (2010).
Note: *, ** and *** denote significance at 10%, 5% and 1% level, respectively.
The number in brackets shows absolute value of t-statistic.

5.2.4.4 The welfare impacts of market participation level

Table 5.7 presents the estimated parameters for determinants of household welfare. The results indicated that level of market participation, education, farm size, value of assets and geographical location are all statistically significant in influencing household welfare. The coefficient of the level of market participation was positive and significant for consumption expenditure per capita for both maize and pigeonpea. This implies that increase in the level of

market participation increases consumption expenditure per capita of maize and pigeonpea smallholder farmers. The positive effect of level of market participation on per capita consumption expenditure is also consistent with Awotide *et al*. (2013) in Nigeria. This suggests that improving smallholder farmers' capacity to produce marketable surplus is a key mechanism for improving market participation and household welfare.

Table 5.7. The determinants of household welfare: Ordinary least squares

Variable	Maize		Pigeonpea	
	Coef.	Std. Err.	Coef.	Std. Err.
Level of market participation	0.005**	0.002	0.003**	0.001
Age	0.002	0.002	0.006*	0.003
Gender	-0.018	0.088	0.075	0.138
Education	0.033***	0.010	0.018	0.013
Labour	-0.001	0.015	0.040*	0.022
Farm size per AEU	0.043***	0.011	-0.039	0.024
Log value of farm assets per AEU	0.161***	0.019	0.077***	0.025
Distance to market	-0.002	0.005	-0.008	0.006
Access to off-farm income	0.063	0.076	-0.051	0.158
Karatu - reference				
Mbulu	-0.155*	0.089	1.079**	0.405
Mvomero	0.265**	0.093	0.124	0.120
Kilosa	0.325***	0.084	0.237**	0.102
Constant	10.137***	0.275	10.906***	0.401
Number of observations	663		253	
F(12,650)/(12,240)	15.52***		4.97***	
R-squared	0.223		0.207	

Source: SIMLESA project survey data (2010).
Note: *, ** and *** denote significance at 10%, 5% and 1% level, respectively.
Dependent variable: log consumption expenditure per capita.

5.2.4.5 Heterogeneous impacts

To capture the heterogeneity of impact in different categories of farmers, the differential impact of market participation by categorizing households based on farm size, education level and level of participation was also examined. Table 5.8 shows that the gain in consumption expenditure is higher for households with smaller farm sizes for maize market participation. This is in contrast to Asfaw *et al*. (2012), who found that gain in consumption

expenditure per capita of maize market participation is highest on the highest farm size. For education, the gain of consumption expenditure is highest on highest educational level quintiles (3 and 4) for both maize and pigeonpea market participation. Asfaw *et al*. (2012) also found that gain in consumption expenditure per capita is highest for educated household head for both maize and pigeonpea market participation.

Table 5.8. Heterogeneous impact of market participation by farm size, education and level of market participation

Quintiles	Maize		Pigeonpea	
	Number of observation	Log expenditure per capita	Number of observation	Log expenditure per capita
Stratified by farm size				
1	166	0.076 (5.00) ***	64	0.014 (0.43)
2	168	0.063 (5.01) ***	63	0.024 (0.52)
3	166	0.052 (3.04) ***	65	0.013 (0.46)
4	163	0.035 (1.35)	61	0.049 (1.77) *
Stratified by education status				
1	166	0.041 (2.68) **	64	0.031 (0.66)
2	168	0.044 (3.62) ***	63	0.052 (0.55)
3	166	0.061 (3.37) ***	65	0.104 (1.82) *
4	163	0.047 (2.91) **	61	0.201 (2.26) **
Stratified by level of market participation				
1	166	0.002 (1.10)	64	0.006 (3.04) ***
2	168	0.003 (2.38) **	63	0.007 (5.75) ***
3	166	0.005 (2.72) **	65	0.007 (3.84) ***
4	163	0.007 (5.22) ***	61	0.011 (5.30) ***

Source: SIMLESA project survey data (2010).
Note: *, ** and *** denote significance at 10%, 5% and 1% level, respectively. The number in brackets shows absolute value of t-statistic.

Similarly, per-capita consumption also increased with the level of market participation for both maize and pigeonpea market participation. This reflects the importance of marketable surplus in market participation and welfare outcome. These results suggest that more educated farmers and the poor might benefit more from market participation, and that providing farmers with basic education might enhance productivity and hence household food security and welfare. Also improving household capacity to produce marketable surplus

could increase market participation, food security and welfare. The next section presents the welfare impacts of market channel choice, which comprises the conceptual framework, econometric estimation, data and description of variables and empirical results and discussions.

5.3 Welfare impacts of market channel choice

5.3.1 The conceptual framework

The conceptual framework used in this study adopts the sustainable livelihood approach. This framework (Figure 5.2) includes the following components: assets endowments, the context (policies, programs and institutions), markets, household livelihood strategies, and outcomes (measures of household welfare). For farm households, consumption expenditure is usually influenced by returns from agricultural production, which depend on asset ownership and capacity to produce and access a profitable market (Rao and Qaim, 2011).

Asset endowments such as human, natural, physical and financial assets shape livelihood strategies (Ellis, 2000). Household decisions regarding asset use also determine outcomes such as household income, consumption and food security (Barrett *et al*., 2005). Given asset endowments, households make decisions regarding which crop(s) to grow, market participation and market channel choice. These decisions have a direct impact on the level of farm income and household welfare. Hence, smallholder farmers' participation in sustainable and reliable market channels is one of the important strategies to improve farm household income and welfare (Fafchamps, 2004).

Government policies, programs and institutions shape the behavior of economic agents and present the context. The context in which households operate helps determine the welfare-generating potential of assets. Government policies also affect asset endowments, market access and market channel choice by smallholder farmers. For instance, policies that improve rural infrastructure can result in market access, market channel choice and reduce transaction costs by smallholder farmers that can have significant implications for household income transaction (Asmah, 2011). Institutions such as producer organizations play a big role in farmers' market access and market channel choice by transmitting information, mediating transactions, reducing transaction costs, improving the efficiency of agricultural marketing

through bargaining with customers, providing inputs and technical assistance (World Bank, 2008; Bijman and Wollni, 2008).

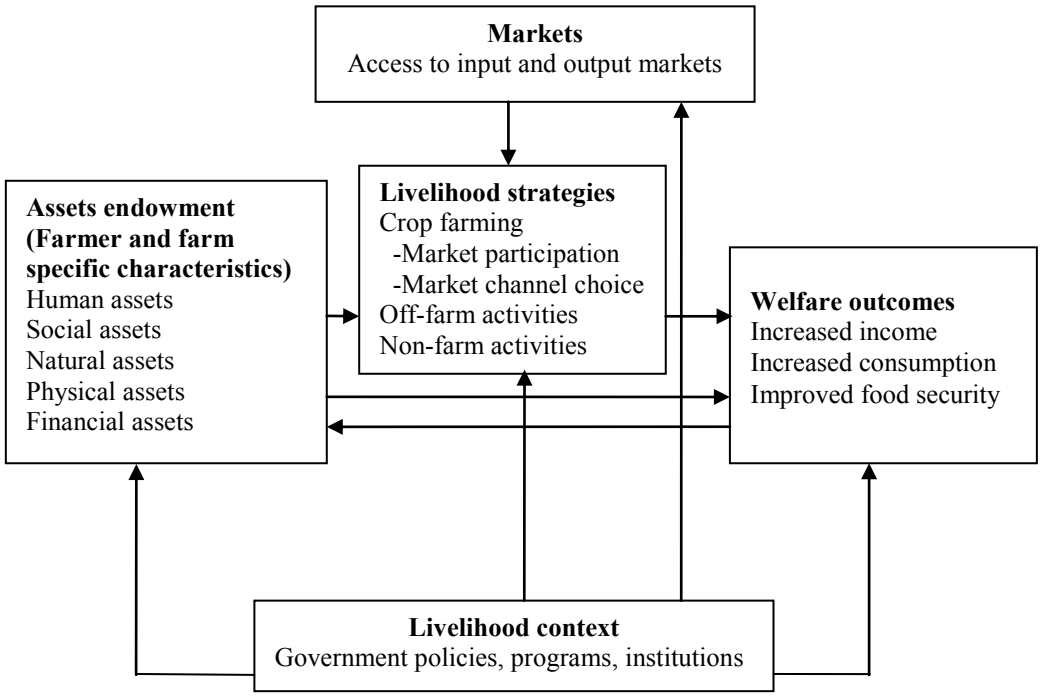


Figure 5.2. Linking market channel choice and household welfare outcomes
Source: Adapted from Nkala *et al*. (2011).

The econometric estimation strategy used to study the effect of market channel choice on household welfare is presented in the following sub-section.

5.3.2 The econometric estimation strategy

In choosing marketing channels by smallholder farmers there may be self-selection, implying that farmers choose their marketing channel based on their own perception of benefits they get out of each marketing channel. Therefore in assessing the impact of marketing channel choice on per capita consumption expenditure at the farmer-level, unobserved characteristics may play an important role, especially self-selection often gives rise to endogeneity problems. The empirical strategy adopted to correct selection bias and to provide consistent estimates of welfare impacts of market channels involves the joint estimation of the endogenous multinomial treatment (i.e. channel choice) and an outcome equation (i.e.

consumption expenditure per capita), following the methodology proposed by Deb and Trivedi (2006a, 2006b).

