ASSESSMENT OF MARKET PARTICIPATION AND MARKETING CHANNEL CHOICE OF SMALLHOLDER MIXED BEAN PRODUCERS IN ZAMBIA

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A Thesis submitted to the University of Zambia in partial fulfillment of the requirements of the degree of Master of Science in Agricultural Economics

UNIVERSITY OF ZAMBIA

LUSAKA

DECLARATION

I, **Kennedy Chilimboyi** declare that this thesis:

a) Represents my own work;

b) Has not previously been submitted for a degree at this or any other University; and

c) The work enshrined in the thesis is the product of my own work except where duly acknowledged.

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CERTIFICATE OF APPROVAL

This dissertation by Kennedy Chilimboyi is approved as fulfilling the requirements for the award of Master of Science in Agricultural Economics degree by the University of Zambia.

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ABSTRACT

Food legumes are an important source of food and cash in developing countries such as Zambia. However, producers of food legumes, which includes mixed beans, continue to face market access challenges exacerbated by maize centric policies. This study evaluated market participation and further assessed factors that influence channel choice of markets among smallholder mixed beans farmers in Zambia. The study used secondary cross sectional data from the Rural Agricultural Livelihoods Survey (RALS) conducted by the Indaba Agricultural Policy Research Institute (IAPRI) in 2015. The sample used in the current study consists of 1,326 mixed beans producing households. The study used descriptives to characterize the mixed beans households by market participation and by marketing channel type. To evaluate factors influencing decision and extent of market participation, the study utilized the Heckman Two-Stage Model. The Multinomial Logit Model was used to assess the factors that influence the market channel choice of households.

Factors that positively influenced market participation in the mixed beans market include education level of the household head, quantity of beans harvested, access to price information, being domiciled in Agro-ecological region III and net off-farm income. Being in Agro-ecological region I had a negative influence on market participation. The education level of household head, area planted, and quantity harvested had a positive influence on extent of market participation. The age of household head, adult equivalent, TLU and being in Agro-Ecological Region I negatively influenced the extent of participation. These results suggest policies aimed at capacity building to improve farmers' production, including marketing and business skills, improving bean farmers' access to price information is essential.

Farmers sell mixed beans to four major marketing channels: small-scale traders, other households, retailers/marketeers and other buyers. Choice of the retailer/marketeer market outlet was influenced by the education level of household head, quantity harvested, access to price information, and access to extension services. Distance to the market and being in Agro-Ecological Region I had a negative influence on the choice of retailer/marketeer. Choice of the other households market outlet was influenced by net off-farm income, and being located in Agro-Ecological Region I. Growing other crops (Simpson Index of Diversity), area planted and quantity harvested negatively influenced choice of the other households market outlet. Education level, quantity harvested and net off-farm income had a positive influence on choosing the other buyers outlet. Being in Agro-Ecological Region I had a negative influence on the choice of other buyers market outlet. These results suggest policies aimed at improving price information access, extension service delivery system to enhance decision-making, and investment in rural road infrastructure to aid in accessing profitable markets for beans.

***Key Terms**: Market participation, Extent of Participation, Marketing channel, Smallholder farmers*

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LIST OF ABBREVIATIONS

ACIAR	Australian Centre for International Research
AER	Agro-Ecological Region
AEU	Adult Equivalent Unit
AGRA	Alliance for a Green Revolution in Africa
CSO	Central Statistical Office
FAO	Food and Agricultural Organization of the United Nations
GDP	Gross Domestic Product
GRZ	Government of the Republic of Zambia
IAPRI	Indaba Agricultural Policy Research Institute
MNL	Multinomial Logit Model
MoA	Ministry of Agriculture
NAP	National Agricultural Policy
OLS	Ordinary Least Squares
PABRA	Pan-Africa Bean Research Alliance
RALS	Rural Agricultural Livelihoods Survey
SID	Simpson Index of Diversity
SNAP	Second National Agricultural Policy
SSA	Sub-Saharan Africa
TLU	Tropical Livestock Unit
UN	United Nations
VIF	Variance Inflation Factor
WB	World Bank
WFP	World Food Program
ZARI	Zambia Agricultural Research Institute

CHAPTER 1 - INTRODUCTION

1.1 Background

The agricultural sector is the primary livelihood source of most poor rural households in Zambia and contributes an average of 9.8% to the nation's GDP (Seventh National Development Plan, 2017). The sector supports livelihoods of over 66% of the country's population, making it a critical livelihood and employment source (Tembo and Sitko, 2013). The Zambian government's focus on crop diversification in rural areas is seen as a solution to address undernutrition, food insecurity, and poverty among other challenges (GRZ, 2016). However, in Sub Sahara Africa (SSA), agriculture remains subsistence, characterised by poor infrastructure, limited access to modern agricultural technology, under-investment and weak policy environment (ACIAR 2012). This limits farming households' income levels. Hence, the need for structural transformation from subsistence agriculture to a market-oriented sector, moving from primary-dependent sectors to diversified economic base (AGRA 2016).

It is however, critical to realise the need for farmers to operate within a commercialised setting to gain significant benefits from their ventures, if market provide incentives to increase production and enhance household income generation (Delgado 1999). Markets are therefore critical in the agricultural transformation process (Sigei 2014). However, majority of the smallholder farmers are domiciled in remote areas with poor transport and poor market infrastructure, leading to the high transaction costs. Transaction costs have been noted to be the key reasons for smallholder farmers' failure to participate in the markets (Makhura *et al*., 2001).

In Zambia, mixed beans (*Phaseolus vulgaris L.)* is among the important food crops being integrated in the crop diversification programme. The bean crop is essentially grown for consumption; hence area cultivated is usually low. The small areas coupled with low yields lead to difficulties for the smallholder farmers to fully participate in the markets. National yields of all crops in Zambia are considered well below global averages (Tembo and Sitko, 2013). Beans are well known for the nutritional benefits they provide. They are a good source of plant protein, folic acid, dietary fibre, iron, and complex carbohydrates (FAO 1999). Economically, beans are a potential income earner as the surplus is sold as

dry grain or processed (canned) forms. In Zambia, beans are considered one of the most profitable crops, and is considered the second most important economic legume crop (Hamazakaza *et al.,* 2014; Muimui 2010; and Sichilima *et al.,* 2016). Beans are also known for their atmospheric nitrogen fixation capabilities; hence, beneficial in the maize-legume rotations and/or intercropping (Siame *et al.,* 1998; Assefa *et al*., 2017; Cheruiyot *et al.,* 2001; and Salmerón-Miranda 2008).

The Ministry of Agriculture and Central Statistical Office (2018) reports the average yield for mixed beans was estimated at 0.55 MT/Ha in the 2016/17 season and 0.62 MT/Ha in the 2017/18 season, hence an increase in yield rate of 12.71%. However, these yields are still low compared to potential yields that range from 1MT/Ha to 3MT/Ha (Afriseed, 2018). The importance of beans, in terms of income and food, has been growing over the years (Mumui *et al.,* 2016). Although widely grown in several parts of Zambia, Northern Province accounts for a higher proportion of bean growers (56%), followed by Muchinga (13%), Northwestern (9%), Luapala (6%)' and Central (5%). These provinces lie in AER III with high rainfall patterns. The least is Western province accounting for 1% of the total beans production in the country.

Several factors are said to limit bean production in Zambia. According to Muimui (2010) bean producing farmers encounter multiple constraints, including inadequate production resources leading to low production levels. The Second National Agricultural Plan – Implementation Plan (SNAP-IP) for 2016-2020, notes that despite the growth in the sector, agriculture has continued to be hampered by challenges such as low production and productivity, little value addition, over-dependence on rain for crop production, limited capital and market access for smallholder farmers and high post-harvest crop losses. In terms of yield potential, local cultivars of beans are said to have an average of between 0.3 to 0.5 tons per hectare whilst improved ones range between 1 to 3 tons per hectare (MAFF Info Pack 2000, Hamazakaza *et al.,* 2016).

Produce marketing is essential for every farmer that produces a surplus. Ekoja *et al.,* (2018) posit that agricultural produce marketing is a crucial part of a viable farm enterprise in a food production process. Ekoja *et al*., (2018) further describe agricultural produce marketing as the flow of goods and services from the point of initial farm production to

ultimate consumer's hands. However, the produce should not just flow without any benefit regarding profit accruing to the producer (farmer). Hence, Onyeabor (2009) adds that agricultural produce marketing depicts a process of sellers' demands and motivation to distribute food items unto ultimate consumers at a profit. It is therefore crucial that markets exist to ensure the produce moves from the producer to the end-user.

Amid the low-income levels in rural Zambia, smallholder farmers must engage in agricultural commercialization through increased market participation. Sigei (2014) postulates that markets act as a pivotal point in the agricultural transformation process. Beans production is one avenue that smallholder farmers can earn income in Zambia. Market participation by bean producers is expected to increase farmers' income as they sell more of their produce. This is against the backdrop that smallholder farmers with low level of market participation are characterized by poverty, smaller cultivated fields, and low yields (Mathenge *et al*., 2010). In a liberalized market economy like Zambia, farmers face challenges of where to sell their produce, hence it is cardinal to have information on available markets. For instance, Tsourgiannisa *et al.,* (2008) point out that marketing channels used when selling the product has a bearing on the profit farmers may make. Hamazakaza *et al*., (2014) found that farm gate is the most common point of first sale for beans accounting for 65.5 percent of the transactions since most of the households have no market in the villages of their residences. It is believed that buyers usually offer low prices to farmers for the produce in order to make profits after reselling.

Several studies have investigated market participation and channel choice of markets involving several agricultural enterprises to understand what influences the decisions of farmers to participate in a particular market (Awotide *et al.,* 2013; Amao and Egbetokun 2018) or choose a particular market outlet (Tola 2014; Siddique 2018; Mukarumbwa, *et al*, 2018). Such studies have drawn essential recommendations to influence policy and improve the welfare of the producers of the various agricultural commodities.

1.2 Statement of the Problem

Monoculture associated with maize growing in Zambia has long been recognized and understood to be a threat to income, food and nutrition security of smallholder farmers.

Currently, maize dominates Zambian agriculture, covering two-thirds of the cropped area and grown by approximately 98.7% of farming households. The nation's diet mirrors maize dominance and the low diversity of crops, with 63% of total dietary energy derived from cereals (Mwanamwenge and Harris, 2017). Consequently, the Zambian food system is not delivering enough affordable or nutritious foods for most of the population. The 2018 State of Food Insecurity and Nutrition in the World report lists Zambia among the countries with the highest undernourishment rates (FAO *et al*., 2018). Similarly, Zambia's hunger index remains among the highest globally with 38% of the population estimated to experience hunger (WHH & CWW, 2018).

Amid hunger, poverty, and health concerns, the Government of the Republic of Zambia through its agricultural policy reform updates, has emphasized crop diversification to integrate food legumes in the smallholder farming systems. Mixed beans (*Phaseolus vulgaris L.*) are among other food legume crops that have so far shown promise to contribute to income food and nutrition security of rural households, most of whom live in poverty. Mango, *et al*., (2018) highlight market participation and marketing channels to significantly affect production and productivity because of their potential to cause inefficiencies in market linkages. This may lead to farmers producing less and selling to limited market outlets, offering low prices. Hamazakaza *et al*., (2014) found that farm gate is the most common point of first sale accounting for 65.5 percent of the transactions since most of the households have no market in the villages of their residences. Furthermore, Muimui (2010) pointed out inadequate linkages among supply chain actors especially between smallholder farmers and canning industries.

Several studies have been carried out on market participation and channel choice decisions globally to date. These studies have been important in highlighting socio economic and institutional factors influencing market participation (Chalwe 2011; Moono 2015) and channel choice decisions (Mmbando 2014; Tumukunde 2018).

However, despite a wealth of knowledge on market participation, information on factors influencing extent of participation, particularly in the bean sector is limited in Zambia. Chalwe (2011)'s study only focused on factors influencing market participation in the bean market. In addition, information on factors influencing market channel choice of

several bean market outlets is limited in Zambia despite the liberalised market system. The study by Chalwe (2011)' only explored factors influencing marketing channels on two outlets. This study therefore, extends the earlier study by including factors that influence extent of participation, and highlights factors that influence channel choice of multiple outlets in Zambi

1.3 Research Objectives

1.3.1 Overall Objective

This study's objective was to assess market participation and factors that influence extent of market participation and to further assess factors that influence the market channel choice among smallholder mixed beans farmers in Zambia.

1.3.2 Specific Objectives

The specific objectives of the study were to:

i. To characterize smallholder mixed bean producers by market participation and marketing channel.
ii. To evaluate the factors that influence the decision and extent of participation by smallholder farmers in the market of mixed beans.
iii. To assess the factors that influence the choice of marketing channel by smallholder mixed bean producers

1.4 Research Questions

i. What are the characteristics of smallholder mixed bean producers by market participation and type of marketing channel?
ii. What factors influence smallholder farmers' participation and level of participation in mixed bean markets in Zambia?
iii. What factors influence the choice of market outlet for mixed beans in Zambia?

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1.5 Justification

Literature contends that market participation by smallholder farmers in developing countries is meagre, a development which has slowed down agriculture driven economic growth and exacerbated poverty levels. For example, in a survey of the literature of smallholder participation in food grain markets covering six countries in east and southern Africa, Barrett (2008) finds that the per cent of net-sellers ranged between 25 per cent (Ethiopia, 1996) to 39 per cent (Kenya, 1998). Mather *et al*., (2013) also find that the percentage of net-sellers of food grains in Mozambique (2005) and Zambia (2008) were as low as 15 and 27 per cent, respectively. However, increased participation of smallholder farmers in agricultural output markets holds the potential to lift farmers out of high-risk and low-productivity subsistence farming to more commercial and profitable agriculture (Heltberg and Tarp 2002; Barrett 2008; Von Braun *et al.*, 1994; Timmer 1988). This information clearly shows that a relatively low portion of smallholder farmers participate in food markets as net sellers in many sub Saharan African (SSA) countries.

Another less explored aspect of smallholder market participation in the developing country context is the choice of marketing channel that households make when faced with several buyer types, such as, private traders of various scales, government agencies, and other households in the village. According to Tsourgiannis *et al*., (2008), the marketing channel used when selling the product has a bearing on the profit farmers may make.

Given an understanding that most studies in the literature on the choice of a marketing channel for agricultural output are limited in their analysis to the choice between selling at a distant market versus at the farm gate as well as abstracting away from the potential constraint of imperfect input markets, this study sought to understand farmer circumstances by conducting a wholesome analysis of the technical, environmental and socio-economic factors. The results can be used by policymakers, extension service providers and smallholder farmers to inform decision making.

1.6 Organisation of the Report

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The remaining parts of the report are structured as follows. Chapter 2 presents the literature review beginning with the definition of terms and reviews previous research studies on market participation and channel choice of market outlets. Chapter 3, describes the research methodology, theoretical and analytical frameworks, whilst chapter 4 discusses the results of the study, both descriptive and econometric. Chapter 5 presents the conclusion and recommendations based on the findings of this study.