Specifically, the choice of marketing channel follows a mixed multinomial distribution was considered, which means that, the probability of observing farmer *i* in channel *j* (i.e. $s_{ij} = s_{i1}, s_{i2}...s_{iJ}$) can be described as

$$\Pr(s_{ij} \mid z_i, I_i) = \frac{\exp(z'_i \alpha_j + \delta_j l_{ij})}{1 + \sum_{k=1}^{J} \exp(z'_i \alpha_k + \delta_k l_{ik})} \tag{5.17}$$

Here, the likelihood of being assigned to channel s_j depends on pre-determined characteristics z_i (mainly socio-economic characteristics of the i^{th} farmer) and latent factors l_{ij} with their respective factor loadings (δ), which represent the unobserved individual heterogeneity affecting the utility of selling in a given channel.

The expected value of the final outcome (i.e. consumption expenditure per capita) can be expressed as,

$$E(y_i \mid s_i, x_i, l_i) = x'_i \beta + \sum_j \gamma_j s_{ij} + \sum_j \lambda_j l_{ij} \tag{5.18}$$

which is considered to be a linear function of a vector of control variables x_i with the associated parameters β and γ, a set of dummies denoting channel choice relative to the control group (*s= brokers channel*) and the latent factors l_{ij}, capturing the unobserved factors determining channel choice that also affect the final outcome. The associated factor loadings λ_j can be interpreted as selection terms, which reflect the correlation between the unobservable determinants of channel choice (relative to the base category) and welfare outcome. Assuming that the latent factors follow a standard normal distribution, the estimation of this joint model for channel choice and welfare outcome can be carried out using maximum simulated likelihood based on Halton Sequences, using the STATA routine "mtreatreg".

Given the nonlinear functional form of the multinomial equation, the parameters of this joint model for channel choice and welfare impacts can, in principle, be identified even if the

variables that appear in the two equations are identical, i.e. $x_i = z_i$ (Deb and Trivedi, 2006a). The next sub-section presents the data collection procedure and description of variables used in the analysis.

5.3.3 Data collection and description of the variables

The analysis for this section relied on the same dataset of 562 selling transactions, made by 372 households that participated in the market used in chapter four.

Outcome variable

The consumption expenditure adjusted by the number of adult equivalents (hereafter referred to as consumption expenditure per capita) was used as a proxy for household welfare indicator. The consumption expenditure data was collected for the preceding year covering a period of 12 months. This was collected using purchased items and the amount spent during each month and then aggregated to the annual level. The standard per capita consumption indicator of household welfare is based on food (household's own consumption of home produced food + purchased food + aid or gift food) and non-food expenditure adjusted to adult equivalent.

Dependent variables

The dependent variable in the selection equation of the endogenous multinomial logit treatment regression was market channels through which farmers sold their maize and pigeonpea during 2008/09 cropping season, namely: brokers, rural traders and wholesalers. For this analysis, brokers channel was made as a reference because this channel was chosen by most of the farmers to trade their maize and pigeonpea and was left out of the model to avoid the dummy variable trap (please refer to chapter four, section 4.5 for details).

Independent variables

The independent variables included to the estimations are summarized in Table 5.9. These include the household socio-economic characteristics and location characteristics.

Household socio-economic characteristics

The household socio-economic characteristics control variables used were age, gender, education, value of farm assets, access to off-farm and remittances. Age is expected to impact

positively on household welfare based on increased potential for higher income generation, better risk management skills through life experiences, improved asset endowment and enhanced portfolio of livelihood strategies (Caglayan and Astar, 2012). Male-headed households are expected to maintain higher levels of welfare than female-headed households. Social and cultural norms that may limit females' access to critical farm resources (land, labor, and cash) could hinder the capacity of female-headed households to maintain welfare levels comparable with male-headed households (Ellis, 2000). As household heads are the main income earners in the household, education level of the household heads should be a critical factor in determining household welfare (Knight *et al*., 2011). Households with more education may have greater access to non-farm income and thus positively correlated with consumption per capita.

The wealth status of household was controlled using value of farm assets and access to other sources of income such as off-farm and remittances. These are assumed to positively affect household welfare. Wealthier farmers with more farm assets and access to alternative sources of income such as off-farm and remittances are more likely to experience high expenditures (Chambers and Foster, 1983). Access to remittances has a significant impact on poverty reduction by increasing income, smoothing consumption and easing capital constraints of the poor (Jongwanich, 2007).

Location characteristics

The unobserved location-specific effects were controlled using distance to nearest market and district dummy variables. These variables were included in the model to capture differences in the household welfare conditions that might have arisen due to infrastructure, remoteness, production potential and resource endowment across districts. The dummy for Karatu district was made as a reference and was left out of the model to avoid the dummy variable trap. In addition, the same set of household socio-economic characteristics and location characteristics was included in the selection equation and the welfare outcome equation. The next sub-section presents the empirical results and discussions.

5.3.4 The empirical results and discussions

5.3.4.1 Descriptive statistics

Table 5.9 shows descriptive statistics of maize and pigeonpea sample households. For maize sample households, on average, the head of household is about 45 years old with five years of formal education. The producers selling to wholesalers have, on average, about two more years of formal schooling than those selling their maize to traders and brokers. On average, a higher proportion of sample households are male-headed households. The average value of farm assets was about 456,610 TSh.

Table 5.9. Definitions and summary statistics of the variables used in the endogenous multinomial treatment model

Variable	Maize				Pigeonpea			
	Mean values by marketing channel			Total	Mean values by marketing channel			Total
	Trader	Wholesaler	Broker		Trader	Wholesaler	Broker	
Socio-economic characteristics								
Age of the household head (years)	45.22 (13.04)	45.78 (14.08)	44.73 (13.83)	45.00 (13.65)	47.24 (14.13)	46.48 (17.06)	47.13 (13.30)	46.67 (13.83)
Gender of the household head (1= male)	0.88 (0.32)	0.87 (0.33)	0.93 (0.25)	0.91 (0.28)	0.94 (0.24)	0.91 (0.28)	0.89 (0.30)	0.91 (0.29)
Education of the household head (years)	5.12 (2.78)	7.14 (2.41)	4.69 (0.25)	5.28 (2.71)	5.17 (2.79)	6.22 (3.03)	4.76 (3.14)	5.20 (3.27)
Value of farm assets ('000 TSh)[a]	664.04 (225.25)	674.21 (219.63)	309.05 (698.78)	456.61 (1536.9)	962.44 (262.41)	948.88 (240.16)	394.44 (957.39)	566.19 (161.65)
Access to off-farm income (1=yes)	0.19 (0.39)	0.14 (0.35)	0.17 (0.38)	0.15 (0.29)	0.20 (0.41)	0.35 (0.49)	0.19 (0.39)	0.22 (0.41)
Access to remittances (1=yes)	0.10 (0.31)	0.06 (0.24)	0.12 (0.33)	0.12 (0.314)	0.32 (0.47)	0.13 (0.34)	0.09 (0.28)	0.14 (0.35)
Location characteristics								
Distance to nearest market (km)	4.26 (5.32)	4.48 (6.17)	6.77 (7.47)	4.71 (6.16)	4.52 (5.67)	5.34 (7.55)	6.51 (8.21)	5.32 (7.31)
Household is located in Karatu district (1=yes) - reference	0.44 (0.49)	0.55 (0.50)	0.02 (0.13)	0.21 (0.41)	0.57 (0.50)	0.61 (0.50)	0.417 (0.49)	0.47 (0.50)
Household is located in Mbulu district (1=yes)	0.25 (0.43)	0.16 (0.37)	0.23 (0.42)	0.22 (0.42)	0.03 (0.17)	0.01 (0.11)	0.01 (0.09)	0.11 (0.10)
Household is located in Kilosa district (1=yes)	0.18 (0.38)	0.08 (0.28)	0.54 (0.49)	0.38 (0.49)	0.31 (0.47)	0.13 (0.34)	0.38 (0.49)	0.18 (0.39)
Household is located in Mvomero district (1=yes)	0.133 (0.34)	0.20 (0.41)	0.22 (0.41)	0.19 (0.39)	0.09 (0.28)	0.26 (0.45)	0.19 (0.40)	0.34 (0.47)

Source: SIMLESA project survey data (2010).
Note: [a]The exchange rate at the time of the survey was about 1 US$ = 1,500 TSh.
The number in brackets shows standard deviations.

Farmers that sell to wholesalers had relatively high value of farm assets (TSh. 674,210) than those who supplied to traders (TSh. 664,040) and brokers (TSh. 309,050). On average, about 15% and 12% of sample households have access to off-farm income and remittances, respectively. The average distance to nearest market was about 4.7 km. Distance to nearest market is longer for farmers selling to brokers (6.8 km) as compared to farmers supplying to traders (4.3 km) and wholesalers (4.5 km). For pigeonpea sample households, on average, the head of household is about 47 years old with five years of formal education. On average, a higher proportion of sample households are male-headed households. The average value of farm assets was about 566,190 TSh. Farmers that sell to traders had relatively high value of farm assets than those who supplied to wholesalers and brokers. On average, about 22% and 14% of sample pigeonpea households have access to off-farm income and remittances, respectively. The average distance to nearest market was about 5.3 km, whereby farmers selling to brokers are located far from markets compared to farmers supplying to traders and wholesalers.

5.3.4.2 Marketed volumes and average price by marketing channel and timing of sale

Table 5.10 presents maize and pigeonpea marketed volumes and average price by marketing channel and timing of sale. Analysis show that 57% and 65% of maize and pigeonpea grain are sold immediately after harvest (i.e. 1-3 months after harvest), respectively, while the remaining volumes are sold 4-5 months after harvest. For maize, brokers accounted for 44% of the volume traded while rural traders accounted for 36% of the traded volume. Rural wholesalers accounted for 16% of the volume and consumers (i.e. farmers who are deficit producers) accounted for less than 5% of the volume of maize purchased from farmers. For pigeonpea, brokers accounted for 65% of the volume traded while rural traders accounted for 22% of the traded volume. Rural wholesalers and consumers accounted for 12% and 1% of the traded volume, respectively. This shows that brokers and rural traders jointly control more than 80% of the maize and pigeonpea traded volumes. Considering that brokers are operating in often remote rural villages, and buy at farm-gate does not seem to be attractive for farmers to travel long distances for grain marketing. On average brokers offer the lowest price of the available channels for both maize and pigeonpea.

Table 5.10. Marketed volumes and average price by marketing channel and timing of sale

Buyer	Share (%)		Average price (TSh/kg)[a]	Std. dev. of price
	Sellers	Volume		
Maize				
Sale immediately after harvest				
Consumers	1.23	0.73	205.34	34.35
Brokers	33.06	25.38	203.42	39.03
Rural traders	15.78	20.85	208.09	43.66
Rural wholesalers	7.53	9.57	209.25	38.36
Sale 4–5 months after harvest				
Consumers	2.04	3.61	323.68	49.32
Brokers	21.00	19.03	322.58	103.01
Rural traders	13.98	14.81	329.57	78.48
Rural wholesalers	5.38	6.11	342.72	54.66
Pigeonpea				
Sale immediately after harvest				
Consumers	1.01	1.21	735.27	287.45
Brokers	43.90	39.62	733.09	253.40
Rural traders	10.37	16.18	761.82	237.19
Rural wholesalers	6.21	9.06	779.51	291.98
Sale 4–5 months after harvest				
Consumers	-	-	-	-
Brokers	22.11	25.10	746.47	210.33
Rural traders	10.63	5.86	776.65	238.18
Rural wholesalers	5.79	2.97	796.78	210.85

Source: SIMLESA project survey data (2010).
Note: [a]The exchange rate at the time of the survey was about 1 US$ = 1,500 TSh.

Timing of marketing has impact on output price received by farmers. The price spread between the timing of sale showed that farmers who sell their maize and pigeonpea 4-5 months after harvest they got higher prices than those who sell their entire produce immediately after harvest. Accordingly maize prices were quite low immediately after harvest (1-3 months), but higher during the intervening periods when local supply is limited. For example, farmers who are able to sell their maize 4–5 months after harvest received about TSh 119/kg, TSh 122/kg and TSh 134/kg more than those that sell immediately after harvest through brokers, rural traders and wholesalers, respectively. Similarly, farmers who are able to sell their pigeonpea 4–5 months after harvest receive an average of TSh 13/kg, TSh 15/kg and TSh 17/kg more than those that sell immediately after harvest through brokers, rural

traders and wholesalers, respectively. Therefore, farmers can benefit from higher prices by storing grain for some months after harvest. This however needs some sort of production and marketing groups that could exploit seasonal price differentials through temporal arbitrage involving bulking and storage.

5.3.4.3 The econometric results

The selectivity-corrected impact of market channel choice on consumption expenditure per capita resulting from the joint estimation of equations (5.17) and (5.18) for both maize and pigeonpea households are presented in Table 5.11. The test for exogeneity of the selection equation indicates that selection is not exogenous for both maize and pigeonpea, and hence that it is appropriate to use a two-stage estimation framework. The coefficient on the latent factor, lambda for traders and wholesalers channels are significantly negative for maize, suggesting that farmers who are more likely to choose traders and wholesalers channels relative to brokers channel, on the basis of their unobserved characteristics, have less consumption expenditure per capita. For pigeonpea, lambda coefficient is significantly positive in the case of traders channel suggesting that farmers who are more likely to choose traders channel relative to brokers channel, on the basis of their unobserved characteristics have more consumption expenditure per capita.

The results indicate that, after controlling for selection on unobservable characteristics, there is a significant positive impact on consumption expenditure per capita of supplying to rural traders and wholesalers channels (as compared to the brokers channel) for both maize and pigeonpea. This implies that supplying to rural traders and wholesalers channel increases per capita consumption expenditure of smallholder farmers relative to brokers channel for both maize and pigeonpea farm households. This confirms the role of formal channels in improving the welfare of smallholder farmer as compared to informal channels such as brokers. These findings are in line with other studies that have analyzed welfare effects of market channel choice in agrifood supply chain (e.g. Vandeplas *et al*., 2011; Rao and Qaim, 2011; Falkowski *et al*., 2008; Miyata *et al*., 2009). Vandeplas *et al*. (2011) found that farmers that supply to informal channels are less efficient and earn less profit per dairy animal than farmers supplying the cooperative and the multinational sector. Rao and Qaim (2011) found that participation in supermarket channels is associated with a 48% gain in average household

income, which also contributes to poverty reduction in rural Kenya. Although the rural traders and wholesalers channel demonstrated that they have significant impact on smallholder farmers' welfare but also associated with transaction costs that can hinder majority of smallholder farmers to sale through this channel (Sitko and Jayne, 2014). Yet, the majority of smallholder farmers are unable to produce sufficient quantities to make it attractive to arrange their own transport to these more distant buyers. Interventions that reduce transaction costs and enhance capacity of smallholder farmers to produce surplus production could improve income and welfare of rural households.

Table 5.11. The impact of market channel choice on consumption expenditure per-capita

Variable	Maize		Pigeonpea	
	Coef.	**Std. Err.**	**Coef.**	**Std. Err.**
Market channel choice				
Traders channel	0.338**	0.137	0.346*	0.199
Wholesalers channel	0.230*	0.131	0.268**	0.137
Household socio-economic characteristics				
log(age)	-0.102	0.134	0.193	0.200
Gender	0.120	0.141	-0.103	0.087
log(education)	0.087	0.098	0.405**	0.143
log(value of farm assets)	0.229***	0.028	0.125**	0.063
Access to off-farm	0.120	0.173	0.085	0.136
Access to remittances	0.231	0.205	0.012*	0.007
Location characteristics				
log(distance to nearest market)	0.035	0.070	-0.001	0.120
Karatu district - reference				
Mbulu district	-0.103*	0.056	0.020	0.187
Kilosa district	0.165	0.113	0.037	0.121
Mvomero district	0.044	0.133	-0.146**	0.060
Constant	9.818***	0.676	11.333***	0.951
Number of observations	305		148	
lnsigma	-0.834**	0.342	-0.848	0.357
$Lambda_{traders}$	-0.364***	0.122	0.507***	0.161
$Lambda_{wholesalers}$	-0.441**	0.166	0.120	0.100
LR-test exogeneity of selection equation	4.240		52.661	
P-value LR-test	0.000		0.000	

Source: SIMLESA project survey data (2010).
Notes: Base category is brokers channel.
*, ** and *** denote significance at 10%, 5% and 1% level, respectively.
The dependent variable is log consumption expenditure per capita.

Among the control variables, education, value of farm assets, remittances and location dummies variables are found to have statistically significant positive influence in per capita consumption expenditure. Value of farm assets was significant and positively related to per capita consumption expenditure for both maize and pigeonpea households. Remittances have a positive impact on per capita expenditure for pigeonpea households. In terms of geographical locations and in comparison to households located in Karatu district, the results show that households located in Mbulu and Mvomero districts had significantly less per capita consumption expenditure for maize and pigeonpea, respectively. This implies that maize households in Mbulu and pigeonpea households in Mvomero tend to be consumption poor than households in Karatu districts.

5.4 Summary

This chapter analyzed the impacts of maize and pigeonpea market participation, and channel choice on household welfare measured by consumption expenditure per capita. Propensity score matching and endogenous switching regression techniques were employed to estimate the welfare impact of market participation for binary treatment, while linear regression was employed to analyze the welfare impact of level of market participation. The results from both the propensity score matching and switching regression were consistent and indicated that maize and pigeonpea market participation has a significant positive impact on consumption expenditure per capita. The results also indicated that the level of market participation for both maize and pigeonpea has a significant positive impact on consumption expenditure per capita. These confirm the role of market participation and level of participation in improving rural household welfare. This chapter further indicated that market channel choice have significant positive impact on household welfare, which are in line with other studies that have analyzed welfare effects of market channel choice in agrifood supply chain. The estimation results further show that supplying to rural traders and wholesalers channels has a significant positive effect on consumption expenditure per capita for both maize and pigeonpea households relative to brokers. This implies that rural traders and wholesalers channels (i.e. formal channel) are beneficial to smallholder farmers if they can access them as compared to brokers (i.e. informal channel). Policies aimed at improving market access such as improved rural infrastructure for reducing the transaction costs, and household capacity to produce marketable surplus stand out as critical to improve household

market participation and welfare. This study also suggests that policies and programs that support inclusion of smallholder farmers in more profitable markets could improve household welfare and reduce poverty among rural households. The next chapter presents the conclusions drawn from all the empirical findings, the key policy recommendations and areas of further research.