CHAPTER 2 - LITERATURE REVIEW

2.0 Introduction

This chapter begins with a theoretical literature review on factors influencing market participation and channel choice of market outlet. The chapter reviews selected empirical studies carried out on market participation. The chapter further looks at empirical studies on factors influencing channel choice of various agricultural enterprises' market outlets.

2.1 Definition of Key Terms

Market Participation

According to Otekunrin *et al.* (2019), market participation is one of the key concepts in agribusiness management and has been defined differently by various authors. Generally, market participation can be referred to as participation in market related activity, which results in the sale of produce involving cash or in kind (Otekunrin *et al.* (2019). In an agricultural market economy, market participation can also be referred to as market earnings from market activities (Makhura *et al.*, 2001). In this study, market participation is considered from the perspective of farmers selling their produce in the beans market to earn an income.

Extent of Market Participation

The intensity of market participation is considered from volumes of output sold. Jagwe (2011) defines intensity of market participation as the quantity of output sold by a farmer from the total harvested. In this study, the extent of market participation is considered from the view of quantity of mixed beans sold by farmers in the beans market.

Marketing Channel Choice

Marketing channels are an essential institution of any producer's activities. Han (2011), therefore, defines a marketing channel as the specific organizations that are interdependent and interrelated with products and their relevant services that can be transferred from producers to consumers or sellers. Similarly, Giles (1973), defines marketing channels as the system of marketing institutions through which goods or services are transferred from the original producers to the ultimate users or consumers. According to Mmbando (2014),

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. The choice of a particular marketing channel is critical and dependent on several factors.

Smallholder Farmer

The definition of a smallholder farmer differs depending on the context, country, agro-ecological zone and intensity of farming (Vermuelen and Cotula 2010; Nyambo *et al.*, 2019). According to Mmbando (2014), this explains the interchangeable term 'smallholder' with 'small-scale', resource poor' and 'peasant farmer'. Current definitions, however, are centred on common characteristics of smallholder farmers such as access to land, land size, labour, resource endowment, technology and market orientation (Kamara *et al.* 2019). The World Bank (2003) defines smallholders as farmers with a low asset base, operating less than 2 hectares of land of cropland and depending on household members for most of the labour. In Zambia, smallholder farmers are the vast majority among the three farmer categories (small, medium and large-scale). They are characterised by cultivating less than 5 ha, producing mostly for consumption, using few inputs, and selling a small portion of their surplus (Mukutu et al., 2004; IAPRI 2015; Siegel & Alwang 2005;).

2.2 Economic Approaches to Modelling Market Participation

Econometric analysis is used to estimate causal relationships between the dependent and explanatory variables (Moono 2015). In this context, econometric analysis helps to understand the effects of the different factors on market participation and the extent of participation in the beans value chain. Several models have been used to study market participation of agricultural enterprises. These models include the Heckman two-stage, Double-hurdle, Triple-hurdle and Tobit models (Komarek 2010; Moono 2015). The Tobit model (Tobin 1958) was popular, but due to its limitations, the Heckman became more preferred (Sigei 2013). The Tobit model's major limitation is that it assumes that the decision to sell and determine sales volume are influenced by the same set of parameters and variables (Reyes *et al*., 2012). Hence, the Tobit is more appropriate when the decisions to sell and volume to be sold are simultaneously made.

In contrast, Barrett (2007) notes that households face a two-step decision making process regarding market participation. Firstly, households decide whether or not to participate in the market. After that, the household decides on the quantity to sell. The suitable models in cases where decisions are not simultaneously made include the Double-huddle and the Heckman two-step (Mather *et al*., 2011). In this study, the Heckman two-step procedure is used to cater for sample selection bias arising from the data used. The Heckman two-stage model developed by Heckman (1979) has been used to correct for biases arising from sample selection using simple regression. Heckman (1979) demonstrated that the bias that results from using selected samples could be due to omitted variables. As a solution, he proposed that, for the full sample (e.g. market participants and non-market participants), a probit analysis could be used to estimate the individual's probability to be in the selected sample (e.g. will participate in the market). Furthermore, Barret (2007) demonstrated that by using this probability as a regressor in the equation of interest (e.g. farmer's yield), unbiased estimators could be obtained to estimate the extent of participation.

2.3 Economic Approaches to Modelling Market Channel Choice

The Multinomial Logit Model (MNL) was first introduced by McFadden (1974) to explain the choice of transportation modes of urban commuters with the random utility model. In this study, the MNL is used to explain the effects of the independent variables on the preference of a specific market channel for mixed beans. The MNL continues to be a preferred model since it allows the analysis of decisions across more than two categories in the dependent variable (Woodridge, 2008). The MNL model, therefore, makes it possible to determine the choice probabilities of multiple channels. Dougherty (1992) points out that the procedure for formulating a multinomial logistic regression is the same as for binary logistic regression. However, the MNL model differs from the binary Probit and Logit models, which are limited to the maximum of two choice categories (Maddala, 1983). A binary choice model is used where the outcome being investigated is binary in its estimation (Greene, 1997). Hence, the MNL Model choice in this study was based on choice probabilities of multiple channels.

The MNL also suffices when dealing with mutually exclusive dependent variable. In this study, the market channels are considered mutually exclusive. The assumption is that each farmer faces a set of discrete, mutually exclusive choices of market channels. This means that a farmer only chooses one channel at a time to sell their beans and not both/all channels. If the dependent variable is categorical and mutually exclusive, then the dependent variable is assumed to have a multinomial distribution (Green, 1997).

2.4 Factors affecting smallholder farmer market participation and extent of participation

Several factors are known to affect smallholder farmer participation in the markets. These factors range from socio-economic, institutional, market and external factors (Goetz 1992; Sigei 2014; Apind 2015). These factors can negatively or positively influence market participation and the extent of participation of smallholder farmers. Social-economic factors include age, gender, education level, and farming experience of the household head, household size, farm size, level of output, and ownership of productive assets (Sigei 2014; Apind 2015). Institutional factors include: access to extension service, access to credit, membership to groups, and infrastructure. Market factors that may influence market participation include: access to market information, price and access to price information, distance to markets, and transport means. Political stability and natural phenomena such as drought or floods affecting a nation are some of the external factors that may influence market participation (Goetz 1992; Sigei 2014; Apind 2015).

2.4.1 Studies on factors influencing participation in markets

Several studies have been carried out to determine factors influencing market participation and the extent of participation in Sub Sahara Africa and other parts of the world.

Masuku *et al*., (2001) assessed the factors influencing the decision to sell maize and the choice of marketing chain by smallholder farmers in Swaziland. The study employed a logistic regression on the smallholders' decision either to sell or not to sell maize. Factors such as off-farm income activities, experience, access to agricultural information, participation in agricultural schemes, family members without education, and farm size were found to influence the decision to participate in the maize market. Transportation

costs and farm size were found to influence the choice of the maize marketing channel. The study is similar to Chalwe 2011 in that it only focused on assessing factors influencing the decision to participate in the market.

A study by Mathenge *et al*., (2010) examined the factors influencing market participation of crop producers and their impacts on income and poverty among the poor and marginalized groups in Kenya. The study employed the Heckaman two-stage model, and modelled participation in input and output markets. The study focused only on poor and marginalized farmers. Takele (2010), also used the Heckman two-step model to examined the profitability and marketing chain of rice in Fogera Woreda, South Gondar zone of Amhara Regional State in Ethiopia. The Heckman's two-step selection was used to examine determinants of household's rice supply to markets. Takele (2010) further employed the Tobit to answer questions on factors that affect market participation and extent of participation at the same time. Using the Tobit model, the study assumed that all producers are likely suppliers of rice, and that same variables equally influence market participation and extent of market participation. However, Reyes *et al*., (2012), used a Double hurdle model to estimate the factors influencing marketing decisions among smallholder potato growers in the central highlands of Angola using cross-sectional data from three provinces of Angola. The Double hurdle model was used because it is a more flexible alternative than the Tobit model since it allows for the probability that factors influencing the decision to sell a crop be different from factors affecting the decision of how much to sell.

Other studies (Awotide *et al.,* 2013; Tesfaw 2013), used the Heckman two-step model to identify the determinants of market participation in the rice and pepper markets. Kuma *et al.,* (2014) focused on assessing factors affecting milk market participation and volume of supply in volume in Wolaita Zone, Ethiopia. Since, Kuma *et al.,* (2014) focused on a perishable agricultural commodity (milk). Factors influencing participation would therefore be expected to be different with the other studies on non-perishable commodities (rice and pepper).

Studies by Mathenge *et al.,* (2001), Takele (2010), Tesfew (2013), Awotide (2013), and Kuma (2014) were very beneficial to the current study in providing insights into the

various socio-economic, farm level, and market and institutional level variables to use in the model. Even though, they analyzed different agricultural produce, the studies employed the Heckman two-step model, which the current study used to determine factors influencing market participation and extent of market participation for mixed beans farmers. Chalwe (2011)'s study on factors influencing market participation in the beans market in Zambia, used the probit model. However, the current study used the Heckman two-step model, which extends Chalwe (2011) study by including an assessment of factors influencing extent of participation in Zambia.

2.5 Factors affecting channel choice of market outlet

The farmers' decision on where to sell or not to sell their farm produce is referred to as 'channel choice of market outlet'. According to Qadri (2018), channels of distribution are the ways and means employed by manufacturers and sellers to get their products to the market and into the users' hands. In this study, the market channel refers to an outlet where mixed beans produced by farmers ends up. The mixed beans producer chooses among the available market channels for beans. According to Sigei (2014), market outlet choice is determined by the price the farmers receive from the sale of produce. Hence, there is a higher likelihood of the farmer to choose the channel, which is more lucrative. However, various factors are expected to influence the farmers' channel choice decision. The factors that influence channel choice of market outlet include, age and farming experience of household head, farm size, access to extension services, membership to a group(s), the area planted, price and price information, geographical location, and distance to market (Sigei 2014).

2.5.1 Studies on factors influencing channel choice of market outlets

The MNL model has been used in various studies to determine the factors influencing the channel choice of marketing outlets using the MNL model. The advantage of using the MNL model is that it can be applied on multiple-choice categories, unlike the probit or logit models, which are limited to a maximum of two choice categories (Maddala 1983; Wooldridge 2002). The current study is based on multiple choice categories.

Ferto and Szabo (2002) employed a multinomial logit model to identify determinants influencing producers' decision for channel choices of fruit and vegetable producers in Csongrad, Hungary. The study identified three supply channels for namely wholesalers, marketing cooperative and producers' organization. However, a study by Ogunleye and Oladegi (2007) analyzed determinants of the choice of marketing channel choice among cocoa farmers in Nigeria using descriptive analysis. The study by Ferto and Szabo (2002) differs from Ogunleye and Oladegi (2007)'s study differs from Ferto and Szabo (2002)study in that quantitative analysis was used to determine factors influencing the choice of marketing channels in the latter, whilst only descriptives were used in the former.

Chalwe (2011) carried out a study on factors influencing bean producers' choice of marketing channels in Zambia and used the multinomial probit model, focusing on two market outlets. However, most studies (Mmbando *et al.*, 2016; Maina, *et al.*, 2015; Singh 2018) used the MNL to study factors influencing choice in multiple marketing channel outlets. Similarly, Musara *et al.,* (2018) examined the determinants marketing channel choice decisions by small scale sorghum farmers in Zimbabwe's Mid Zambezi valley by segmenting three common marketing channels for sorghum (local, market and combination).

Studies by Ferto and Szabo (2002), Maina *et al.,* (2015), Mmbando *et al.,* (2016), Singh (2018), Musara *et al.,* (2018), and Mukarumbwa *et al.,* (2018) were very beneficial to the current study in providing insights into the various socio-economic, farm level, and market and institutional variables to use. Even though they analyzed different channels, the studies all used the MNL model. The MNL model is considered the best approach for choices based on the decision-maker attributes than the choice itself. Despite Chalwe (2011)'s study, factors influencing choice of beans marketing channels have not been extensively investigated in Zambia. Chalwe (2011) study only focused on two market outlets. In reality more than two channels for marketing products exist. Furthermore, several studies carried out on channel choice decisions have commonly adopted the MNL as a more appropriate method for analyzing factors affecting choice of marketing channels, which the current study endevoured to use.

2.6 Conceptual framework

Figure 2 shows the interrelationships in the study, including interrelations of key variables. The characteristics of interest include socio-economic, farm level, and market and institutional factors. Socio-economic characteristics include factors such as household head's age, sex, and education, family size, and off-farm income. Farm level factors include landholding size, area planted, quantity harvested, quantity sold, the price per kg, and production assets owned. Institutional and market factors include price information, cooperative membership, extension services, and distance to market. Location factors include geographical locations, which capture the pros and cons of different locations with regard to market participation, extent of participation and channel choice of market outlet. The factors mentioned above influence market participation in the mixed beans market, including the extent of participation. The participation in the market and extent of participation, in turn influence the choice of market channel for beans. Consequently, participation in the market, coupled with extent of participation and selection of lucrative market channels, contribute to agricultural commercialization and increased income.

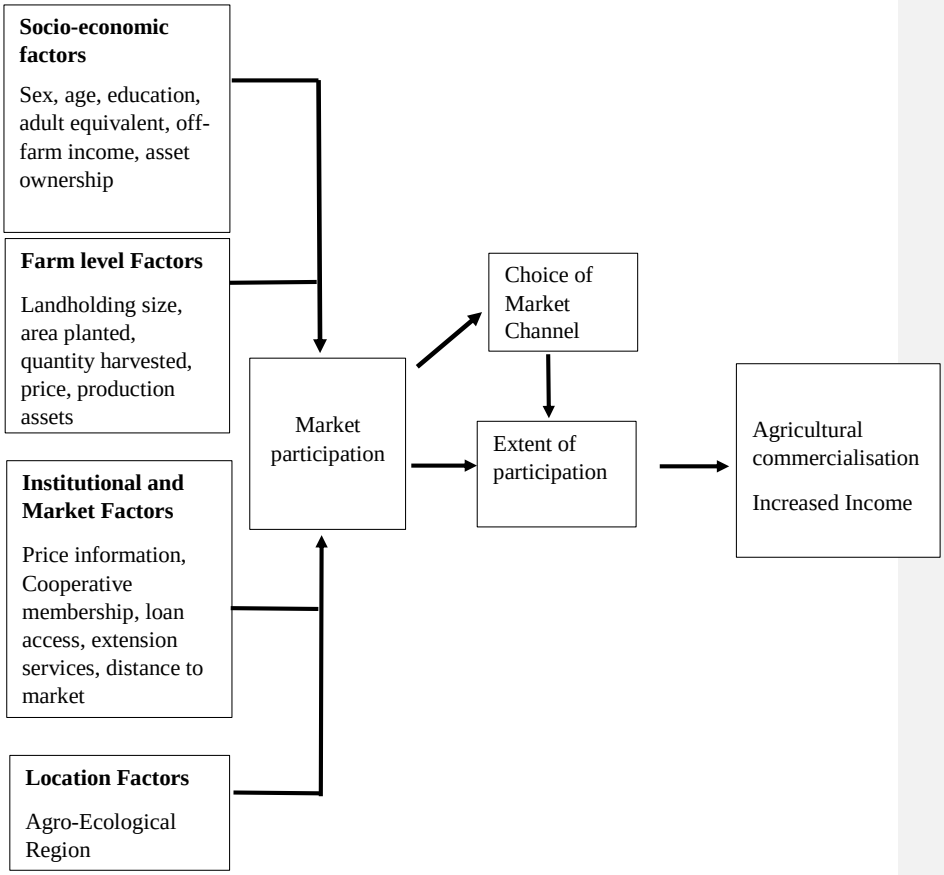

Figure 1: Diagrammatic representation of the Conceptual framework

Source: Own conceptualization based on literature

2.6.1 Justification for inclusion of various variables in the Heckman Two-Stage Equation

Socio-economic Factors

Age of household head: The smallholder farmer's age is a continuous variable measured in years and was used as a proxy for experience in production and marketing. Age is expected to either have a negative or positive influence on the decision to participate in the mixed beans market or not. Regarding the negative influence, it is expected that younger farmers are more energetic and enthusiastic and therefore can participate in marketing of beans than older farmers (). However, the older farmers are expected to use the experience to increase production and to locate better markets for their produce. A study by Chalwe (2011) found age to have a negative and significant influence in the decision to participate in the beans market.

Adult Equivalent Index: is a continuous variable that is a proxy for available household labour force in adult equivalents. A higher adult equivalent is expected to positively associate with participation in the mixed bean market. Mmbando *et al.,* (2016) contends that 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.

Maximum level of Education: is a continuous variable that indicates the number of years in formal school for the household head. Education is associated with efficiency and a better understanding of production and marketing strategies. Hence an educated beans farmer is likely to produce surplus and participate in marketing. Studies by Sigei (2014) and Astewel (2010) found that education level positively influenced market participation in pineapple and paddy rice, respectively.

Net off-farm income: is a continuous variable measured in terms of income the producer earned from off farm activities and is expressed in Zambian Kwacha. Off farm income is assumed to be a competitor with on-farm income. This is because the more the farmer earns from off-farm income, the lesser the likelihood of producing food crops such as mixed beans. Hence, off-farm income is expected to have a negative relationship with

market participation. Mbitsemunda and Karangwa (2017) found a negative relationship between off-farm income and the decision to participate in Rwanda's bean market.

Livestock ownership: Is an index that represents ownership of livestock by the household. It is envisaged that a farmer who owns more livestock is wealthy and can invest adequately in the crop of interest. Therefore, livestock ownership is hypothesised to positively influence market participation in the mixed beans market. Tekele (2010) found that the total value of livestock owned increased the probability of participating in the rice market.

Farm Level Factors

Total landholding size: This variable could influence both decisions in market participation and the extent of participation decisions. It is a continuous variable denoting the total area owned by the farmer expressed in hectares. It is envisaged that a larger area owned by the household implies more area allocated to the crop of interest. Hence, increasing the area allocated to beans will directly lead to surplus and subsequent market participation. According to FAO (2015), the larger the farm, the larger the production proportion sold in the markets. This is because larger volumes are assumed to lower transaction costs. Abayneh and Tefera (2013) found farm size to have a positive and significant effect on the decision to participate in the haricot bean market. Equally, Amao and Egbetokun (2018) found that farm size positively influenced the quantity of leafy vegetables supplied to the market.

Area planted: It is a continuous variable that refers to total area allocated to mixed beans by the farmer. The probability to participate in the beans market is expected to increase when area planted is increased. Similar to landholding size, it is envisaged that a farmer who increases area planted could subsequently have surplus production. The variable is therefore expected to have a positive influence on the extent of market participation of the farmer.

Total quantity harvested: is a continuous variable measured in kilogrammes. Quantity harvested is believed to positively influence the decision to participate in the mixed beans

market. An increase in mixed beans harvested is expected to increase the probability and subsequent proportion that the farmer sells. Mbitsemunda and Karangwa (2017) found that the quantity produced positively influenced the household's decision to participate in the bean market.

Simpson Index of Diversity: This index is used to measure the degree of crop diversity. A score closer to 1 indicates increased diversity in terms of number of crops grown. Farmers who grow more crops are expected to participate in the mixed beans market. Growing more crops is also expected to influence the extent of participation. This is because growing diverse crops may increase the farmer's income sources. Rhaman *et al.*, (2009) noted that crop diversification is an important factor of income diversity. More so, growing various crops may enable the farmer to only sell the most profitable crop leaving the others for consumption. Therefore, SID-crops is expected to have a positive influence on market participation. However, a study by Tesfaw (2013) found that production of other crops together with pepper has a negative influence on extent of participation. This is attributed to a lack of specialization in one crop

Institutional Factors

Access to price information: is a dummy variable taking a value of one if the farmer has access to market price information and value of zero if otherwise. It is assumed that access to price information helps the farmer make informed decisions on how much and where to sell to. Therefore, price information is hypothesised to have a positive influence on market participation. Sigei (2014) found that price information positively influenced the extent of market participation in the pineapple market.

Distance to market: is a continuous variable that is measured in kilometres. The variable represents the distance from the producer's residence to the point of sale (market). The shorter the distance, the lesser the marketing costs that are likely to be incurred by the producer. It is therefore, expected that distance will have a negative influence on marketing participation. However, distance to the selling point may have a positive influence depending on the farmers's preference. Zamasiya *et al.*, (2014) noted that smallholder farmers tend to opt for distant markets if local markets are not offering

lucrative returns. A study done by Abayneh and Tefera (2013) found a negative relationship between distance to the market and participation in the haricot bean market.

Access to loans: is a dummy variable that representing the farmer's access to credit facility for farming purposes from formal and informal sources. If the farmer has access to loans, the value taken is one, and zero if otherwise. It is expected that credit will have a positive influence on market participation. This is because credit is known to boost agricultural production as it enables farmers to purchase the needed inputs, implements and labour. Abayneh and Tefera (2013) and Mbitsemunda and Karangwa (2017) found credit to have a positive and significant relationship with market participation in the bean market. Furthermore, Muhammed (2011) found a positive relationship between credit and the extent of participation in the pepper and teff market.

Cooperative membership: Is a dummy variable taking a value of one if the household member belongs to a cooperative and value zero if otherwise. Farmer groups or cooperatives have been found to increase access to inputs and relevant production and market information. Hence, membership tin a cooperative is hypothesisedhypothesised to positively influence market participation of the beans producer. Mathenge *et al.*, (2010) found that belonging to a farmer organization had positively influenced market participation in Kenya's agricultural markets.

Access to extension services: It is a dummy variable taking a value of one if the farmer has access to extension services and zero if otherwise. The variable assesses whether or not the farmer has access to crop diversification and other related information. Access to such information encourages farmers to venture into diverse crops for consumption and selling purposes. Hence, access to extension services can boost production and in turn, positively influence market participation. Siziba *et al.*, (2011) observed that extension training and participation in research positively influenced cereal producers' market participation In addition, a study by Tekele (2010) found that access to extension service increases the household's probability to participate in the rice market.

Location Factors

The Agro-Ecological Regions (AER) refer to the households' geographical locations and are to capture advantages and disadvantages of the different locations with regard to market participation. The Agro-Ecological regions are mutually exclusive; hence, the farmer is only expected to be found in one region and not in two or more at the same time. The relationships revealed by the results are to be explained by the specific attributes of each of the locations. The differences in rainfall pattern in these areas determine the mixed beans production levels and channel choice of market outlets. Three dummy variables, one for Agro-Ecological Region I (**AER I**), one for Agro-Ecological Region II (**AER II**) and one for Agro-Ecological Region III (**AER III**) were defined. **Agro-Ecological Region I (AER I)** was coded as a dummy variable taking a value of one if the household is found in Agro-Ecological Region I and the value zero if otherwise. AER I is characterized by low rainfall (below 1000mm) and covers Zambia's Southern and Western parts of Zambia. Because of the low rainfall found in this region, the production of mixed beans is equally low. Therefore, households found in this region are likely to produce smaller quantities of beans, hence are not likely to participate in the market. **Agro-EcologicalRegion III (AER III),** was coded as a dummy variable taking a value of one if the household is found in Agro-EcologicalRegion III and the value zero if otherwise. AER III is characterised by high rainfall per annum (1200mm and above) and lies in the country's Northern and North-Western parts, favouring beans production (Hamazakaza *et al*., 2016). Unlike farmers in AER I, farmers in this region are likely to produce higher quantities of mixed beans. The larger quantities produced are subsequently expected to positively influence market participation and the extent of participation in the mixed beans market.

2.6.2 Justification for inclusion of various variables in the MNL model

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The independent variables with the potential to influence market channel choice decisions adopted from literature were explored.

Socio-economic Factors

Age of household head: The smallholder farmer' age is a continuous variable measured in years, showing how old the household head was. The variable was used as a proxy indicator for experience in production and marketing beans. The aged household heads are believed to be experienced in looking for markets that offer higher prices. This belief is in line with Tumukunde (2018), who posits that the older the household head, the more information he/she has about profitable marketing channels as they have a network with many actors of the value chain. However, Mukarumbwa *et* al., (2018) argue that younger farmers are expected to be risk-takers, innovative and to be involved in activities such as value addition so as to access alternative markets. Therefore, age is expected to positively or negatively influence the channel choice of mixed beans outlet.

Gender of household head: Is a dummy variable taking the value of one if the farmer is male and the value of zero if otherwise. Male headed households are considered to have more access to resources and market information than their female counterparts. These attributes can enhance the male headed households' capacity to choose lucrative markets for their produce. Besides, Kihoro (2016), posits that men have a higher decision making capability within the household shaped by the norms and roles set out for men in the African culture. Hence the gender of the household is likely to influence the channel choice outlet for mixed beans.

Decision maker: is a dummy variable taking the value of 1 if the decision maker is female and the value of zero if otherwise. The decision-maker variable captures essential information on decision making between men and women in bean marketing in Zambia. Women in Africa provide most of the labour and manage many farming activities daily (FAO, 1994; ILO, 2009). It is also known that women and men grow legume crops, but men tend to take over the decision-making if a crop becomes profitable. This, therefore, tends to limit women from reaching their full potential.

Adult Equivalent Index: is a continuous variable that is a proxy for household labour force. A high labour endowment is expected to contribute to the production and marketing of relatively larger quantities, which can then be transported to the retail market (Mabuza

et al., 2014). This entails that the household is likely to sell to the retailer at a market, offering a higher price than the buyer at farm-gate level.

Maximum level of Education: is a continuous variable that indicates the number of years in formal school for the household head, who is the decision-maker. Education level of the decision-maker is associated with efficiency and better understanding of marketing strategies. Some market channels are complicated, hence require skills and understanding obtained through education of the decision-maker. Anteneh *et al*., (2011) found that household head's the level of education significantly influenced the coffee market outlet's choice.

Net off-farm income. This is a continuous variable denoting the household's net income earned by the household from off-farm activities expressed in Zambian Kwacha. It is expected that off-farm activities add income to the household, thereby enhancing the households's ability to sell to alternative markets away from the farm. Shiferaw *et al.,* (2006) posit that wealthier farmers were likely to be affected by the delay of payment, and therefore, they would choose the channel that provided high prices.

Tropical Livestock Units: is an index used as a proxy for livestock numbers owned by the household. The higher the index, the higher the number of livestock owned. Farmers with more livestock are considered to be wealthy, which means they can allocate adequate resources into beans production to increase yields. In Ethiopia, Hailu and Fana (2017) reveal that TLU had a significant influence on the choice of market outlet for major vegetable crops among smallholder farmers of Ambo and Toke-Kutaye districts. Households with more livestock tend to allocate more of their land to grazing land or fodder production. This entails a reduction in land used for vegetable production and subsequent low production and limited surplus for sale. With this background, the households opt to sell to the direct market outlet relative to the wholesalers who demand for larger quantities.

Farm level Factors

Landholding size: is a continuous variable denoting the total area owned by the farmer expressed in hectares. It is envisaged that larger area owned by the household implies more area allocated to the crop/s of interest. It is, therefore, hypothesised that increasing the area allocated to beans will directly lead to surplus production and subsequent market participation. Singh (2018) argues that households with larger landholdings have less probability of participation in an informal market channel and more in a formal one. This entails that landholding size is an influencing factor in channel choice decision.

Area planted: The area planted is also a continuous variable that measures area planted to beans and is expressed in hectares. Similar to total landholding size, the more the area planted the greater the expected harvest. Therefore, it is envisaged that a larger area planted positively influences the choice of market channel for mixed beans. This is because the quantities that are harvested determine where to sell. Some buyers prefer to purchase in bulk, whilst others prefer smaller quantities.

Quantity harvested: is a continuous variable measured in kilogrammes and shows quantity of beans harvested. A marginal increase in mixed beans harvested has a definite and significant influence on marketable surplus and choice of a particular market channel. Chalwe (2011) found beans yield to influence the choice of selling to private traders than to other households at farm-gate. In another study, Mukarumbwe *et al.,* (2018) noted that the more the quantity of vegetables produced, the more likely the chances that the farmer would participate in distant urban markets.

Simpson Index of Diversity: This index is used to measure the degree of crop diversity. A score closer to 1 indicates increased diversity in terms of the number of crops grown. Growing diverse crops allows the farmer to reserve the crop or crops that give them higher income for sale. The other crops can then be used for consumption. This entails that the crops reserved for sale can then be sold to bulk buyers compared to households who purchase small quantities. Hence, SID-Crops is expected to influence the selection of a market outlet for mixed beans.

Institutional Factors

Access to price information: Is a dummy variable taking a value of one if the farmer has access to market price information and a zero valueif otherwise. It is assumed that access to price information is cardinal as it helps the farmer make informed decisions on which market channel offers the best price for their produce. Sigei (2014) found that price information positively influenced the choice of a market outlet in the pineapple marketing.

Distance to market: It is a continuous variable that is measured in kilometres. The variable represents the distance from the producer's production area to the nearest point of sale and can be used as a proxy for transaction costs. Mukurumbwa *et al.,* (2018) point out that the farmer's profit returns are bound to be reduced due to increased transportation costs and the encountered opportunity cost of time. Riziki *et al.,* (2015) found that distance to the market is a significant determinant for channel choice outlets for the African indigenous vegetables in Kenya

Access to extension services: It is a dummy variable taking a value of one if the farmer has access to extension services and zero if otherwise. The variable assesses whether or not the farmer has access to crop diversification and other related information. Access to such information encourages farmers to venture into diverse crops for consumption and income purposes. Through the extension service, it is expected that prior information on available markets for the crop of interest can be provided. Hence the variable can influence the choice of market channel for mixed beans. Kihoro (2016) found that farmers who had access to extension services easily accessed market information; therefore, they could sell to beneficial channels.

Access to loans: Is a dummy variable representing the farmer's access to credit facility for farming purposes from formal and informal sources. The variable takes the value of one if the farmer has access and zero if otherwise. Credit is known to boost agricultural production as it enables farmers to purchase the needed inputs, implements and labour. Access to credit is therefore hypothesised to influence channel choice of market outlet decisions. In a study by Urquieta (2009), access to loans was found to significantly influence the channel choice of market outlet for potatoes in Bolivia.