CHAPTER 6. CONCLUSIONS AND POLICY RECOMMENDATIONS

6.1 Re-capping the purpose of the study

Considering that agriculture remains a major sector in the attainment of economic growth for most sub-Saharan Africa economies including Tanzania, commercialization of the sector requires improving the ability of smallholder farmers to participate in markets to improve their incomes and create wealth. Thus, markets and improved market access play an important role in improving rural incomes of smallholder farmers. However, participation of smallholder farmers in markets in most sub-Saharan African countries remains low due to a range of constraints, such as high transaction costs. Transaction costs due to distance to market, poor infrastructure, and lack of market information make access to markets difficult and market participation less profitable. They also result in under-use of profitable market channels by smallholder farmers. Overcoming these constraints requires an understanding of the factors influencing smallholder famers' market participation and profitable channel choice. In sub-Saharan Africa, there is a high potential for smallholders to derive livelihoods from market-oriented agriculture. It is widely acknowledged that the involvement of small farmers in mainstream markets can contribute to higher productivity and income growth, which, in turn, can enhance food security, poverty reduction efforts, and overall economic growth.

Following agricultural market liberalization, smallholder farmers have alternative market channels for selling their agricultural produce. These market channels offer different prices and sales services, which determine farmers' choices of the more profitable channel and impact on household income and welfare outcome. Considering the role of market participation and channel choice in improving rural incomes of smallholder farmers, there is a need to unpack the factors that influence them and the welfare impacts therein. However, very few studies have empirically investigated the factors influencing market participation and welfare impacts by smallholder farmers in Tanzania. Furthermore, no empirical study so far has been done on the factors influencing the choice of marketing channel and welfare impacts of channel choice by smallholder farmers in Tanzania.

This study was, therefore, an attempt to address these knowledge gaps and to draw relevant policy implications to improve smallholder market participation and rural household welfare. Specifically, the study pursued the following objectives: (i) identify the factors that influence farmers' decision to participate and intensity of their participation in maize and pigeonpea markets; (ii) examine the factors affecting the choice of market channels by smallholder farmers; and (iii) assess the impact of market participation and channel choice on household welfare.

Various conceptual and empirical models were employed to address the objectives. The Heckman procedure was employed in chapter three to analyze the factors that influence household decisions to participate in maize and pigeonpea markets and the intensity of participation. Multinomial logit model was employed in chapter four to analyze the factors influencing the choice of market channels identified in the study (brokers, rural traders and wholesalers). In chapter five, propensity score matching and endogenous switching regression techniques were employed to estimate the welfare impact of market participation for binary treatment, while linear regression was used to analyze the welfare impact of the level of market participation by maize and pigeonpea smallholder farmers, measured by per capita consumption expenditure. Linear regression was adopted after solving the endogeneity problem between consumption expenditure per capita and level of market participation, which involves the use of predicted values of the potentially endogenous variables as instrumental variables in the estimation of the truly endogenous variables. Multinomial endogenous treatment framework was also applied in chapter five to analyze the welfare impact of market channel choice. This involves the joint estimation of the endogenous multinomial treatment (*i.e.* channel choice) and welfare outcome equation (*i.e.* consumption expenditure per capita), while correcting for the selection bias.

The purpose of this last chapter is to provide the conclusions drawn from the key findings of the study, make policy recommendation and suggest areas for further research. The sections in the remainder of this chapter present the outcomes of the empirical analysis done in the thesis subsequently.

6.2 Conclusions

Based on the empirical findings in chapter three, the significance of farm size implies that land is a critical production asset, having a direct effect on the production of a marketable surplus, therefore, the larger the farm size, the more it allows the household to have marketable surplus to sell. Furthermore, mean village prices were found as an incentive for farmers to sell. Estimated price elasticity for pigeonpea was found to be higher compared to maize, suggesting that pigeonpea prices were found to provide significant incentives for increased sales volume for smallholder farmers. It can be concluded that households with more labour supply have higher probability of market participation and marketed surplus. Considering the labour demand for crop production, this can affect the amount of maize and pigeonpea produced in the household which can also affect marketed surplus.

The results revealed that farmers located far from markets are less likely to participate in markets probably because of the high transaction costs involved in accessing markets. The results suggest that access to means of transport lowers the transaction costs, thereby enhancing market participation. Furthermore, access to communication assets has a great impact on market participation, suggesting that access to information is likely to result in increased agricultural output and improved market participation. Farmer associations play a significant role in market participation and intensity of participation as they are found to be good platforms for exchanging information, enabling farmers to link to buyers at a lower cost and thereby lowering the fixed transaction costs of market participation.

Furthermore, male-headed households participated more in the market, possibly because female-headed households are resource-constrained, lacking access to productive assets (such as land and finance) which limits their production capabilities and market participation. The positive impact of education implies that advancement in education increases ability to obtain and process market information, hence market participation. The impact of geographic location of households on market participation is directly attributed to differences in the physical infrastructure, especially the quality of roads and communication. It may also be affected by other factors such as differences in agro-climatic conditions necessary for production of agricultural crops. In particular, households located in high potential and relatively good physical infrastructure areas were found to be more likely to participate in

markets and be able to produce more marketable surplus compared to the low potential and relatively remote areas.

The empirical results from chapter four established that transaction costs (such as lack of market information, greater distance to market and poor road infrastructure to market) reduce smallholder farmers' opportunity to access distant and profitable market channel, such as wholesalers. As regards the household wealth, it was found that relatively wealthier farmers are more likely to sell to wholesalers in more distant markets, possibly because they are better able to meet transport and other costs incurred in selling through this channel. Farmers were able to access traders and wholesalers market channels when they are members in farmers' associations/groups. Farmers' associations/groups may increase access to information critical to production and marketing decisions and can also contribute towards reduced transaction costs and strengthen farmers' bargaining power. Access to extension services and credit are important in increasing the ability of farmers to acquire relevant price information and related production information which, in turn, increases production and farmer's ability to choose the profitable market channel. Extension services are also expected to facilitate smallholder linkages with input and output markets. Therefore, access to extension services may thus be associated with higher market participation and the likelihood of choosing profitable market channel. The positive, significant effect for trust suggested that farmers' degree of trust towards buyers is important in choosing market channel since higher levels of trust reduce the perception of risk and hence transaction costs in an exchange relationship.

The empirical results from chapter five revealed that maize and pigeonpea market participation have significant positive impact on rural household welfare. The key message drawn from the results is that market participation plays a crucial role in improving food security and poverty alleviation among smallholder farmers. In sub-Saharan Africa, specifically in Tanzania, where the majority of the population relies on agriculture for their livelihood, smallholder farmers can turn their surpluses into income only if they have access to markets. Increased incomes, in turn, increase food security and help to alleviate poverty. Furthermore, the level of market participation has a significant positive impact on household welfare for both maize and pigeonpea. This implies that the level of market participation for both maize and pigeonpea increases per capita consumption expenditure of smallholder farmers in rural Tanzania. The heterogeneous impact of market participation based on farm size, education level and level of market participation shows that gain in consumption

expenditure per capita from market participation is highest for those household heads with better access to education. Although there are significant consumption expenditure per capita gains in all quintiles of farm size for maize, the gain is higher for households with smaller farm sizes. Consumption expenditure per capita also increased with the level of market participation for both maize and pigeonpea. This implies that market participation is likely to benefit the poor and those with better education.

The welfare impact of market channel choice revealed that selling to rural traders and wholesale has a positive and significant effect on consumption expenditure per capita relative to brokers, for both maize and pigeonpea. This confirms the role of formal channels in increasing income for smallholder farmers. Selling to rural traders and wholesale channels can reduce the number of intermediaries and make farmers to realize the benefits of their produce. Although rural traders and wholesale channels have significant positive impact on smallholder farmers' welfare but also associated with transaction costs that can hinder the majority of smallholder farmers from selling through this channel. Yet, the majority of smallholder farmers are unable to produce sufficient quantities to make it attractive to arrange their own transport to these more distant buyers.

Regarding the research hypotheses, the research findings suggest that the null hypotheses of the study outlined in Section 1.4 of Chapter 1 should be rejected.

Hypothesis (i): Farmers with better access and endowment to assets (wealth) do not participate in the market. This hypothesis should be rejected because, the results from Heckman selection model showed that access to assets (such as land, transport and communication assets) have a significant impact on market participation among maize and pigeonpea smallholder farmers. The determinants of the intensity of maize and pigeonpea outputs included farm size and productive assets.

Hypothesis (ii): Transaction costs do not influence smallholder farmers' market participation and channel choice. This hypothesis should be rejected because, the results from Heckman and Multinomial logit models showed that transaction costs have a significant impact on market participation and channel choice among maize and pigeonpea smallholder farmers.

Hypothesis (iii): Market participation and channel choice do not influence household welfare. Empirical analysis from Propensity score matching (PSM) and Multinomial endogenous treatment model suggests that this hypothesis should be rejected because, market

participation and channel choice were found to have a positive impact on household welfare among maize and pigeonpea smallholder farmers.

6.3 Policy Recommendations

The role of proportional transaction cost variables (such as distance and quality of road) to hinder market access and choice of a profitable channel suggests that providing better access to markets by improving rural road infrastructure could be an important policy intervention. Improving rural road infrastructure would also lead to more traders penetrating the rural areas and this will increase competition and could benefit smallholder farmers through better prices and enabling them to take advantage of profitable market channels such as wholesalers.

The empirical findings suggest that improving access to market information through appropriate sources and making them easier to access could lower the transaction costs associated with searching for trading partners, contracting and enforcing the contract among smallholder farmers and enhancing market participation. Policies geared towards enabling farmers to access and utilize telecommunication technologies (such as mobile phones) for trade purposes should be supported. The utilization of these technologies would lower transaction costs, and thus, enhance market participation. Use of communication and information technologies offers exciting new opportunities to smallholder farmers and presents an opportunity to resolve the market information problems commonly encountered in Tanzania. By facilitating the rapid and timely exchange of knowledge and information, they accelerate the spread of improved technologies within rural communities and help get up-to-date market information.