Cooperative membership: is a dummy variable with a value of one if the farmer is a member of a cooperative and zero if otherwise. Belonging to a cooperative is believed to help members source inputs and markets for the crop of interest. A cooperative is also a source of relevant production and market information that can help in the farmer's decision-making process. Furthermore, the cooperative is an avenue for bulking and selling to lucrative market channels, which is advantageous to members. Tumukunde (2018) posits that groups facilitate farmers to bulk their production and sell collectively to gain from economies of scale.

Location Factors

The Agro-Ecological Regions (AER) refer to the households's geographical locations of the households and are intended to capture advantages and disadvantages of the different locations with regard to channel choice of market outlet. The relationships revealed by the results are to be explained by the specific attributes of each of the locations. The differences in rainfall pattern in these areas determine the mixed beans production levels and channel choice of market outlets. Three dummy variables, one for Agro-Ecological Region I (**AER I**), one for Agro-EcologicalRegion II (**AER II**) and one for Agro-Ecological Region III (**AER III**), were defined. **Agro-Ecological Region I (AER I)** was coded as a dummy variable taking a value of one if the household is found in Agro-Ecological Region I and the value zero if otherwise. AER I is characterized by low rainfall (below 1000mm) and covers Zambia'sSouthern and Western parts. Because of the low rainfall found in this region, production of mixed beans is equally low. Therefore, households found in this region are likely to produce smaller quantities of beans, hence influencing channel outlet choice. **Agro-EcologicalRegion III (AER III)** was coded as a dummy variable, taking a value of one if the household is found in Agro-EcologicalRegion III and the value zero if otherwise. AER III is characterized by high rainfall per annum (1200mm and above) and lies in the country's Northern and North-Western parts, favouring beans production (Hamazakaza *et al.*, 2016). Unlike farmers in AER I, farmers in this region are likely to produce higher quantities of mixed beans.

CHAPTER 3 - METHODOLOGY

3.0 Introduction

This chapter presents the methods and procedures used to achieve the objectives of the study. The section presents the source and type of data used. Also, the section presents econometric models used to analyse the factors influencing participation, the extent of participation and factors influencing the choice of marketing outlet of mixed beans in Zambia.

3.1 Data Type, Source and Data Collection Methods

This study used secondary data from the Rural Livelihoods Survey (RALS) of 2015. The RALS 2015 survey was part of a longitudinal study that had two waves at the time of this research i.e. RALS 2012 and RALS 2015. The study only used the RALS 2015 survey data hence being cross-section in design. The RALS 2015 continues from the RALS 2012 survey, which was based on the 2010 Census of Housing and Population sampling frame. Households were selected using a stratified two-stage sample design. The sampling covered all the ten provinces, and a total of 8,840 households were selected for the RALS 2012. With the RALS 2015, a total of 7,934 households were included in the sample. The two surveys were conducted by the Indaba Agricultural Policy Research Institute (IAPRI) in collaboration with ZAMSTATS, formerly the Central Statistics Office (CSO) and the Ministry of Agriculture (MA). The RALS data set was used because it contains a country-wide and broader set of detailed information on smallholder farmers' livelihood activities and outcomes. The sampling procedure involved selecting households growing mixed beans. Using this criterion, a sample of 1,326 smallholder farmers was included in the analysis.

3.2 Sample selection

The main objective of the study was to determine factors influencing participation in the mixed beans market among the bean growers in Zambia. Furthermore, the study aimed to determine factors that influence channel choice of market for the mixed beans growers. For this reason, only beans growing households from the RALS 2015 survey were selected giving a total sample of 1,326 households out of a total of 7,934 households.

3.3 Data Analysis

The study used STATA 15, SPSS 22 and MS Excel software packages for analyzing the data. The STATA 15 package was used for econometric analysis whilst the SPSS 22 package was used for data processing and descriptives. The MS Excel package was used for the generation of tables and graphs. The Heckman and MNL models were used in the econometric analysis, which are further described below.

3.4 Analytical Framework

The models used in this study are the Heckman model and the MNL. The Heckman model was used to evaluate the factors that influence the decision and extent of participation by smallholder farmers in the market of mixed beans. The Multinomial Logit Model was used to assess the factors that influence choice of marketing channel by smallholder mixed bean producers.

3.4.1 Factors Influencing Market Participation

The Heckman model was used to determine factors influencing participation and the extent of participation in the mixed beans market. The Heckman two-step procedure was considered as an appropriate model because of the anticipated problem of selection bias in the sample. Selection bias arose because not all households in the survey produced beans, i.e. 1,326 households out of 7,936 households in the survey were mixed beans producers. Furthermore, 67% of mixed beans producers participated in selling of beans; hence the anticipated selection bias in the data (RALS 2015). The Heckman is popular because it is a relatively simple procedure for correcting sample selection bias (Hoffman and Kassouf, 2005). The Heckman two-step procedure is an estimate that is based on two equations. In this context, the first equation involved estimating whether or not the farmer participates in the mixed beans market.

The first equation of the Heckman model was estimated using the Probit model, whilst the second equation (outcome equation) was estimated using OLS regression. The Probit model predicts the probability of whether the individual farmer participated in the mixed beans market or not as shown below:

$$pr\left(Z_i = 1 \middle| w_{i,} \alpha\right) = \phi\left(\lambda\left(w_{i,} \alpha\right)\right) + u_i \quad (1)$$

Where Z_i is an indicator variable equal to unity for the household that participated in marketing, ϕ is the standard normal cumulative distribution function, w_i is the vector of factors affecting market participation and, α is the vector of coefficients to be estimated, u_i is the error term assumed to be distributed normally with a mean of zero and a variance σ^2. The variable Z_i takes the value of 1 if the marginal utility the farmer i gets from participating in mixed beans marketing is greater than zero, and zero if otherwise. This is shown below;

$$Z_i^* = \alpha w_i + v_i \quad (2)$$

Where,

$$\left.\begin{array}{l} Z_i = 1 \; if \; Z_i^* > 0 \\ Z_i = 1 \; if \; Z_i^* \leq 0 \end{array}\right\} \quad (3)$$

The second step uses a regression model as shown below;

$$Y_i = X_i \beta + \varepsilon_i \quad (4)$$

Where X_i represents a vector of explanatory variables determining market intensity outlined in table 2, β is a vector of coefficients and ε_i the error term.

Table 1 below shows a summary of the explanatory variables hypothesised to influence market participation and extent of participation.

Dependent Variables

Type of household (Typhh): Is a dummy variable used in the Heckman model equation taking one if household is a market participant. One represents actual participation in the market by selling of mixed beans and zero if household produces but does not sell.

Quantity of mixed beans sold (kg_sold): Is a continuous dependent variable used in the outcome equation of the Heckman model measured in kilograms. It measures the actual quantities of mixed beans sold by market participants.

Table 2: Summary of explanatory variables used in the Heckman two-stage model

Variable	Measurement of the Variables	Hypothesised Sign
Dependent Variables		
Type of household	Dummy (1 = market participant, 0 = Non-Market participant)	Dependent
Quantity of mixed beans sold	Kilograms (continuous)	Dependent
Independent Variables		
Farmer and Household Characteristics		
Age in years	Years (continuous)	+/-
Maximum level of education	Years (continuous)	+
Gender	Dummy (1=male, 0=female)	+
Adult equivalent	Number (continuous)	+/-
Household Assets		
Total land holding size	Hectare (continuous)	+
Production Factors		
Total area cultivated	Hectare (continuous)	+
Area planted to beans	Hectare (continuous)	+
Quantity harvested	Kilograms (continuous)	+
Simpson Index of Diversity-Crops	Unit (continuous)	+
Tropical Livestock Unit (TLU)	Unit (continuous)	+/-
Net-off-farm income	Zambian Kwacha (Continuous)	+/-
Institutional Factors		
Access to loans	Dummy (1 = yes, 0 = otherwise)	+
Dummy access to price information	Dummy (1 = yes, 0 = otherwise)	+
Dummy Cooperative membership	Dummy (1 = yes, 0 = otherwise)	+
Dummy access to extension service	Dummy (1 = yes, 0 = otherwise)	+
Distance to market	Kilometer (continuous)	-
Location Factors		
Agro-Ecological Region I (AER I)	Dummy (1=yes, 0=otherwise)	-
Agro-Ecological Region III (AER III)	Dummy (1=yes, 0=otherwise)	+

Source: Adapted from literature

To correct for potential selection bias, an additional regressor in the equation is included. The regressor is the Inverse Mills Ratio (IMR). The IMR is therefore computed as follows;

$$\frac{\varphi\left(h\left(w_{i,}\tilde{a}\right)\right)}{\varphi\left(w_{i,}\tilde{a}\right)} \quad (5)$$

Where φ is the normal probability density function. Hence, the second-stage equation is given by:

$$E = (Y_i|Z = 1) = f\left(x_{i,}\beta\right) + \lambda\frac{\varphi\left(\lambda\left(w_{i,}\tilde{a}\right)\right)}{\varphi\left(w_{i,}\tilde{a}\right)} \quad (6)$$

Where;

E is the expectation operator, *Y* is the (continuous) proportion of mixed beans sold by the farmer,

x is the vector of independent variables affecting the quantity of mixed beans sold, β is the vector of the corresponding coefficients to be estimated.

Hence, Y_i can be expressed as follows:

$$Y_i^* = \beta' x_i + y\lambda_i + u_i \quad (7)$$

Y_i^* is only observed for those mixed beans farmers participating in the market. Where;

$u_i \sim N(0, \sigma_u).(Z_i = 1)$, in which case $Y_i = Y_i^*$ (8)

The first step that involves the decision of whether or not to participate in mixed beans marketing, can hence be presented as follows:

$$P_{(0,1)} = \beta_0 X_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots\ldots \beta_n X_n + e \quad (9)$$

Where participation is denoted by 1 and non-participation by 0. β_0 is a constant whilst β_1…..n are parameters to be estimated, X_s are vectors of explanatory variables and e is the error term.

Before running the Heckman two-step model, statistical tests were conducted on the data, which include the Variance Inflation Factor. Gujarat (2004) indicated that Variance

Inflation Factor (VIF) is used to check multicollinearity among continuous variables. If the value of VIF is greater than 10, the variables are said to be highly collinear.

VIF (Xj)=1/(1-R_j^2) (10)

Where R_j^2 is the multiple correlation coefficients between explanatory variables , the larger the value of R_j^2, the higher the value of VIF(Xj) causing collinearity in the variable (Xj).

3.4.1.1 Model Specification

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Heckman two-stage procedure

Heckman (1979) proposed a two-stage procedure which only involves the estimation of a standard Probit and a linear regression model. The exclusion restrictions were invoked in estimating the Heckman two-stage procedure. According to Certo *et al.*, (2016), Heckman models require exclusion restrictions in the first stage that do not appear in the second stage. Certo *et al.*, (2016), further contend that when the exclusion restrictions are poor in a model (or do not exist at all), IMR will correlate too highly with *x*, thus introducing multicollinearity problems in the second stage of the model (Sartori 2003). Before running the Heckman model, some diagnostic tests were carried out to check for multicollinearity.

The variance inflation factor (VIF) was used to test for multicollinearity and the results are shown in Appendix1.

The two equations for the two-stage procedure are therefore specified as follows:

Selection equation

Type of Household (market participant/non market participant) $(\boldsymbol{P_i(0,1)}) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots\ldots \beta_n X_n + e$ (11)

$$P_i(0,1) = \beta_0 + \beta_{1headage} + \beta_{2dhhsex} + \beta_{3ae} + \beta_{4edu\_max} + \beta_{5landholdingsz15} + \beta_{6mixedbeansha} + \beta_{7totharv} + \beta_{8SID\_crops} + \beta_{9dinf\_price} + \beta_{10net_{off\_farm}} + \beta_{11dist\_market} + \beta_{12dadv\_ext} + \beta_{13AERI} + \beta_{14AERIII} + \beta_{15dloan} + \beta_{16dcoop\_mem} +$$

$\beta_{17TLU} + \varepsilon_i$ (12)

Outcome equation

Quantity of bean sold $(\boldsymbol{Y_i}) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots\ldots \beta_n X_n + e$ (13)

Following the exclusion restrictions, the following variables were not included in the second stage of the Heckman Two-Stage Model. These include access to loan, membership to cooperative and Tropical Livestock Unit

The proportion of mixed beans sales:

$$Y_i = \beta_0 + \beta_{1headage} + \beta_{2dhhsex} + \beta_{3ae} + \beta_{4edu\_max} + \beta_{5landholdingsz15} + \beta_{6mixedbeansha} + \beta_{7totharv} + \beta_{8SID\_crops} + \beta_{9dinf\_price} + \beta_{10net_{off\_farm}} + \beta_{11dist\_market} + \beta_{12dadv\_ext} + \beta_{13AERI} + \beta_{14AERIII} + \varepsilon_i \quad (14)$$

3.4.2 Factors influencing channel choice of market outlet

The Multinomial Logit model was used to determine factors influencing channel choice of market for mixed beans among Zambian smallholder farmers. The choice of a particular market outlet is discrete because it is selected among other alternative outlets.

Let P_{ij} represent the probability of choice of any given market outlet by mixed beans farmers. The equation will therefore be as follows;

$$P_{ij} = \beta_0 + \beta_1 X_1 + \ldots \beta_k X_k + e \quad (15)$$

In this study, the farmers have four market outlets to sell their mixed beans produce, therefore i takes values (1, 2, 3, 4), each representing the choice of the market outlet (small scale traders =1, retailer/marketeers =2, other households =3, other buyers =4). The MNL model predicts the relative probability that a producer would choose one of the four categories based on the nature of the explanatory variables. X_i are factors affecting choice of a market outlet, β are parameters to be estimated and e is a randomized error. j are the alternative choices, and the probability of choosing outlet j is given by:

$$Prob(Y_i = j) = \frac{e_{z_j}}{\sum_{k=0}^{j} e_{zk}} \quad (16)$$

Where

Z_i a choice and Z_k is an alternative choice that could be choosen (Greene 2000). The model estimates are used to determine the probability of choice of a market outlet given j factors that affect the choice X_i. With a number of choices log odds ratio is computed as follows;

$$\text{In}\left(\frac{P_{ij}}{P_{i^*}}\right) = \alpha + \beta_1 X_1 + \beta_2 X_2 + \ldots\ldots\ldots \beta_k X_k + e_i \quad (17)$$

Where:

P_{ij} and P_{ik} are probabilities that a farmer will choose a given outlet and an alternative outlet respectively.

$\text{In}\left(\frac{P_{ij}}{P_{i^*}}\right)$ is a natural log of probability of choice j relative to probability choice k, where;

α is a constant, β is a matrix of parameters that reflect the impact of changes in X on probability of choosing a given outlet, e is the error term that is independent and normally distributed with a mean zero.