The importance of local collective action organizations (such as farmer groups/associations) in influencing market participation, marketable surplus and profitable market channel choice, call for appropriate policies to strengthening establishment and existence of farmer groups/associations which can act as platforms for smallholders' technology and information exchange, enhancing bargaining capacities and trust between farmers and buyers, especially in areas where infrastructure is weak. Collective action organizations are also critical factor in enabling farmers' access to production assets (such as tractors, machinery and vehicles to transport produce to market). However, there is a need for policies and programs that support

inclusion of smallholder farmers in more profitable marketing channels. This can be done through supporting the development and strengthening of functional, effective and sustainable farmer production and marketing groups, which could reduce transaction costs, improve collective action and rural household welfare. Moreover, institutional support from different stakeholders (such as NGOs and government organizations) could improve market participation among smallholder farmers. This can be done through designing appropriate institutional support programs that could better link smallholder farmers to markets such as public–private partnerships. For instance, the public sector may provide the physical infrastructure and market linkage services could be offered by private agents.

Policies and interventions which support smallholders' asset building and wealth creation should be encouraged. Such policies could target enhancing productivity and market participation. Policies that improve farm households' access to assets enhance smallholders' productivity and capacity to produce marketable surplus and result in better market participation and profitable market channel choice. Such policies could involve designing appropriate property right regimes that enable smallholders acquire, own and transfer production assets.

Improvement of human capital appears to be crucial in smallholder market participation, marketed supply and welfare effects. Improved human capital that complements other forms of capital can increase agricultural productivity which is often considered as an engine for economic growth and rural development, especially in developing countries. The importance of market participation to more educated households suggests that providing farmers with basic education might enhance productivity, market participation and household welfare. Moreover, increased targeting of women for market participation may increase the impact of policy interventions focused on improved market access and welfare of rural households. Providing sustainable support to women, who supply more than 70% of agricultural labour in sub-Saharan Africa, will be a critical element of any new smallholder-led development effort. When women obtain the same level of education, experience, farm inputs and market information as men, they produce significantly higher yields in a range of farming systems and reduce poverty.

Household capacity to produce marketable surplus stand out as critical to improve household market participation, level of participation and welfare. New innovations and technologies that target increased agricultural productivity should be promoted. In addition, the government should also consider advances in knowledge through training in farm production and farm business management for increased productivity, market participation and household welfare. The next section highlights the limitations of the study and makes suggestions for further research.

6.4 Limitations of the study and suggestions for future research

In the pursuit of this thesis, several limitations became apparent. Firstly, in this study, welfare impacts of market participation and profitable market channel choice are analyzed using cross-section data that were available. The results from cross-section data, however, have limitations in giving a general and robust picture of the move towards welfare effects. In this regard, the impact of market participation and profitable channel choice on household welfare can be analyzed more effectively using panel data. The main advantage of panel data, compared to a single cross-section is that it allows one to control for temporally persistent differences among individuals that in many instances may bias estimates obtained from cross-sections (Hsiao, 1986). Panel data treat individual firms, states or countries as heterogeneous. Cross-section studies are not adequately capable of controlling for this heterogeneity and run the risk of obtaining biased results (Klevmarken, 1989). Using panel data in future research in the areas of measuring welfare impacts of market participation and profitable channel choice can provide further insight on the relationship between market participation, channel choice and household welfare. This is achieved because panel data can control for unobserved specific heterogeneity, provide more robust evidence and enable the researcher see whether the results persist over time.

Secondly, one of the set of variables that seemed to be significant in determining market participation and market channel choice was transaction cost variables. Considering that transaction costs are “hidden costs”, quantifying them can be a challenge. This study only captures variables relating to transaction costs but falls short of quantifying them. Future research that attempts to quantify transaction costs for better observations and inference

should be considered. This may involve quantifying actual costs incurred in searching for trading partners, negotiating, bargaining, contracting and enforcing a contract.

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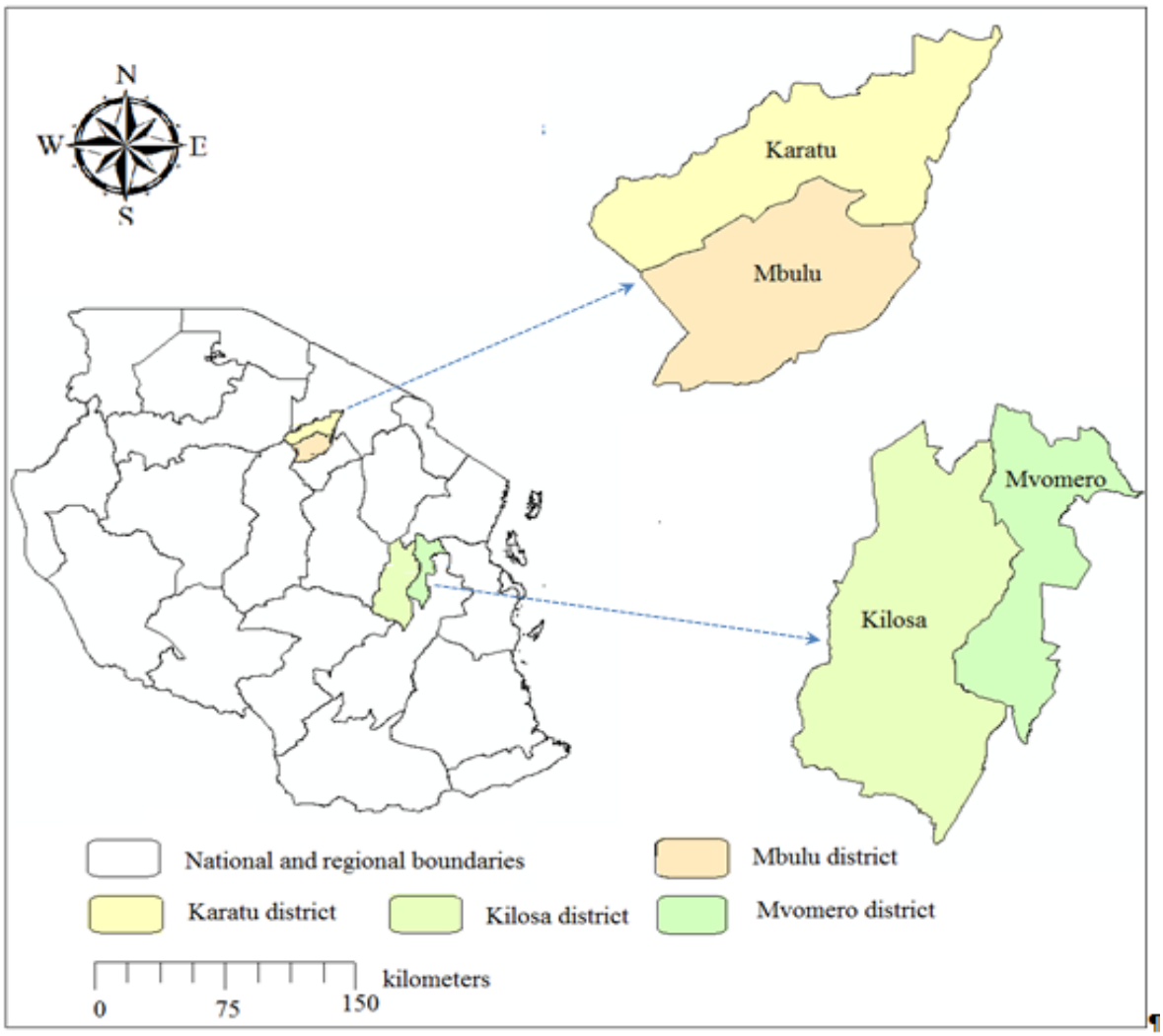
APPENDICES

Appendix 3.1. Map of the research area



Appendix 3.2. Household survey questionnaire

PART 0: INTERVIEW BACKGROUND

1. Respondent's name:.....

2. Mobile phone No……..…… Landline phone no.....

3. Date of interview: Day:…..…… Month:..... Year:…….……...

4. Interviewed by (enumerator's name):….....

5. Date checked: Day:……..…… Month:..... Year:……..……..

6. Checked by (supervisor's name) .....

7. Date entered: Day:…… Month:..... Year:…..…….

8. Entered by:…….....

9. Zone..... 10. Region.....

10. District:…..……..…..……. 13. Division ……..…….

11. Ward ..... 15. Village.....

PART 1: FARMERS IDENTIFICATION AND VILLAGE CHARACTERISTICS

1. Major family language …….....

2. Religion of the household head (Codes A).....

3. Does main residential house have the following inbuilt? (Codes B) 1. Kitchen…… 2. Grain store.....; 3. Livestock pen…….

4. Type of toilet used .....1. Flash toilet private; 2. Flash toilet shared; 3. Pit latrine private; 4. Pit latrine shared; 5. Bucket latrine; 6. No toilet/use open air

5. Main walling material of main residential house……...(Codes C)

6. Main roofing material of main residential house……..…….. (Codes D)

7. Experience in growing maize (years)……..……..

8. Experience in growing legumes (years) Haricot bean..... Soybean……...…. Pigeonpea……. Groundnut…..…… Cowpea……. (Other, specify name) .....Years of experience…….....

9. Taking all means into consideration (own food production + food purchase + help from different sources + food hunted from forest and lakes, etc), how would you define your family's food consumption in the last year?..... 1. Food shortage through the year, 2. Occasional food shortage, 3. No food shortage but no surplus, 4. Food surplus.