The parameter estimates of the MNL provide only the direction of the effect of the independent variable on the dependent variable but do not represent either the actual magnitude of change nor probabilities. The marginal effects or marginal probabilities are functions of the probability itself and measure the expected change in the probability of a particular choice being made with respect to a unit change in an independent variable from the mean (Green 2000).

The marginal effects of the attributes on choice are determined by getting the differential of probability of a choice and it is given by;

$$(\delta) = \frac{dP_i}{dX_i} = pi(\beta_j - \sum_{k=0}^{j} P_k \beta_k = P_i(\beta_i - \beta) \quad (18)$$

Therefore, the MNL Model is given as follows:

$$\textbf{Market Channel Outlet } (\boldsymbol{P_{ij}}) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 \ldots\ldots \beta_n X_n + \varepsilon_i \quad (19)$$

Choice of market outlet:

The Multinomial logit model was specified as a function of 17 independent variables influencing mixed beans farmers' market channel choices:

$$P_{ij} = \beta_0 + \beta_{1headage} + \beta_{2dhhsex} + \beta_{3ae} + \beta_{4edu\_max} + \beta_{5landholdingsz15} + \beta_{6mixedbeansha} + \beta_{7totharv} + \beta_{8SID\_crops} + \beta_{9dinf\_price} + \beta_{10net_{off\_farm}} + \beta_{11dist\_market} + \beta_{12dadv\_ext} + \beta_{13AERI} + \beta_{14AERIII} + \beta_{15dloan} + \beta_{16dcoop\_mem} + \beta_{17TLU} + \varepsilon_i \quad (20)$$

The explanatory variables included in the above model were: age, gender, and education level of the household head, adult equivalent, landholding size, area planted, quantity harvested, Simpson Index of Diversity (SID-Crops), distance to nearest market, TLU, access to price information, net off-farm income, cooperative membership, access to loans, access to extension service, Agro-ecological region I, and Agro-ecological region III.

Table 2 below shows a summary of the explanatory variables which are hypothesised to influence the dependent variable.

The Dependent Variable

Marketing channel outlet (Channel): Is a variable that is measured by the probability of selling mixed beans to either of the markets. The dependent variable is a discrete choice in the MNL model, with the farmers grouped into four categories based on their pattern of choice of market for their produce. The farmers' choice involves selecting from among the four channels which are the model's dependent variables for the model. In the model, Y_1 represents farmers who choose to sell to "small scale traders" (base category), Y_2 represents farmers who choose to sell to "retailer/marketeers", Y_3 represents farmers who choose to sell to "Other households", and Y_4 represents farmers who choose to sell to "Other buyers".

Table 3: Summary of Variables used in the MNL Model

Variable	Measurement of the Variables	Hypothesised Sign
Dependent Variable:		
Households' channel choice of mixed beans market outlet	(Small scale traders = 1 [base category], Retailer/marketeer = 2, Other households = 3, Other buyers = 4)	Dependent
Independent Variables:		
Farmer and Household Characteristics		
Age in years	Years (continuous)	+/-
Maximum level of education	Years (continuous)	+
Gender	Dummy (1=male, 0=female)	+
Adult equivalent units	Number (continuous)	+
Household Assets		
Total land holding size	Hectare (continuous)	+
Production Factors		
Total area cultivated	Hectare (continuous)	+
Area planted to beans	Hectare (continuous)	+
Quantity harvested	Kilograms (continuous)	+
Simpson Index of Diversity-Crops	Unit (continuous)	+
Value of production assets	Zambian Kwacha (continuous)	+
Tropical Livestock Unit (TLU)	Unit (continuous)	+/-
Off-farm income	Dummy (1 = yes, 0 = otherwise)	+/-
Institutional Factors		
Access to loans	Dummy (1 = yes, 0 = otherwise)	+
Dummy access to price information	Dummy (1 = yes, 0 = otherwise)	+
Dummy Cooperative membership	Dummy (1 = yes, 0 = otherwise)	+
Dummy access to extension service	Dummy (1 = yes, 0 = otherwise)	+
Distance to market	Kilometer (continuous)	-
Location Factors		
Agro-Ecological Region I (AER I)	Dummy (1=yes, 0=otherwise)	-
Agro-Ecological Region III (AER III)	Dummy (1=yes, 0=otherwise)	+

Source: Adapted from literature

CHAPTER 4 – RESULTS AND DISCUSSION

4.0 Introduction

This chapter initially presents the characteristics of smallholder bean growers in Zambia. The smallholder bean growers are categorized into mixed beans market participants and non-market participants and overall mixed beans producers. After that, results and discussion from econometric analysis on factors that influence market participation and extent of participation, and market channel choice for beans are presented.

4.1. Characteristics of Sample Households

The characteristics of the farm household head and the household at large are likely to influence the decision to participate or not to participate in the beans market. To better understand factors that influence market participation, the bean producers were classified into market participants and non-market participants. The market participants refer to bean producers that sold their beans whilst the non-participants were the category that did not sell. For continuous variables, the t test was used to determine whether there was any significant difference between the two groups of market participants and non-participants. The chi square test was also used to determine the significant difference for categorical variables between the two groups. The characteristics of the 1,326 mixed beans producers are presented in Table 4 and Table 5.

Mean age results indicate that there was no significant difference between the market participants and non-market participants. Market participants had an average of 48.19 years, and 49.52 years for non-market participants. Adult equivalent results show that there was no statistical difference between the two groups. The Adult equivalent result for the market participants was 5.29 and 5.31 for the non-market participants.

Education level results did not show any significant difference between the two groups. On average, market participants had achieved 8.68 years of schooling, whilst the non-market participants had achieved 8.67 years. The implication is that most bean producers had reached secondary education level. Makhura *et al*., (2001) state that human capital represented by the household head's formal education is expected to increase a household's understanding of market dynamics and improve decision about the amount

of output sold. Table 3 below shows bean producers' characteristics in terms of continuous variables

Table 4: Household Characteristics of Bean Producers (Continuous Variables)

Variable Name (Continuous variables)	**Total Sample (N=1,326)**	**Market Participant (N=894)**	**Non-Market Participant (N=432)**	**T-Test**
	Mean	Mean	Mean	
Farmer and Household Characteristics				
Age (Yrs)	48.62	48.19	49.52	1.62
Adult Equivalent Units (Units)	5.31	5.29	5.31	-0.13
Education level (Yrs)	8.67	8.68	8.67	-0.1
Land holding (Ha)	6.92	7.67	5.35	-2.69**
Land cultivated (Ha)	3.03	3.2	2.68	-3.61**
Area planted (beans) (Ha)	0.43	0.51	0.26	-8.23***
Quantity harvested (Kg)	199.45	257.74	77.13	-8.87***
Volume sold (Kg)	120.79	179.16	0	-11.18***
Simpson Index of Diversity (SID)	0.54	0.56	0.51	-5.45***
Net off-farm income (ZMW)	7,779.87	7,094.47	9,198.25	1.55
Livestock holding (TLU)	2.9	2.55	3.62	1.79*
Production assets (ZMW)	22,342.09	20,430.75	26,353.20	1.22
Market Access & Institutional factors				
Distance to market (Km)	25.72	26.24	24.62	-0.84

Note: ***Significant at 1 per cent; **Significant at the 5 per cent level *Significant at the 10 per cent level

Source: Owner's own computation

Landholding size results show a significant difference between market participants and non-market participants. Market participants had an average of 7.67 hectares, whilst non-participants had an average of 5.35 hectares. Also, land under cultivation results show a significant difference between the two groups. Market participants cultivated an average of 3.2 hectares, whilst non-market participants only had 2.68 hectares. Cultivating more land entails that the farmer is likely to increase the area allocated to the crop of interest. In addition, increasing land cultivated increases the probability of larger harvests and subsequent surplus for sell.

Land planted to beans results show a significant difference between market participants and non-market participants. Market had a higher proportion of land planted to beans

averaging 0.51 hectares, whilst non-market participants only had 0.26 hectares. Allocating larger area to beans leads to a subsequent increase in the harvest.

Quantity harvested results indicate a significant difference between market participants and non-market participants. Market participants had higher average quantities harvested at 257.74 Kg, non-market participants had 77.13 Kg. This means that larger harvests lead to increased chances of participating in the mixed beans market. Mean volumes sold also show a significant difference between the two groups. The market participants sold an average 179.2 kilograms, whilst non-market participants did not sell (0 kilograms). This shows that only participating farmers could sell beans compared to the non-participating farmers who did not sell.

The Simpson Index of Diversity (SID) results show a significant difference between the two groups. Market participants show a higher score of 0.56, whilst the non-market participants show a score of 0.51. This shows that market participants practiced crop diversification than the non-market participants. The SID is used to measure the degree of crop diversity, and a score closer to 1 indicates that there is increased diversity in terms of the number of crops grown (Rahman *et al.*, 2009).

In addition to farming activities, the smallholder mixed bean farmers engage in off-farm activities, which contribute to their overall financial position. Net off-farm income results did not show any significant difference between the two groups. Market participants earned an average of ZMW 7,094.47, whilst non-market participants earned an average ZMW 9,198.25. Some studies (Mirie and Zemedu, 2018) suggest that non-farm income has a positive influence on the decision to participate in a market.

Livestock holding (TLU) results show that there was a significant difference between the two groups. Market participants had a lower TLU index of 2.55, whilst non-market particpants had an index of 3.62. This indicates that non-market participants had more livestock than the market participants. Value of productive assets results did not show any statistical difference between the two groups. Productive assets include land, farm equipment and livestock (Kumaraswamy *et al.*, 2020.), which enhance productive capacity of farmers leading to larger harvests and access to transport.

Distance to market for bean results show that there is no significant difference between market participants (26.2 kilometres) and non-market participants (24.6 kilometres) Distance is one of the crucial factors that determine market participation. According to Tesfew (2013), farmers whose residences are closer to the market would have more access and a higher level of market participation than those who live away from the nearest market centre. This is because distance coupled with poor roads characteristise of rural areas can be associated with high transport costs.

The t test results revealed that there were significant differences between the mixed beans market participants and non-market participants for seven variables of landholding size, land cultivated, area planted, quantity harvested, quantity sold, SID-Crops, and TLU. However, t test results for six variables for age, adult equivalent, education level, net-off farm income, production assets and distance to market did not portray any significant difference between the two groups. Table 4 below shows characteristics of bean producers in terms of categorical variables

Table 5: Household Characteristics of Bean Producers (Categorical Variables)

Variable Name (Categorical Variables)	**Total Sample (N=1,326)** %	**Market Participant (N=894)** %	**Non-Market Participant (N=432)** %	**Chi Square**
Farmer and Household Characteristics				
Gender (=1 if male)	0.83	0.85	0.81	3.36*
Decision maker (=1 if female)	0.24	0.15	0.36	12.66***
Market Access & Institutional factors				
Access to price information (=1 if yes)	0.75	0.76	0.71	5.15**
Access to extension service (=1 if yes)	0.58	0.58	0.58	0.01
Cooperative member (=1 if yes)	0.68	0.7	0.63	5.60**
Access to loan (=1 if yes)	0.09	0.08	0.1	0.89
Location factors				
AER I	0.04	0.01	0.08	35.072***
AER II	0.15	0.12	0.408	18.97***
AER III	0.82	0.87	0.71	46.53***

Note: ***Significant at 1 per cent; **Significant at the 5 per cent level *Significant at the 10 per cent level

Source: Owner's own computation

Gender results show that 85% of market participants are male-headed, whilst 81% of non-market participants are male-headed. Traditionally, most households in Zambia are male-

headed. Furthermore, results for market participants show that only 15% of decision-makers on whether to produce bean or not in a household are female. However, non-participants results show a higher percentage of 36% of females being decision-makers on whether to produce bean or not in the household.

Access to price information results indicate a significant difference between market participants (76%) and non-market participants (71%). Prior information on the price of a commodity influences the production decision. Furthermore, price information assists the bean producer make informed decisions on selling. Access to extension service results show no significant difference between market participants and non-market participants. Access to extension service assists farmers increase their knowledge in production and marketing.

Membership to cooperatives show significant difference between market participants (70%) and non-market participants (63%). Cooperatives are sources of inputs and relevant information that contribute to increased production. Access to loan results show that there was no significant difference between market participants (8%) and non-market participants (10%). Loan access improves the farmers' ability to acquire, among others, inputs and labour to improve production and productivity. The result show that few mixed beans farmers access loans to support their agricultural production.

Geographical location is one of the critical factors in the production of beans in Zambia. AER I results show that there was significant difference between the two groups. Market participants in AER I were only 1%, whilst non-market participants were 8%. AER II results indicate a statistical difference between the two groups. Market participants in AER II were only 12%, whilst non-market participants were 40.8%. AER III results also indicate a significant difference between the two groups. Market participants in AER III were 87%, whilst non-market particpants were 71%. It is therefore expected that mixed bean producers in AER III are likely to participate in the market.

The chi square test portrayed significant results for ten categorical variables apart from the three categories of primary education, access to extension services, and access to loan.

A scatterplot was used to assess the bivariate relationship between the quantity harvested and quantity sold for mixed beans. Figure 3 shows the possible relationship between two variables.

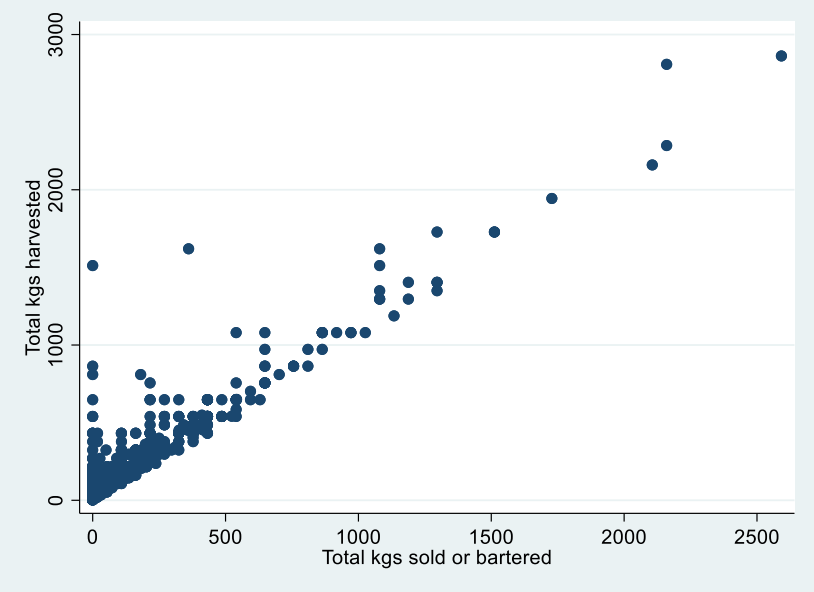

Figure 2: Scatterplot of quantity harvested and quantity sold

Source: Authors own computation

Results from Figure 2 show a positive relationship between quantity harvested and quantity sold for mixed beans. The data shows an uphill pattern as we move from left to right. In addition, the pattern assumes a linear form; hence, it can be hypothesised that as quantity harvested increases, quantity sold also increases. This entails that farmers with larger bean harvests are more likely to sell than those with relatively lower harvests.