10. Distance to the village market from residence (km) .....minutes of walking time .....

11. What means of transport do you use mainly to get to the village market? (Code E)……..

12. Average single trip transport cost (per person) to the village market using this means of transport (TSh/person)……...

13. Distance to the nearest main market from residence (km)…….…..……..minutes of walking time……..……...……

14. Number of months road to main market is passable for cars in a year.....

15. Quality of road to the main market…….1= Very poor; 2= Poor; 3= Average; 4=Good; 5= Very good

16. Average single transport cost (per person) to the main market using a car (TSh/person).....

17. Distance to the nearest source of seed dealer from residence (km) .....minutes of walking time …….....

18. Distance to the nearest source of fertilizer dealer from residence (km) .....minutes of walking time …….....

19. Distance to nearest source of herbicides and pesticides from residence (km).....…minutes of walking time .....

20. Distance to the nearest farmer cooperative from residence (km)……..……minutes of walking time .....

21. Distance to the nearest farmers group from residence (km)…..……..……minutes of walking time .....

22. Distance to the nearest agricultural extension office from residence (km)…….minutes of walking time……...…

23. Distance to the nearest health center from residence (km)……..…minutes of walking time…..…….……..

24. Main source of drinking water……...(Codes F below)

25. Do you boil water for drinking?..... (Codes B)

26. Distance to main water source for drinking from residence (km)……..……minutes of walking time……..…..

27. GPS readings of village: a) Altitude.....; b) Latitude…….……;

c) Longitude……

Codes A: 0. No religion/atheist; 1. Orthodox Christian; 2. Catholic; 3. Protestant; 4. Other Christian 5. Muslim; 6. Other, specify……

Codes B: 1. Yes: 0.No

Codes C: 1. Burned bricks; 2. Unburned bricks; 3. Stone; 4. Earth; 5. Wooden (timber); 6. Other, specify……..…...……

Codes D: 1. Grass thatch; 2. Iron sheet; 3. Tiles; 4. Other, specify……..…

Codes E: 1. Walking; 2. Bicycle; 3. Tractor; 4. Minibus; 5. Other, specify……

Codes F: 1. Piped; 2. Borehole protected and covered; 3. Borehole unprotected & uncovered; 4. Stream; 5. River; 6. Lake;
7. Ponds or floods Note: protected refers to water sources internally plastered and covered with a cap of wood, stone or concrete)

PART 2: CURRENT HOUSEHOLD COMPOSITION AND CHARACTERISTICS

Family code	Name of household member (start with respondent)	Sex Codes A	Marital status Codes B	Age (years, if under 1: 0)	Education (years) Codes C	Relation to HH Codes D	Occupation Codes E		Own farm labour contribution Codes F	For those under the age of 6 (see column 5)		
							Main	Secondary		Weight (kg)	Height (cm)	Had diarrhea in 2009/10 Codes G
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
01												
02												
03												
04												
05												
06												
07												
08												
09												
10												
11												
12												
13												
14												
15												

Codes A	**Codes B**	**Codes C**	**Codes D**	**Codes E**	**Codes F**	**Codes G**
0. Female 1. Male	1. Married living with spouse 2. Married but spouse away 3. Divorced/separated 4. Widow/widower 5. Never married 6. Other, specify……	0. None/Illiterate 1. Adult education or 1 year of education * Give other education in years completed	1. Household head 2. Spouse 3. Son/daughter 4. Parent 5. Son/daughter in-law 6. Grand child 7. Other relative 8. Hired worker 9. Other, specify……	1. Farming (crop + livestock) 2. Salaried employment 3. Self-employed off-farm 4. Casual labourer on-farm 5. Casual labourer off-farm 6. School/college child 7. Non-school child 8. Herding 9. Household chores 10. Other, specify……	1. 100% 2. 75% 3. 50% 4. 25% 5. 10% 6. Not a worker	0. No 1. Yes

PART 3: SOCIAL CAPITAL AND NETWORKING

Section A: Membership in formal and informal institutions <u>in the last 3 years</u> (husband and wife/wives only. One group membership per row)

Family code	Type of group the husband/wife is/was a member of: (**codes A**)	Most important group functions: **(codes B)**			Year joined (YYYY)	Role in the group **(codes C)**	Still a member now? **(codes D)**	If No in column 8, reason/s for leaving the group (**codes E**), Rank 3		
		1st	2nd	3rd				1st	2nd	3rd
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**

Codes A		**Codes B**	**Codes C**	**Codes D**	**Codes E**
1. Input supply/farmer coops/union 2. Crop/seed producer and marketing group/coops 3. Local administration 4. Farmers' Association 5. Women's Association 6. Youth Association 7. Church/mosque association/congregation 8. Saving and credit group	9. Funeral association 10. Government team 11. Water User's Association 12. Other, specify…….	1. Produce marketing 2. Input access/marketing 3. Seed production 4. Farmer research group 5. Savings and credit 6. Funeral group 7. Tree planting and nurseries 8. Soil & water conservation 9. Church group/congregation 10. Input credit 11. Other, specify……	1. Official 2. Ex-official 3. Ordinary member	1. Yes 0. No	1. Left because organization was not useful/profitable 2. Left because of poor management 3. Unable to pay annual subscription fee 4. Group ceased to exist 5. Other, specify……

Section B: Social networks

1. Number of years the respondent has been living in this village …….....

2. Number of people that you can rely on for critical support in times of need within this village
   Relatives..... Non-Relatives.....

3. Number of people you can rely on for support in times of need outside this village
   Relatives……..…….. Non-Relatives .....

4. Are any of your friends/ relatives in leadership positions in formal/informal institutions?
   ..... **Codes:** 1. Yes, 0. No

5. Number of grain traders that you know in this village who could buy your grain……

6. Number of grain traders that you know outside this village who could buy your grain…….……

7. Generally speaking, would you say that most traders can be trusted?.....(**Codes A** below)

8. If answer in Question 7 above is 1, 2 or 3, then which types of traders do you trust more? – give names ……..……..……

……

And why do you trust these types of traders more?

…….....……

……

……

9. Do you think you can rely on government support (subsidies, food aid etc) if your crop fails?.....**Codes:** 1.Yes; 0. No

10. Are you confident of the skills of government officials including extension workers to do their job?.....(**Codes** A)

Codes A: 1. Strongly disagree; 2. Disagree; 3. Slightly disagree; 4. Slightly agree; 5. Agree; 6. Strongly agree

PART 4: HOUSEHOLD ASSETS

Section A: Production equipments and major household furniture

Asset	Number	Original purchase price (TSh)	If you would sell one of the [….] how much would you receive from the sale? (TSh)	Total Value
1	**2**	**3**	**4**	**5= 2*4**
1. Horse/mule cart				
2. Donkey cart				
3. Horse/Mule saddle				
4. Push cart				
5. Ox-plough				
6. Sickle				
7. Pick Axe				
8. Axe				
9. Hoe/Jembe				
10. Knapsack sprayer				
11. Water carrier made of canvass/skin/inner tire tube				
12. Stone grain mill				
13. Motorized grain mill				

14. Water mill				
15. Mechanical water pump (hand, foot)				
16. Motorized water pump (diesel)				
17. Spade or shovel				
18. Radio, cassette or CD player				
19. Cell phone				
20. Improved charcoal/wood stove				
21. Kerosene stove				
22. Bicycle				
23. Motorbike				
24. Cars				
25. picks-ups				
26. trucks				
27.tractors				
28.trailers				
29. Jewellery: gold, silver, wristwatches				
30. Wooden box				
31 Metal box				
32. Leather bed				
33. Wooden bed				
34. Metal bed				
35. TV				
36. Chairs/sofa				
37. Table				
38. Gun				
39. Grass roofed house				
40. Corrugated iron sheet house				
41.Fish pond				
42.				
43.				
44.				
45.				

Section B: Land holding (acres) during the 2008/2009 cropping year (last cropping year)

Land category	Short rain season		Long rain season	
	Cultivated	Uncultivated (e.g. grazing, homestead etc)	Cultivated	Uncultivated (e.g. grazing, homestead etc)
1	2	3	4	5
1. Own land used (A)				
2. Rented in land (B)				
3. Rented out land (C)				
4. Borrowed in land (D)				
5. Borrowed out land (E)				
6. Total owned land (A+C+E)				
7. Total operated land (A+B+D)				
8. Bought land during long rain season				
9. Sold land during long rain season				

Total owned land 5 years ago (2004/2005) – (acres)……..

PART 5: CROP PRODUCTION, UTILIZATION AND FOOD SECURITY

One row per crop and season (e.g. add production from all maize plots together for season)

Crop Codes A	Season	Form Codes B	Stock before 2008/09 harvest (kg)	Production (Total harvest in kg) during 2008/09	Total available stock after 2008/09 harvest =Column 4 +5
1	2	3	4	5	6

Codes A
1. Maize
2. Haricot bean
3. Pigeonpea
4. Soybean
5. Groundnut
6. Cowpea

Codes B
1. Fresh/green
2. Dry

Part 5 (contd)

From the total available stock after 2008/09 harvest (**column 6**)…					Ending stock (Stock before 2009/10 harvest) (kg)	If total available stock of 2008/09 was not sufficient for consumption until 2009/10 harvest:	
Quantity sold after 2008/09 harvest (kg)	In-kind payments (labour, land & others) paid during 2009/10 cropping year (kg)	Seed used during 2009/10 cropping year (kg)	Gift, tithe, donations given out during 2009/10 cropping year (kg)	Consumption during 2009/10 cropping year (kg)		Amount bought (kg)	Food aid/gifts received (kg)
7	**8**	**9**	**10**	**11**	**12=6-7-8-9-10-11**	**13**	**14**

Codes A
1. Maize
2. Haricot bean
3. Pigeonpea
4. Soybean
5. Groundnut
6. Cowpea

Codes B
1. Fresh/green
2. Dry

PART 6: MARKETING OF CROPS

One row per sale (different months, different buyers), per crop and per season

Crop (From Column 1 of Part 5)	Season (From Column 2 of Part 5)	Form (From Column 3 of Part 5)	Market type Codes A	Quantity sold kg (From Column 7 of Part 5)	Who sold Codes B	Price (TSh /kg)	Month sold Codes C	Period to payment after selling, weeks (if immediate write zero)	Buyer Codes D
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**

Codes A
1. Farmgate
2. Village market
3. Main/district market

Codes B
0. Female
1. Male

Codes C
1. January
2. February
3. March
4. April
5. May
6. Jun
7. July
8. August
9. September
10. October
11. November
12. December

Codes D
1. Farmer group
2. Farmer Union or Coop
3. Consumer or other farmer
4. Rural assembler
5. Broker/middlemen
6. Rural grain trader
7. Rural wholesaler
8. Urban wholesaler
9. Urban grain trader
10. Exporter,
11. Other, specify…….

Part 6 (contd)

Relation to buyer Codes E	Quality Codes F	Sales tax or charges (TSh)	Time taken to sell crop (minutes)	Time taken to get to the market (minutes)	Mode of transport Codes G	Actual transport cost (TSh)
11	**12**	**13**	**14**	**15**	**16**	**17**

Codes E
1. No relation but not a long time buyer
2. No relation but a long term buyer
3. Relative
4. Friend
5. Money lender
6. Other, specify……

Codes F
1. Below average
2. Fair and Average
3. Above average

Codes G
1. Bicycle
2. Hired truck
3. Public transport
4. Donkey
5. Oxen/horse cart
6. Back/head load
7. Other, specify….

PART 7: TRANSFER AND OTHER SOURCES OF INCOME DURING 2008/09 CROPPING YEAR

[If several household members earn the same income source, fill according to the earning family member in separate rows]

Sources	Who earned/ received? 0= None; 1=Women 2=Men; 3=Both	Unit (e.g. month, week, day)	No. of units worked/ received	Amount per unit (Cash & in-kind)		Total income (cash & in-kind)		Total income (TSh)
				Cash **(TSh)**	Payment in kind **Cash equivalent**	Cash **(TSh)**	Payment in kind **Cash equivalent**	
1	**2**	**4**	**5**	**6**	**7**	**8= 5*6**	**9= 5*7**	**10= 8+9**
1. Rented/sharecropped out land								
2. Rented out oxen for ploughing								
3. Salaried employment								
4. Farm labour wages								
5. Non-farm labour wages								
6. Non-farm agribusiness NET income (e.g. grain milling/trading)								
7. Other business NET income (shops, trade, tailor, sales of beverages etc)								
8. Pension income								
9. Drought/flood relief								

10.Safety net or food for work								
11. Remittances (sent from non-resident family and relatives living elsewhere)								
12. Marriage Gifts								
13. Sales of firewood, brick making, charcoal making, poles etc								
14. Sale of maize crop residues								
15. Sale of legumes crop residues								
16. Sale of wheat crop residues								
17. Sale of teff crop residues								
18. Sale of other crop residues								
19. sale of hay								
20. Quarrying stones								
21. Sale of dung cake								
22.Rental property (other than land)								
23.								
24.								
25.								

PART 8: ACCESS TO FINANCIAL CAPITAL, INFORMATION AND INSTITUTIONS

Section A: Household credit need and sources during 2008/09 cropping year

Reason for loan	Needed credit? **Codes A**	If **Yes** in column 2, then did you get it? **Codes A**	If **NO in column 3**, then why not? **Rank 3 (codes C)**			If **Yes in column 3**...				
			1st	2nd	3rd	Source of Credit, **Codes B**	How much did you get **(TSh)**	Did you get the amount you requested **Codes A**	Annual interest rate charged **(%)**	Debt outstanding including interest rate at end of season **(TSh)**
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
1. Buying seeds										
2. Buying fertilizer										
3. Buy herbicide and pesticides										
4. Buy farm equipment/implements										
5. Invest in transport										

(bicycle etc)										
6. Buy oxen for traction										
7. Buy other livestock										
8. Invest in irrigation system										
9. Invest in seed drill or minimum tillage system										
10. Non-farm business or trade										
11. To pay land rent										
12. Buy food										
13. Consumption needs (health/education/travel /tax, etc)										

0. No 1. Yes	**Codes B** 1. Money lender 2. Farmer group/coop 3. Merry go round	4. Microfinance 5. Bank 6. SACCO	7. Relative 8. Other, specify:	**Codes C** 1. Borrowing is risky 2. Interest rate is high 3. Too much paper work/ procedures	4. Expected to be rejected, so did not try it 5. I have no asset for collateral 6. No money lenders in this area for this purpose	7. Lenders don't provide the amount needed 8. No credit association available 9. Other, specify……	

Section B: Household savings

Saving family member (1=Husband; 0=Wife)	Has bank account number (0=No; 1=Yes)	Saving with (codes A)	Total amount saved during 2008/09 (TSh)
1	**2**	**3**	**5**

Codes A

1. Saving at home (personal)	3. Rural micro-finance	5. Merry go-round	7. Saving by lending to money lender
2. Commercial or other banks	4. SACCO (credit society)	6. M-Pesa	8. Other, specify……..…

Section C: Access to extension services

Issue	Did you receive training or information on [……] before 2008/09? (**Codes A**)	Received training or information on […..] during 2008/09? (**Codes A**)	Main information source for 2008/09 (codes B)			Number of contacts during 2008/09 (days/year)		
			Rank 1	Rank 2	Rank 3	Govt extension	Non-profit NGOs	Private Companies
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
1. New varieties of maize								
2. New varieties of legumes								
3. Field pest and disease control								
4. Soil and water management								
5. Crop rotation								
6. Minimum tillage								

7. Leaving crop residue in the field								
8. Adaptation to climate change								
9. Irrigation								
10. Crop storage pests								
11. Output markets and prices								
12. Input markets and prices								
13. Collective action/farmer organization								
14. Livestock production								
18. Tree planting								

Codes A
0. No
1. Yes

Codes B
1. Government extension service
2. Farmer Coop or groups
3. Neighbour farmers
4. Seed traders/Agrovets
5. Relative farmers
6. NGOs
7. Other private trader
8. Private Company
9. Research center
10. School
11. Radio/TV
12. Newspaper
11. Mobile phone
12. Other, specify……

Section D. Market access

Crop	Did you get market information before you decided to sell the crop? **(code A)**	If yes in column 2, where did you get the information? **(Code B)**	Ever failed to sell due to lack of buyers or poor price? **Codes A**		No. of buyers who came to buy at farm gate last season (2008/09)				If you did not sell to some of these buyers, then why? **Codes C** (Rank 3)			
			Lack of buyers	Poor price	Assemblers or brokers	Wholesalers	Farmer group or coops	Consumers	Assemblers or brokers	wholesalers	Farmer group or coops	Consumer
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
1. Maize												
2. Beans												
3. Pigeonpea												
4. Groundnut												
5. Soybean												
6. Cowpea												

Codes C: 1. No buyer came
2. Price offered was low
3. Unreliable scale or weight
4. Unable to meet the desired quality
5. Other, specify…….

PART 9: LIVESTOCK OWNERSHIP

Livestock type	Number of livestock at end of 2008/09 cropping season (including bought ones)	If you would sell one of the […], how much would you receive from the sale? (TSh)
Cattle		
1. Indigenous milking cows		
2. Cross-bred milking cows		
3.Exotic milking cows		
4. Non milking cows (mature)		
5. Trained oxen for ploughing		
6. Bulls		
7. Heifers		
8. Calves		
Goats		
9. Mature milking goats		
10. Other mature female goats		
11. Young male goats		
12.Young female goats		
Sheep		
13. Mature female sheep		
14. Mature male sheep		
15. Young female sheep		
16. Young male sheep		
Other livestock		
17. Mature trained donkeys		
18. Young donkeys		
19. Horses		
20. Mules		
21. Mature chicken		
22. Local Bee hives		
23.Modern Bee hives		
24.Pigs, mature		
25.Pigs, young		
26.Turkeys, mature		
27.Guinea fowls, mature		
28.Ducks, mature		
29.Rabbit, mature		

PART 10: HOUSEHOLD EXPENDITURE

(Not during 2008/09 but looking back from today)

(*Here, wife and/or the person involved in purchases should be the principal respondent/s).*

Section A: Food consumption

Item	**Unit** (e.g. kg, liter, packet, bundle)	Total **consumed in the last 7 days** for only members of the family			**Bought in the last 12 months**				
		Own produced	Bought	Cost of bought (TSh)	Frequency of buying (e.g., 2 times per month)	Average quantity each time (e.g. 2 kg; 4 bundles etc)	Total quantity per year	Average price per unit (TSh)	Total cost of purchased (TSh)
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10= 8*9**
Staple foods									
1. Maize (dry)									
2. Maize (green)									
3. Teff									
4. Wheat									
5. Barley									
6. Rice									
7. Sorghum									
8. F/millet									
9. P/millet									
10. Cassava									
11. Potatoes									
12. Beans dry									
13. Beans fresh									
14. Cowpea fresh grain									
15. Cowpea dry grain									
16. Cowpea leaves									
17. Groundnut fresh									
18. Groundnut dry									
19. Soybean									
20. Pigeonpea fresh									
21. Pigeonpea dry									
22. Greengram									
23. Bananas (for cooking)									
24.									
25.									
26.									
Vegetables									
27. Tomatoes									
28. Onions									
29. Cabbage									
30. Spinach									
31. Kale									
32. Carrot									
33. Okra									
34. Pumpkin									
35. Egg plant									