4.1.2 Characterizing mixed beans households by market channel

In the current study, mixed bean farmers are faced with four choices of market channels, these are small scale traders, retailer/marketeer, other households, and other buyers. The small scale trader was taken as the base category to analyze the determinants of the farmer's choice of market channel. In this study, the other buyers outlet comprise large scale traders, NGOs/Faith Based Organizations/Churches, Cooperatives, Community Markets for Conservation (COMACO), Government institutions (schools, hospitals/health centres). Other buyers are characterized by purchasing mixed bean in bulk from the farmer and entering into contractual arrangements.

Figure 3 shows the preference of market channels for beans. Results indicate that "Small-scale traders" are the most preferred market channel with 474 households (53%). This could be attributed to the high mobility of small-scale traders. Small-scale traders can move from place to place in search of merchandise of interest. In this way, the farmers' transaction costs are minimized as they do not incur transportation costs for the produce. In addition, the frequent interaction between the small-scale traders and mixed beans growers contributes to building long standing business relationships. Anh and Bokelmann (2019) note that repeated economic transaction embedded in the social relationship indicates the largest sales volume".

The "Other households" market channel was the second most preferred market outlet with 205 households (23%). This could be that other households are usually found near the beans farmers. The close proximity helps to reduce transaction costs for the beans farmers. The "Retailer/Marketeer" is the third most preferred market channel with 175 households (20%). The retailers/marketeers are usually located at market places or common trading places and buy moderate quantities for resale in smaller quantities directly to consumers. Farmers have to transport the beans for sale to the retailer/marketeer hence incurring transaction costs.

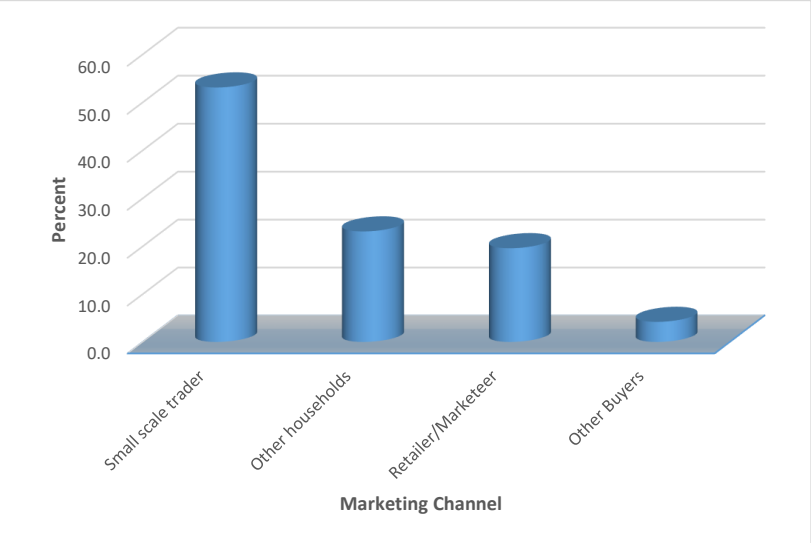

Figure 3: Most preferred market channel for mixed beans

Source: Authors own computation

The least preferred market channel is the "Other buyers" with 38 households (4%). This channel is composed of large scale buyers, institutions (schools, health institutions), NGOs and private companies. The "Other buyers" are known to purchase large quantities from individual farmers. In addition, the other buyers are known to enter into contracts or legal agreements with farmers to assure ready market and other obligations between parties. It can, therefore, be assumed that only farmers who produce large quantities and understand contractual obligations manage to trade with "other buyers" market channel.

4.2 Econometric Model Outputs

4.2.1 Factors influencing market participation

The Heckman two-step procedure was used to analyse the determinants of market participation among smallholder mixed bean producers. Before running the Heckman model, some diagnostic tests such as the VIF were carried out to check for multicollinearity in the data. The results indicate a VIF less than 10. The variables included in the model were household head's age, education level, adult equivalent, TLU,

landholding size, area planted to beans, quantity of beans harvested, SID, access to price information, access to extension services, distance to market for beans, access to loans, cooperative membership, AER I, and AER III. Post estimation of the selection equation was carried out after analysing the data, this was done to obtain marginal effects, which were used for interpretation.

The results indicate that six variables (education level, quantity harvested, access to price information, AER I, AER III, and net off-farm income) significantly influenced the smallholder farmers' decision to participate in the mixed bean market. The Inverse Mills Ratio (IML/Lambda) term was significant and positive at (0.004) suggesting that the error term in the selection and outcome equations is positively correlated. The implication is that unobserved factors making participation in mixed bean marketing are more likely to be associated with higher scores on the dependent variable. Table 5 below presents results of the selection equation, marginal effects.

Age of the household head negatively and significantly influenced market participation. An increase in the age of household head by one year decreases the probability of participating in the mixed bean market by 0.2%, all other factors held constant. The implication is that younger people are more enthusiastic about participating in the mixed bean market than older people. This is in line with Sigei (2014) and Sebatta *et al.,* (2013) findings, that age had a significant but negative influence on the decision to participate in the pineapple and potato markets in Kenya and Uganda respectively.

Results revealed that education level positively and significantly influences the decision to participate in the mixed beans market. An increase in one year of schooling increases the probability to participate in the mixed beans market by 0.8%, all other factors held constant. This could be that formal education increases the managerial aspects, leading to increased production and marketing skills, which enable the farmer to participate in the market. The results are consistent with Mango *et al.,* (2018) who found a positive relationship between level of education and participation in the rice market.

Table 6: Factors affecting decision to participate in the mixed bean market (Heckman Selection equation results)

Variable	Marginal effects	Std. Err.	P>z
Age	-0.001	0.001	0.172
Gender	0.013	0.033	0.703
Adult Equivalents	0.000	0.006	0.938
Education level	0.007*	0.004	0.099
Landholding soze	0.002	0.001	0.258
Area planted	0.008	0.044	0.856
Quantity harvested	0.001***	0.000	0.000
Access to loans	-0.015	0.043	0.719
Cooperative membership	0.005	0.026	0.844
SID _crops	0.122	0.075	0.102
Access to price information	0.047*	0.028	0.089
Distance to market	0.000	0.000	0.490
Access to extension services	0.023	0.025	0.371
TLU	-0.001	0.002	0.521
AERI	-0.210***	0.069	0.002
AERIII	0.139***	0.034	0.000
Net off-farm income	0.000***	0.000	0.008
/Mills			
Lambda	36.195	12.514	0.004
rho	0.514		
sigma	70.394		

***Significant at 1 per cent; **Significant at the 5 per cent level *Significant at the 10 per cent level
Source: Authors own computation

Results further show that the quantity harvested positively and significantly influenced the decision to participate in the mixed bean market. As expected, an increase in quantity harvested by one-kilogram increases the probability of participating in the mixed bean market by 0.2%, all other factors held constant. This implies that as mixed bean yield increases, participation in the market also increases. The results are consistent with Mbitsemunda and Karangwa (2017), who found that the quantity produced positively influenced the household's decision to participate in the bean market.

Agro-ecological region I (AER I) significantly but negatively influence the decision to participate in the mixed bean market. AER I's negative coefficient indicates that relative to AER II, farmers in AER I are less likely to participate in the mixed bean markets.

As expected, Agro-ecological region III (AER III) positively and significantly increased the decision of mixed bean producers to participate in the bean market. The positive coefficient on AER III indicates that relative to AER II, farmers in AER III are more likely to participate in the mixed bean market.

4.2.2 Factors influencing the extent of participation in the mixed bean market

The OLS regression was estimated in the outcome equation. The dependent variable was the extent of market participation measured by the quantity of output (kg of beans) sold. The Wald Chi goodness of fit measured by Prob>Chi2 =0.000 showed that the explanatory variables used in the second stage of the Heckman procedure explained the variations in the extent of participation.

The results of the analysis are presented in Table 6 below and explanation on the factors that were statistically significant follow. The positive and negative significant relationships in the result indicate that a unit increase or decrease in the variables will lead to an addition or reduction in the quantity of mixed beans sold. Seven variables (household head's age, adult equivalent, household head's education level, quantity of beans harvested, TLU and Agro-Ecological Region I (AER I) significantly influenced the volume of mixed beans sold to the mixed bean market.

The coefficient of age significantly but negatively influenced the extent of market participation. An increase in the household head's age by one year reduces the quantity of mixed bean supplied to the market by 0.55 Kg; all factors held constant. The possible explanation could be that younger farmers are more energetic and enthusiastic and, therefore, can participate in beans marketing than the older farmers. Besides, older farmers tend to have more children and dependents, which increases consumption thereby reducing the quantities for sale.

Table 7: Factors influencing the extent of participation in the mixed bean market (Heckman outcome equation results)

Variable	Coef	Std. Err.	P>z
Age	-0.550***	0.187	0.003
Gender	0.580	6.951	0.933
Adult equivalent	-4.870***	1.242	0.000
Education level	2.476***	0.898	0.006
Landholding size	0.187	0.165	0.258
Area planted	18.792***	4.951	0.000
Quantity harvested	0.789***	0.007	0.000
Access to loans	1.697	8.713	0.846
Cooperative membership	-2.945	5.389	0.585
Simpson Index of Diversity	-6.173	16.346	0.706
Price information access	2.042	5.782	0.724
Distance to nearest market	0.080	0.072	0.266
Extension service access	5.772	4.978	0.246
TLU	-1.127***	0.421	0.008
AER I	-37.783*	20.559	0.066
AER III	-8.424	8.036	0.295
No. obs = 1283	Selected = 867,		
Wald Chi2 (16) = 14249.22	Prob >Chi2 = 0.000		

* significant at 10% level; ** significant at 5% level; *** significant at 10% level
Source: Author's own computation

Adult equivalent unit negatively and significantly influenced the extent of market participation. An increase in adult equivalents by a unit reduces the quantity of mixed bean for sale by 4.87 Kg; all other factors held constant. This entails that family labour force has an inverse relationship with quantity for sale. This could be that a larger family labour force requires larger amounts for consumption, which in turn reduces the quantities available for sale. This confirms Beadgie & Reddy (2020)'s finding, that family size (measured in adult equivalent) negatively influenced the supply of maize to the market.

Education level significantly and positively influenced the extent of market participation. An increase in education by one year increases the quantity of mixed bean sales by 2.48 Kg; all factors held constant. Mango *et al*., (2018) argue that a higher education level has positive implications for the ability to understand and interpret extension information. This leads to increased surplus production and subsequent proportion available for sale.

Area planted positively and significantly influenced the extent of market participation. A unit increase in area planted by 1 hectare increases the quantity of mixed bean sales by 18.79 Kg; all factors held constant. Therefore, increasing area planted leads to increased quantities harvested and subsequent proportion of mixed beans for sale.

As expected, quantity harvested significantly and positively influenced the extent of market participation. A unit increase in quantity harvested by 1 kilogram increases the quantity of mixed bean sales by 0.79 Kg; all factors held constant. Therefore, increasing the quantity harvested increases the subsequent proportion of mixed beans that can be for sale. This result conforms to Apind (2015) result who found that an increase in level of rice output produced by the household implied an increase in the marketable surplus thus increasing the extent of market participation.

TLU negatively and significantly influenced the extent of market participation. An increase in livestock owned by a unit reduces the quantity of mixed bean sold by 1.13 Kg; all factors held constant. This shows an inverse relationship with bean production and marketable surplus. Rehima (2006) study found a negative relationship between livestock ownership and quantity of pepper sales in Ethiopia.

AER I negatively and significantly influenced the extent of market participation. The negative coefficient entails being in AER I reduces the quantity expected to be sold by 37.78 Kg; all factors held constant.

4.2.3 Factors affecting the choice of mixed bean marketing channels

In identifying factors influencing determinants of marketing channel of choice for beans, the study used the MNL model. Small-scale traders were taken as the base category because it had more observations. The MNL gives a McFadden's R^2 (Pseudo R^2) of 0.1154 which means that the explanatory variables explain 11.5% of the variation in the dependent variable. The estimated probability was greater than the chi-square value (P>Chi2 = 0.000), which implies that the variable were jointly significant in explaining the dependent variable (Table 7)

Table 8: Marginal effects of factors influencing choice of market channel outlet

Variable	Retailer/Marketeer		Other Households		Other Buyers	
	Marginal effects	P>z	Marginal effects	P>z	Marginal effects	P>z
Age	-0.0001	0.955	0.0009	0.164	0.0002	0.613
Gender	0.059	0.149	-0.0202	0.491	0.0078	0.569
Adult equivalent	-0.005	0.595	-0.0013	0.794	-0.0017	0.553
Education level	0.011*	0.074	-0.0031	0.400	0.005**	0.013
SID	0.014	0.903	-0.1392**	0.030	-0.0471	0.137
Landholding size	0.001	0.343	0.0004	0.502	-0.0007	0.205
Area planted	0.014	0.632	-0.1653***	0.001	-0.0049	0.300
Quantity harvested	0.0002***	0.000	-0.0006***	0.000	0.0000	0.823
Price information access	0.070**	0.048	-0.0329	0.222	-0.0034***	0.002
Loan access	-0.016	0.773	0.0056	0.882	0.0031	0.879
Cooperative membership	-0.057	0.125	0.0177	0.391	0.0151	0.223
Distance to market	-0.002**	0.012	-0.0001	0.841	-0.0001	0.390
Net off-farm income	0.066	0.347	0.000***	0.004	0.0000***	0.005
Extension service access	0.066**	0.040	0.0108	0.595	0.0108	0.362
TLU	-0.008	0.218	0.0024	0.294	0.0002	0.796
AER I	-0.149*	0.080	0.5301***	0.003	-0.0396***	0.000
AER III	-0.040	0.452	0.0212	0.467	-0.0001	0.994
Number of obs. = 867			Wald chi2(51) = 924.73			
Prob>chi2 = 0.000			Pseudo R2 = 0.1154			
Log pseudolikelihood = -862.79885						

Note: ***, ** and * represents significance at 1%, 5% and 10% probability levels respectively.

Source: Authors own computation

The household head's education level significantly affected the choice of retailer/marketeer and other buyers market outlets. An additional year in school was associated with a 1.1% and 0.5% increase in the probability of choosing retailer/marketeer and other buyers' market outlets, respectively, relative to small scale traders (base category). This could be because education is associated with efficiency and better understanding of marketing strategies leading to higher profits. The Retailer/Marketeer and other buyers outlets offered a higher unit price compared to the small scale trader. Mango *et al*., (2018) note that education levels affect market information interpretation, and hence, marketing channel choice by farmers. A study by Anteneh *et al*., (2011) found that the level of education of the household head significantly influenced the choice of the coffee market outlet.

Simpson index of diversity (SID) negatively influenced the choice of other households outlet relative to the small-scale trader. A unit increase in the index for crop diversity

reduced the probability of choosing the other household outlet by 13.9% relative to the small scale trader outlet. A farmer who cultivates diverse crops is expected to earmark the crop that fetches higher income for the market whilst reserving the other crops for consumption. In Zambia, beans are considered one of the most profitable crops (Sichilima *et al.,* 2016). Since the farmer has other crops for consumption, they can then sell more of the mixed bean to bulk buyers such as the small-scale trader to earn higher income.

As expected, area planted significantly affected the choice of other households outlet. The probability of choosing the other household outlet decreased by 16.5% for every hectare planted compared to small scale traders. This implies that as area planted increases, harvests will also increase hence, the farmer may opt for a channel which will purchase in bulk to avoid postharvest losses. The small scale traders purchase in bulk compared to other households.

As expected, quantity harvested had a significant influence on the choice of the retailer/marketeer, other households, and other buyers market outlets. An increase in quantity harvested by one kilogram increased the probability of choosing the retailer/marketeer and other buyers market outlets by 0.02% and 0.03% respectively, relative to the small scale trader outlet. On the other hand, an increase in quantity harvested by one kilogram reduced the probability of choosing the other households market outlet by 0.06%, relative to the small scale trader. Similar to area planted, the implication is that as farmers produce more, they will seek channels that offer better prices and also purchase in bulk. A study by Sigei (2014) found that quantity harvested increased the opportunity of farmers with larger produce to sell at the market places than those with little produce.

As expected, access to price information access had a positive influence on the choice of the retailer/marketeer and other buyers market outlets. Access to price information increased the farmer's probability of choosing the retailer/marketeer market by 7.0% relative to the small-scale trader outlet. However, access to price information reduced the farmer's probability of choosing the other buyers' outlet by 0.34% relative to the small-scale traders outlet. Prior access to price information enhances the farmer's ability to make informed decisions about the choice of a market outlet offering a better price. The retailer/marketeer market outlet offered a higher price per kilogram of beans compared to

the small scale trader. Tola (2013) notes that farmers' marketing decisions are based on market price information, and poorly integrated markets may convey inaccurate price information, leading to inefficient product movement. A study by Negeri (2015) found access to price information to be statistically significant in the choice of the cooperative market outlet for coffee in Ethiopia.

As expected, a one kilometer increase in distance to nearest market reduced the farmer's likelihood of selling to the retailer/marketeer outlet by 0.2% relative to small scale traders. This entails that distance is associated with the choice of a market channel because small scale traders buy at farm gate hence reduce costs of transporting to markets. The finding concurs with Chalwe (2011) who found that distance to market was a significant factor influencing channel choice of market outlet for beans.

Net off-farm income positively influenced the choice of other households and other buyers outlets relative to the small scale traders outlet. An increase in net off income by ZMW 1 increases the probability of selling to the other households and other buyers by 0.0002% and 0.0005% respectively. This could be that farmers in off-farm activities have less time for on-farm activities hence produce less, which can only cater for other households compared to larger buyers. Another possible justification is that farmers engaged in off-farm activities establish networks with bulk buyers over time, hence opt to sell to them. A study by Mamo and Dagnet (2012) also found that off-farm income had a statistically significant influence on the choice of the livestock market outlet in Ethiopia.

Extension service significantly affected the choice of retailer/marketeer outlet relative to the small scale trader outlet. An increase in access to extension services was associated with 6.6% increase in the probability of selling in the retailer marketeer outlet. This is because extension services increases farmers access to vital information on production and marketing on crops of interest. The marketing information enhances the farmer's ability to choose channels offering better prices. The retailer/marketeer outlet had a higher price per kilogram for bean compared to the other market outlets. A study by Kihoro (2016) found that farmers who had access to extension services easily accessed market information, therefore, they could sell to lucrative marketing outlets.

Agro-Ecological Region I (AER I) significantly influenced the farmer's choice of the retailer/marketeer, other households and other buyers outlet. Agro-Ecological Region I was associated with 14.9% and 3.9% reduced probability of choosing the retailer/marketeer and other buyers market outlets respectively compared to the small scale trader outlet. On the other hand, AER I increased the probability to sell to the other households market outlet by 53% relative to the small scale trader outlet. The possible justification is that farmers in AER I are likely to have small harvests, which influences their selling to other households. Other households purchase in small quantities compared to bulk buyers such as the small scale traders.

CHAPTER FIVE - CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter presents conclusions on factors influencing market participation and channel choice decisions in the mixed bean market. Policy recommendations are made concerning the study findings to enhance market participation and choice of market outlets among bean farmers in Zambia.

5.2 Conclusions

Understanding market participation and the extent of participation, including market channels, are essential to help mixed beans farmers achieve commercialization and market integration. Several socio-economic and institutional factors predispose farmers' ability to participate in the market, the extent of participation, and choice of a particular market channel.

Econometric results of this study show that the main determinants of market participation were Socio economic factors (household head's education level, quantity harvested, net off-farm income), institutional factors (access to price information, access to extension services), and location factors (AER III). These variables were found to positively influence the decision to enter the mixed beans market. These results differ from Chalwe (2011) study who only found price and price barter to be the positive determinants in influencing the decision to participate in the bean market in Zambia. The current study further shows that the extent of participation in the mixed beans market was positively influenced by the household head's education level and as expected, area planted to beans and quantity harvested.

The results from the MNL model show that factors such as the household head's education level, area planted, quantity harvested, net off-farm income, access to price information, access to extension services, distance to the market for beans, and AER I were significant. The determinants of the choice of the retailer/marketeer market outlet were education level, where more years schooling increased the probability of choosing the retailer/marketeer, quantity harvested, where larger harvests increased the probability of choosing the retailer/marketeer channel, access to price information, where increased access to price information increased the probability of choosing the retailer/marketeer

channel, access to extension services, where increased access to crop diversification information increased the probability of choosing the retailer/marketeer channel. However, other factors such as distance to the market and AER I reduced the probability for farmers to sell to the retailer/marketeer outlet.

The main determinants for farmers' choice of other households outlet over small-scale traders were, net off-farm income, where higher net-off farm income earned increased the probability of choosing other households, and AER I, where AER I region increased the probability of choosing the other households outlet. Other factors such as the SID, and an increase in area planted and quantity harvested reduced the probability to choose the other household market outlet.

The study shows that the main determinants of farmers' choice of other buyers outlet over the small-scale traders were, education level, where more years on schooling increased the probability to choosing the other buyers outlet, quantity harvested, where larger harvests increased the probability to choose other buyers, net off-farm income, where earning larger incomes from off-farm activities increased the probability to choose small-scale traders. Other factors such as AER I reduced the probability of choosing the other buyers.

The study concludes that socio-economic (household's adult equivalent, household head's age, education level, area planted, quantity of beans harvested, Simpson Index of Diversity), institutional (access to price information and access to extension services, distance to the market), and location factors (AER I, AER III) are important factors in determining market participation, extent of participation and channel choice decisions among smallholder mixed bean farmers in Zambia. Based on these findings, policy recommendations can be made to increase market participation, the extent of participation and improve access to lucrative market outlets.

5.3 Recommendations

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The small-holder bean producers in Zambia have the potential to graduate into commercial farming and reduce poverty levels in the rural areas. This can be achieved through full participation in the bean market.

Based on the study results, the following recommendations or policy implications are drawn in order to address some of the factors constraining full participation. Crop diversification should be encouraged through tailored extension messages. This and an NGO and government sponsored crop diversification programme are a necessity in achieving crop diversity. Farmers should be encouraged to increase the area allocated to mixed beans to ensure surplus production and market participation. The need to increase mixed beans farmers' access to price information is cardinal to enable timely informed decision-making in terms of choice of marketing channel outlets. This should be complimented by infrastructure development in terms of good road network to enhance market participation and movement of produce to lucrative market outlets. Good road network is expected to reduce dependence on limited market channels and on the costs associated with poor roads.

5.4. Limitations of the study

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The study used secondary data collected by IAPRI/CSO. The data collected for the overall sample was broad and not entirely focused on the crop of interest (mixed beans). However, despite the limitations, findings of the study on factors influencing market participation and marketing channel choice decisions can be generalized.

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APPENDICES

Appendix 1. Variance Inflation Factor (VIF) results for the Heckman model

```
. vif

    Variable |       VIF       1/VIF
-------------+----------------------
mixedbeansha |      1.50    0.666089
     totharv |      1.46    0.683454
      AERIII |      1.39    0.720262
     edu_max |      1.21    0.823771
        AERI |      1.21    0.825616
         TLU |      1.17    0.852529
          ae |      1.17    0.857273
net_off_farm |      1.12    0.891457
      dhhsex |      1.11    0.897863
   dcoop_mem |      1.11    0.899408
    dadv_ext |      1.11    0.903203
   SID_crops |      1.10    0.908711
     headage |      1.10    0.911071
       dloan |      1.06    0.946886
landholdsz15 |      1.05    0.947935
  dinf_price |      1.05    0.952846
 dist_market |      1.02    0.976033
-------------+----------------------
    Mean VIF |      1.17
```

Appendix 2. Breusch-Pagan / Cook-Weisberg test for heteroskedasticity – Heckman Model

```
. hettest headage dhhsex ae edu_max landholdsz15 mixedbeansha totharv dloan SID_crop
> s dinf_price dloan dcoop_mem net_off_farm dist_market dadv_ext TLU AERI AERIII

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: headage dhhsex ae edu_max landholdsz15 mixedbeansha totharv
                    dloan SID_crops dinf_price dcoop_mem net_off_farm dist_market
                    dadv_ext TLU AERI AERIII

         chi2(17)     =    39.82
         Prob > chi2  =   0.0014
```

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Appendix 3, Heckman regression results of mixed bean market participation and intensity of participation.

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```
. heckman kgsold_total headage dhhsex ae edu_max landholdsz15 mixedbeansha totharv d
> loan dcoop_mem SID_crops dinf_price dist_market dadv_ext TLU AERI AERIII, select(t
> yphh = headage dhhsex ae edu_max landholdsz15 mixedbeansha totharv SID_crops dinf_
> price dloan dcoop_mem net_off_farm dist_market dadv_ext TLU AERI AERIII) twostep

Heckman selection model -- two-step estimates   Number of obs     =      1,283
(regression model with sample selection)              Selected    =        867
                                                      Nonselected =        416

                                                Wald chi2(16)     =   14249.22
                                                Prob > chi2       =     0.0000
```

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
kgsold_total						
headage	-.5501749	.1870035	-2.94	0.003	-.916695	-.1836548
dhhsex	.5802521	6.950908	0.08	0.933	-13.04328	14.20378
ae	-4.869571	1.241768	-3.92	0.000	-7.303392	-2.435751
edu_max	2.475904	.8978239	2.76	0.006	.716202	4.235607
landholdsz15	.1865147	.1647481	1.13	0.258	-.1363857	.509415
mixedbeansha	18.79244	4.951497	3.80	0.000	9.087688	28.4972
totharv	.7886269	.0073404	107.44	0.000	.7742399	.8030139
dloan	1.697414	8.712968	0.19	0.846	-15.37969	18.77452
dcoop_mem	-2.945389	5.388916	-0.55	0.585	-13.50747	7.616693
SID_crops	-6.173098	16.34557	-0.38	0.706	-38.20983	25.86363
dinf_price	2.042185	5.782466	0.35	0.724	-9.291241	13.37561
dist_market	.0797921	.0717933	1.11	0.266	-.0609203	.2205044
dadv_ext	5.772365	4.977633	1.16	0.246	-3.983617	15.52835
TLU	-1.126634	.4213863	-2.67	0.008	-1.952536	-.3007323
AERI	-37.78253	20.55902	-1.84	0.066	-78.07747	2.512406
AERIII	-8.424109	8.036271	-1.05	0.295	-24.17491	7.326692
_cons	-11.2572	21.77011	-0.52	0.605	-53.92583	31.41143
typhh						
headage	-.0041198	.0030272	-1.36	0.174	-.010053	.0018134
dhhsex	.0423967	.111394	0.38	0.703	-.1759314	.2607249
ae	-.0016384	.0209309	-0.08	0.938	-.0426622	.0393853
edu_max	.024287	.0147892	1.64	0.101	-.0046993	.0532732
landholdsz15	.0051741	.0045818	1.13	0.259	-.0038061	.0141543
mixedbeansha	.027079	.1492817	0.18	0.856	-.2655078	.3196658
totharv	.0040162	.0003832	10.48	0.000	.0032651	.0047673
SID_crops	.4112476	.2527147	1.63	0.104	-.084064	.9065593
dinf_price	.1575804	.0931763	1.69	0.091	-.0250417	.3402025
dloan	-.0518838	.1443977	-0.36	0.719	-.3348981	.2311304
dcoop_mem	.0174425	.0888283	0.20	0.844	-.1566578	.1915428
net_off_farm	-4.65e-06	1.77e-06	-2.63	0.009	-8.11e-06	-1.18e-06
dist_market	.0008576	.0012419	0.69	0.490	-.0015764	.0032917
dadv_ext	.0764455	.0855008	0.89	0.371	-.0911329	.244024
TLU	-.0033625	.0052459	-0.64	0.522	-.0136442	.0069192
AERI	-.7063008	.2357347	-3.00	0.003	-1.168332	-.2442694
AERIII	.4681076	.1154439	4.05	0.000	.2418416	.6943735
_cons	-.8983909	.2735581	-3.28	0.001	-1.434555	-.3622269
/mills						
lambda	36.19492	12.51386	2.89	0.004	11.66822	60.72163
rho	0.51417					
sigma	70.394405					

Appendix 4. Marginal effects for the Heckman selection equation

```
Average marginal effects                        Number of obs     =      1,283
Model VCE    : Conventional

Expression   : Pr(typhh), predict(psel)
dy/dx w.r.t. : headage dhhsex ae edu_max landholdsz15 mixedbeansha totharv dloan
               dcoop_mem SID_crops dinf_price dist_market dadv_ext TLU AERI AERIII
               net_off_farm
```

	Delta-method dy/dx	Std. Err.	z	P>|z|	[95% Conf.	Interval]
headage	-.0012259	.0008982	-1.36	0.172	-.0029864	.0005346
dhhsex	.0126156	.033143	0.38	0.703	-.0523434	.0775746
ae	-.0004875	.0062283	-0.08	0.938	-.0126948	.0117197
edu_max	.0072268	.0043817	1.65	0.099	-.0013611	.0158147
landholdsz15	.0015396	.0013607	1.13	0.258	-.0011273	.0042065
mixedbeansha	.0080576	.0444183	0.18	0.856	-.0790006	.0951159
totharv	.0011951	.0001052	11.36	0.000	.0009889	.0014012
dloan	-.0154386	.0429604	-0.36	0.719	-.0996394	.0687623
dcoop_mem	.0051902	.0264295	0.20	0.844	-.0466106	.056991
SID_crops	.1223709	.0749124	1.63	0.102	-.0244546	.2691965
dinf_price	.0468897	.0275942	1.70	0.089	-.0071939	.1009733
dist_market	.0002552	.0003693	0.69	0.490	-.0004686	.000979
dadv_ext	.0227472	.025419	0.89	0.371	-.0270732	.0725675
TLU	-.0010005	.0015601	-0.64	0.521	-.0040583	.0020572
AERI	-.210167	.0693405	-3.03	0.002	-.3460718	-.0742622
AERIII	.1392902	.033577	4.15	0.000	.0734804	.2050999
net_off_farm	-1.38e-06	5.21e-07	-2.65	0.008	-2.40e-06	-3.61e-07

Appendix 5. Marginal effects for the Heckman Outcome equation