Section A: Food consumption (contd)

Item	**Unit** (e.g. kg, liter, packet, bundle)	Total **consumed in the last 7 days** for only members of the family			**Bought in the last 12 months**				
		Own produced	Bought	Cost of bought (TSh)	Frequency of buying (e.g., 2 times per month)	Average quantity each time (e.g. 2 kg; 4 bundles etc)	Total quantity per year	Average price per unit (TSh)	Total cost of purchased (TSh)
1	2	3	4	5	6	7	8	9	10
Vegetables (contd)									
36.Cucumber									
37.Pepper									
38. Garlic									
39.									
40.									
Fruits									
41. Oranges									
42. Mangoes									
43. Pawpaws									
44. Pineapple									
45. Bananas (ripe)									
46. Apple									
47. Guava									
48. Coconut									
49. Sugar cane									
50.									
51.									
Meat & other animal products									
52. Cow meat									
53. Goat meat									
54. Sheep meat									
55. Pig meat									
56. Chicken									
57. Turkey									
58. Ducks									
59. Bush meat									
60. Fish									
61. Eggs									
62. Milk									
63. Cheese/Ghee									
64. Butter									
65. Yoghurt									
66. Honey									
67.									
68.									
Beverages and drinks									
69. Tea (leaves)									
70. Tea (liquid)									
71. Coffee (powder)									

Section A: Food consumption (contd)

Item	**Unit** (e.g. kg, liter, packet, bundle)	Total **consumed in the last 7 days** for only members of the family			**Bought in the last 12 months**				
		Own produced	Bought	Cost of bought (TSh)	Frequency of buying (e.g., 2 times per month)	Average quantity each time (e.g. 2 kg; 4 bundles etc)	Total quantity per year	Average price per unit (TSh)	Total cost of purchased (TSh)
1	2	3	4	5	6	7	8	9	10
Beverages and drinks (contd)									
72. Coffee (liquid)									
73. Soft drinks									
74. Juices									
75. Local beer									
76. Bottled beer									
77. Wine									
78. Drinking water									
79. Water for livestock									
80. Water for other uses									
81.									
82.									
83.									
84.									
Fats, oils, sweeteners, snacks and others									
85. Cooking fat									
86. Margarine									
87. Groundnut oil									
88. Coconut oil									
89. Bread									
90. Biscuits									
91. Popcorn									
92. Cashew nuts									
93. Sugar									
94. Salt									
95. Chocolate									
96. Curry									
97. Ginger									
98.									
99.									
Meals eaten away from home (specify)									
100.									
101.									
102.									
103.									
104.									

Section B: Expenditure on non-food items in the last 12 months

Expense Item	Frequency of purchase (e.g., 2 times per month)	Average quantity each time (e.g. 2 kg; 4 bundles etc)	Total quantity per year	Average per unit price (TSh)	Total cost of purchase (TSh)
1	**2**	**3**	**4**	**5**	**6**
1. Clothing					
2. Shoes					
3. Blankets					
4. Bed sheets					
5. Soap/washing products					
6. Electricity					
7. Fuel wood					
8. Charcoal					
9. Kerosene					
10. Batteries					
11. School fees					
12. School books and supplies					
13. Health care (medicare, treatment etc)					
14. Grain milling					
15. Land tax					
16. Church contributions					
17. Dowry					
18. Contributions to farmer associations/cooperatives					
19. Contributions to other associations/cooperatives					
20. Other membership fees					
21. Funeral group payments					
22. House building/construction					
23. Contribution to sports					
24. Guard/security					
25. Newspapers, magazines etc					
26. Travel expenses					
27. Mobile phone air time (voucher)					
28. Radio/TV service charge					
29. Payment for extension advisory services					
30. Pay for improvement of communal services (roads etc)					
31. Kitchen utensils					
32. Personal care (soap, toothpaste etc)					
33. Furniture (tables, chairs, beds etc)					
34. Home repairs					
35. Purchase of cars					
36. Purchase of bicycle, motorcycle etc					
37. Repairs for vehicles, bicycles etc					
38. Petrol and engine oils for cars					
39. House rent					

40. Utility bills (water, telephone etc)					
41. Cigarettes, tobacco etc					
42. Remittances paid					
43. Deposits to savings account					
44. Debt payments					
45. Ceremony and other entertainments					
46.					
47.					
48.					
49.					
50.					

END, Thank you for your cooperation

Appendix 4.1. Hausman test of the independence of irrelevant alternatives

Omitted outcome	Distribution	Test statistic	p-value
Maize			
Traders	$\chi^2(12)$	7.920	0.791
Wholesalers	$\chi^2(12)$	8.342	0.758
Brokers	$\chi^2(12)$	10.709	0.554
Pigeonpea			
Traders	$\chi^2(12)$	3.807	0.987
Wholesalers	$\chi^2(12)$	0.450	1.000
Brokers	$\chi^2(12)$	9.604	0.651

Appendix 4.2. Eigenvalues of PCs for WINDEX

Component	Maize		Pigeonpea	
	eigen values	% variance	eigen values	% variance
PC_1	**2.44**	**27.14**	**2.70**	**30.05**
PC_2	**1.73**	**19.27**	**1.23**	**13.68**
PC_3	**1.13**	**12.52**	**1.19**	**13.29**
PC_4	0.99	11.07	0.95	10.59
PC_5	0.87	9.66	0.87	9.70
PC_6	0.84	9.33	0.70	7.80
PC_7	0.49	5.44	0.59	6.54
PC_8	0.32	3.52	0.41	4.58
PC_9	0.18	2.04	0.34	3.78

Appendix 5.1. Two-stage estimation to test for exogeneity of the NGO market linkage program variable

Variable	Maize		Pigeonpea	
	Coefficient		Coefficient	
	First stage probit	Second stage probit	First stage probit	Second stage probit
Age	0.001	-0.007*	-0.001	-0.011
	(0.004)	(0.004)	(0.006)	(0.007)
Male	0.246*	0.078	0.143	0.540
	(0.149)	(0.193)	(0.277)	(0.393)
Education	0.031*	-0.015	0.004	0.011
	(0.017)	(0.023)	(0.027)	(0.032)
Labour	0.010	0.001	0.039	0.253**
	(0.025)	(0.027)	(0.045)	(0.100)
Farm size per AEU	0.021**	-0.008	-0.003	0.024
	(0.009)	(0.013)	(0.019)	(0.029)
Log value of farm assets per AEU	-0.015	0.061*	0.065	0.069
	(0.033)	(0.036)	(0.051)	(0.142)
Access to off-farm	0.027	-0.048	0.106**	0.267
	(0.029)	(0.034)	(0.046)	(1.171)
Distance to market	-0.018**	0.010	-0.021	-0.063
	(0.008)	(0.012)	(0.013)	(0.038)
Mbulu	-0.115	-0.094	0.367	-0.259
	(0.155)	(0.172)	(0.630)	(0.855)
Mvomero	0.298*	-0.632***	0.340	-0.070
	(0.161)	(0.215)	(0.246)	(0.730)
Kilosa	0.053	0.320**	-0.051	-0.466*
	(0.146)	(0.155)	(0.214)	(0.261)
NGO market linkage programs	0.133	0.648***	-0.021	0.706***
	(0.116)	(0.107)	(0.189)	(0.245)
Mobile phone	0.245**	0.033	-0.013	0.403*
	(0.105)	(0.138)	(0.193)	(0.219)
Extension services	0.003	0.004	0.003	0.028
	(0.009)	(0.010)	(0.019)	(0.026)
Residual from first stage probit		0.126		-6.726
		(0.218)		(6.413)
Constant	-0.427	-2.746***	-1.854**	0.431
	(0.469)	(0.656)	(0.821)	(1.227)
Number of observations	663		253	

Source: SIMLESA project survey data (2010).
Notes: First stage probit: NGO market linkage program probit; Second stage probit: Market participation probit. Robust standard errors in parentheses.
*, ** and *** denote significance at 10%, 5% and 1% level, respectively.

Appendix 5.2. Test on the validity of the selection instruments for endogenous switching regression

Variable	Maize		Pigeonpea	
	Model 1	**Model 2**	**Model 1**	**Model 2**
	Market participation 1/0	Log consumption expenditure per capita by farm households that did not participate	Market participation 1/0	Log consumption expenditure per capita by farm households that did not participate
Information sources				
Extension service	0.017	0.011	0.167***	0.126
	(0.011)	(0.010)	(0.056)	(0.212)
Mobile phone	0.673***	0.122	0.102**	0.050
	(0.106)	(0.123)	(0.051)	(0.042)
Wald test on information sources	$\chi^2 = 125.59^{***}$	*F*-stat. = 1.29	$\chi^2 = 49.19^{***}$	*F*-stat. = 1.61
Sample size	663	291	253	63

Source: SIMLESA project survey data (2010).
Notes: Model 1: Probit model; Model 2: ordinary least squares.
Robust standard errors in parentheses.
*, ** and *** denote significance at 10%, 5% and 1% level, respectively.