```
. margins, dydx(*)

Average marginal effects                        Number of obs     =      1,283
Model VCE    : Conventional

Expression   : Linear prediction, predict()
dy/dx w.r.t. : headage dhhsex ae edu_max landholdsz15 mixedbeansha totharv dloan
               dcoop_mem SID_crops dinf_price dist_market dadv_ext TLU AERI AERIII
               net_off_farm
```

	dy/dx	Delta-method Std. Err.	z	P>|z|	[95% Conf.	Interval]
headage	-.5501749	.1870035	-2.94	0.003	-.916695	-.1836548
dhhsex	.5802521	6.950908	0.08	0.933	-13.04328	14.20378
ae	-4.869571	1.241768	-3.92	0.000	-7.303392	-2.435751
edu_max	2.475904	.8978239	2.76	0.006	.716202	4.235607
landholdsz15	.1865147	.1647481	1.13	0.258	-.1363857	.509415
mixedbeansha	18.79244	4.951497	3.80	0.000	9.087688	28.4972
totharv	.7886269	.0073404	107.44	0.000	.7742399	.8030139
dloan	1.697414	8.712968	0.19	0.846	-15.37969	18.77452
dcoop_mem	-2.945389	5.388916	-0.55	0.585	-13.50747	7.616693
SID_crops	-6.173098	16.34557	-0.38	0.706	-38.20983	25.86363
dinf_price	2.042185	5.782466	0.35	0.724	-9.291241	13.37561
dist_market	.0797921	.0717933	1.11	0.266	-.0609203	.2205044
dadv_ext	5.772365	4.977633	1.16	0.246	-3.983617	15.52835
TLU	-1.126634	.4213863	-2.67	0.008	-1.952536	-.3007323
AERI	-37.78253	20.55902	-1.84	0.066	-78.07747	2.512406
AERIII	-8.424109	8.036271	-1.05	0.295	-24.17491	7.326692
net_off_farm	0	(omitted)				

Appendix 6: Variance Inflation Factor (VIF) results for the Multinomial Logit Model

```
. vif
```

Variable	VIF	1/VIF
mixedbeansha	1.46	0.686396
totharv	1.42	0.702214
AERIII	1.26	0.791646
TLU	1.23	0.811692
edu_max	1.19	0.837118
ae	1.19	0.842290
AERI	1.14	0.880489
dhhsex	1.12	0.891081
dcoop_mem	1.12	0.894125
dadv_ext	1.11	0.901340
headage	1.10	0.907526
net_off_farm	1.10	0.907915
SID_crops	1.07	0.931805
dloan	1.06	0.938995
dinf_price	1.06	0.945540
landholdsz15	1.05	0.949392
dist_market	1.03	0.970276
Mean VIF	1.16	

Appendix 7. Breusch-Pagan / Cook-Weisberg test for heteroscedasticity - MNL

```
. hettest headage dhhsex ae edu_max SID_crops landholdsz15 mixedbeansha totharv dinf
> _price dloan dcoop_mem dist_market net_off_farm dadv_ext TLU AERI AERIII

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: headage dhhsex ae edu_max SID_crops landholdsz15 mixedbeansha
                    totharv dinf_price dloan dcoop_mem dist_market net_off_farm
                    dadv_ext TLU AERI AERIII

         chi2(17)     =    18.90
         Prob > chi2  =   0.3343
```

Appendix 8. Coefficient results of the Multinomial Logit Regression

```
. mlogit channel headage dhhsex ae edu_max SID_crops landholdsz15 mixedbeansha totha
> rv dinf_price dloan dcoop_mem dist_market net_off_farm dadv_ext TLU AERI AERIII, r
> obust

Iteration 0:   log pseudolikelihood = -975.31902
Iteration 1:   log pseudolikelihood = -907.99101
Iteration 2:   log pseudolikelihood = -880.26845
Iteration 3:   log pseudolikelihood = -869.40092
Iteration 4:   log pseudolikelihood = -863.66722
Iteration 5:   log pseudolikelihood = -862.84222
Iteration 6:   log pseudolikelihood = -862.80024
Iteration 7:   log pseudolikelihood = -862.79898
Iteration 8:   log pseudolikelihood = -862.79888
Iteration 9:   log pseudolikelihood = -862.79885

Multinomial logistic regression                 Number of obs     =        867
                                                Wald chi2(51)     =     924.73
                                                Prob > chi2       =     0.0000
Log pseudolikelihood = -862.79885               Pseudo R2         =     0.1154
```

channel	Coef.	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
small_scale_tra~r	(base outcome)					
retailer_market~r						
headage	.0013832	.0078057	0.18	0.859	-.0139156	.016682
dhhsex	.368568	.2907045	1.27	0.205	-.2012023	.9383383
ae	-.032938	.0514735	-0.64	0.522	-.1338242	.0679482
edu_max	.0704264	.0373208	1.89	0.059	-.002721	.1435737
SID_crops	-.2124107	.68215	-0.31	0.756	-1.5494	1.124579
landholdsz15	.0046318	.0054919	0.84	0.399	-.0061321	.0153958
mixedbeansha	-.1863968	.1601683	-1.16	0.245	-.5003209	.1275273
totharv	.0001225	.0002342	0.52	0.601	-.0003365	.0005815
dinf_price	.4036824	.2459814	1.64	0.101	-.0784323	.8857971
dloan	-.0882999	.3511239	-0.25	0.801	-.77649	.5998902
dcoop_mem	-.2869335	.2098685	-1.37	0.172	-.6982682	.1244013
dist_market	-.0092983	.003538	-2.63	0.009	-.0162326	-.002364
net_off_farm	7.92e-06	5.47e-06	1.45	0.148	-2.80e-06	.0000186
dadv_ext	.4459934	.2003158	2.23	0.026	.0533816	.8386052
TLU	-.0474245	.0396971	-1.19	0.232	-.1252293	.0303804
AERI	-.3454983	1.276946	-0.27	0.787	-2.848266	2.15727
AERIII	-.1994783	.295029	-0.68	0.499	-.7777246	.378768
_cons	-1.596741	.7284331	-2.19	0.028	-3.024443	-.1690381
other_households						
headage	.0095624	.0066183	1.44	0.149	-.0034092	.022534
dhhsex	-.0876237	.2661281	-0.33	0.742	-.6092252	.4339779
ae	-.0230563	.0492188	-0.47	0.639	-.1195235	.0734108
edu_max	-.0057781	.0369	-0.16	0.876	-.0781008	.0665446
SID_crops	-1.435514	.6134167	-2.34	0.019	-2.637788	-.2332392
landholdsz15	.0038365	.005578	0.69	0.492	-.0070962	.0147693
mixedbeansha	-1.62701	.50229	-3.24	0.001	-2.611481	-.64254
totharv	-.0054452	.0012231	-4.45	0.000	-.0078423	-.003048
dinf_price	-.2028605	.222444	-0.91	0.362	-.6388427	.2331217
dloan	.0339579	.3547384	0.10	0.924	-.6613166	.7292324
dcoop_mem	.1134884	.2160661	0.53	0.599	-.3099935	.5369703
dist_market	-.003119	.0027764	-1.12	0.261	-.0085607	.0023226
net_off_farm	.0000166	5.57e-06	2.99	0.003	5.72e-06	.0000275
dadv_ext	.2289629	.1998255	1.15	0.252	-.1626879	.6206137
TLU	.0110819	.018615	0.60	0.552	-.0254028	.0475666
AERI	2.512541	.7928066	3.17	0.002	.9586683	4.066413
AERIII	.1593955	.3266408	0.49	0.626	-.4808087	.7995998
_cons	.8863022	.6664852	1.33	0.184	-.4199848	2.192589
other_buyers						
headage	.0080045	.0130452	0.61	0.539	-.0175636	.0335726
dhhsex	.3290066	.5105207	0.64	0.519	-.6715956	1.329609
ae	-.0639439	.0914438	-0.70	0.484	-.2431704	.1152826
edu_max	.1694168	.068795	2.46	0.014	.0345811	.3042524
SID_crops	-1.702307	1.00597	-1.69	0.091	-3.673973	.2693579
landholdsz15	-.019109	.0162566	-1.18	0.240	-.0509714	.0127534
mixedbeansha	-.398667	.2769051	-1.44	0.150	-.941391	.144057
totharv	.0002786	.0002732	1.02	0.308	-.0002567	.000814
dinf_price	-.0466207	.4552938	-0.10	0.918	-.9389802	.8457387
dloan	.0781677	.5982648	0.13	0.896	-1.09441	1.250745
dcoop_mem	.4615277	.4630062	1.00	0.319	-.4459478	1.369003
dist_market	-.0069963	.0054437	-1.29	0.199	-.0176657	.0036731
net_off_farm	.0000184	5.64e-06	3.27	0.001	7.40e-06	.0000295
dadv_ext	.4736957	.3930678	1.21	0.228	-.296703	1.244094
TLU	-.0031023	.0230088	-0.13	0.893	-.0481987	.0419941
AERI	-12.4376	.816945	-15.22	0.000	-14.03878	-10.83641
AERIII	-.0338483	.526637	-0.06	0.949	-1.066038	.9983411
_cons	-3.79329	1.494602	-2.54	0.011	-6.722656	-.8639239

Appendix 9. Marginal Effects Results – Retailer/Marketeer Market Channel

```
. mfx, predict (pr outcome(2))

Marginal effects after mlogit
      y  = Pr(channel==retailer_marketeer) (predict, pr outcome(2))
         =  .21935145
```

variable	dy/dx	Std. Err.	z	P>|z|	[95% C.I.]		X
headage	-.0000727	.00129	-0.06	0.955	-.002598	.002452	47.2964
dhhsex*	.0587262	.04074	1.44	0.149	-.02113	.138583	.852364
ae	-.0045708	.0086	-0.53	0.595	-.021418	.012277	5.43706
edu_max	.0109857	.00616	1.78	0.074	-.001082	.023054	8.67935
SID_cr~s	.0137189	.11298	0.12	0.903	-.207716	.235153	.561156
landh~15	.0008305	.00088	0.95	0.343	-.000885	.002546	7.35854
mixedb~a	.0137793	.02878	0.48	0.632	-.042626	.070185	.516103
totharv	.0001622	.00005	3.58	0.000	.000073	.000251	261.796
dinf_p~e*	.0700613	.03542	1.98	0.048	.000645	.139477	.770473
dloan*	-.0162283	.05628	-0.29	0.773	-.126539	.094082	.083045
dcoop_~m*	-.0571082	.03718	-1.54	0.125	-.129988	.015772	.700115
dist_m~t	-.0014595	.00058	-2.52	0.012	-.002595	-.000324	26.5934
net_of~m	7.84e-07	.00000	0.94	0.347	-8.5e-07	2.4e-06	7313.59
dadv_ext*	.0658352	.03198	2.06	0.040	.00315	.128521	.580161
TLU	-.00839	.00681	-1.23	0.218	-.021741	.004962	2.3481
AERI*	-.149071	.08516	-1.75	0.080	-.315988	.017846	.014994
AERIII*	-.0396083	.05261	-0.75	0.452	-.142729	.063512	.866205

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

Appendix 10. Marginal Effects Results – Other households Market Channel

```
. mfx, predict (pr outcome(3))

Marginal effects after mlogit
      y  = Pr(channel==other_households) (predict, pr outcome(3))
         =  .11996076
```

variable	dy/dx	Std. Err.	z	P>|z|	[95% C.I.]		X
headage	.0009414	.00068	1.39	0.164	-.000385	.002268	47.2964
dhhsex*	-.0202354	.02936	-0.69	0.491	-.077777	.037306	.852364
ae	-.0013143	.00504	-0.26	0.794	-.011198	.008569	5.43706
edu_max	-.0031336	.00373	-0.84	0.400	-.010436	.004169	8.67935
SID_cr~s	-.1392216	.06428	-2.17	0.030	-.265201	-.013243	.561156
landh~15	.0003588	.00053	0.67	0.502	-.000689	.001406	7.35854
mixedb~a	-.1652814	.05147	-3.21	0.001	-.266168	-.064395	.516103
totharv	-.0005792	.0001	-5.86	0.000	-.000773	-.000386	261.796
dinf_p~e*	-.0329071	.02693	-1.22	0.222	-.085684	.019869	.770473
dloan*	.005612	.03787	0.15	0.882	-.068604	.079827	.083045
dcoop_~m*	.0177299	.02068	0.86	0.391	-.022803	.058262	.700115
dist_m~t	-.0000569	.00028	-0.20	0.841	-.000612	.000498	26.5934
net_of~m	1.47e-06	.00000	2.90	0.004	4.8e-07	2.5e-06	7313.59
dadv_ext*	.010766	.02024	0.53	0.595	-.028909	.050441	.580161
TLU	.0024301	.00232	1.05	0.294	-.002108	.006968	2.3481
AERI*	.5300508	.17553	3.02	0.003	.186011	.87409	.014994
AERIII*	.0212024	.02914	0.73	0.467	-.035916	.078321	.866205

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

Appendix 11. Marginal Effects Results – Other buyers market channel

```
. mfx, predict (pr outcome(4))

Marginal effects after mlogit
      y  = Pr(channel==other_buyers) (predict, pr outcome(4))
         =  .03298817
```

variable	dy/dx	Std. Err.	z	P>|z|	[95% C.I.]		X
headage	.0002075	.00041	0.51	0.613	-.000596	.001011	47.2964
dhhsex*	.0077543	.0136	0.57	0.569	-.018906	.034415	.852364
ae	-.0017102	.00288	-0.59	0.553	-.007355	.003934	5.43706
edu_max	.0049176	.00198	2.48	0.013	.001028	.008807	8.67935
SID_cr~s	-.0470858	.0317	-1.49	0.137	-.109213	.015042	.561156
landh~15	-.0006583	.00052	-1.27	0.205	-.001676	.000359	7.35854
mixedb~a	-.0049301	.00884	-0.56	0.577	-.022258	.012398	.516103
totharv	.0000296	.00001	3.10	0.002	.000011	.000048	261.796
dinf_p~e*	-.003374	.01508	-0.22	0.823	-.032921	.026173	.770473
dloan*	.003087	.02021	0.15	0.879	-.036514	.042688	.083045
dcoop_~m*	.0150582	.01236	1.22	0.223	-.00917	.039286	.700115
dist_m~t	-.0001436	.00017	-0.86	0.390	-.000471	.000184	26.5934
net_of~m	4.65e-07	.00000	2.83	0.005	1.4e-07	7.9e-07	7313.59
dadv_ext*	.010776	.01182	0.91	0.362	-.012385	.033937	.580161
TLU	.0002003	.00077	0.26	0.796	-.001318	.001719	2.3481
AERI*	-.0396138	.00782	-5.06	0.000	-.054948	-.02428	.014994
AERIII*	-.0001312	.01647	-0.01	0.994	-.032408	.032145	.866205

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