

**GROUNDNUT VARIETY REPLACEMENT, MARKET STRUCTURE, MARKETED
SURPLUS AND DEMAND FOR IMPROVED VARIETIES IN MALAWI: THE CASE OF
SMALLHOLDERS AND TRADERS**

By

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ABSTRACT

Groundnut is an important crop for the Malawian agricultural sector. It has the potential to increase agricultural farm incomes and contribute to improving food security for the predominantly maize-based food production system. The Government of Malawi also considers groundnut as one of the legume crops to complement dwindling export earnings from tobacco, which is the main export crop for the country. Despite its potential to contribute to the economic wellbeing of smallholders and the economy at large, the empirical literature has not adequately investigated how factors inherent in the production and marketing chain affect the performance of the groundnut subsector. Given this, the objectives of this study were to: investigate factors that determine smallholder' replacement decisions of conventional and modern varieties of groundnuts; assess effects of marketed surplus on demand for improved varieties by smallholders, and determine market competitiveness and entry barriers for groundnut markets among intermediary traders in central and northern Malawi. These objectives were achieved with survey data collected from groundnut smallholder producers and intermediary traders. Simple and systematic random sample sizes of 416 and 124 respectively were selected. The study focused on five potential groundnut producing districts, namely, Lilongwe, Mchinji, Kasungu and Salima in central Malawi, and Mzimba in northern Malawi. Several econometric techniques were applied to analyze the data, namely, Bivariate Probit (BVP), Endogenous Switching Probit (ESP), and the Multivariate Probit (MVP) regression models.

The empirical results of the Bivariate Probit (BVP) model indicated that among the smallholders that replaced conventional with improved varieties, few reverted to the cultivation of the former. Other findings suggest that the probability that farmers would replace groundnut varieties, improved or conventional, was lower than the probability for not replacing them. Conversely, the probability of maintaining modern varieties was higher than that of maintaining conventional ones. Further results indicated that the production of groundnuts for food and income increased the probability of replacing both conventional and improved varieties. The statistical significance and the probability for this dual-purpose production were stronger and higher in the replacement of conventional varieties than for the modern ones. Factors related to the road infrastructure network decreased the likelihood of replacing conventional varieties, whereas institutional factors and smallholder' productive assets increased the likelihood of replacement of the same.

Finally, farm household characteristics and related institutional factors positively influenced the probability of replacing modern groundnut varieties. These findings suggest that promoting dual-purpose production of groundnuts could increase the adoption of modern varieties while concurrently maintaining the diversity of the conventional ones. Farmers that belong to farmer organizations, those experienced in groundnut production and human capital development of the farmers, are also critical in contributing to the conservation of conventional varieties through strategies that mitigate their erosion.

The results of the Endogenous Switching Probit (ESP) showed that marketed surplus had a positive effect on demand for improved varieties. The average treatment effect for smallholders with a marketed surplus (ATET) on the probability that they demanded improved varieties increased by 40%. Conversely, the average treatment effect for smallholders that did not have marketed surplus, the untreated (ATU), on the probability that they demanded improved varieties declined by 14%. Further, the marginal treatment effect (MTE) and average treatment effect (ATE) of marketed surplus on the probabilities to demand improved varieties increased by about 30% and 26%, respectively. Other results of this analysis revealed that despite groundnut productivity remaining constant for over a decade at smallholder level, marketed surplus, as indicated by the average commercialization index, was observed to be about twice the household's average consumption index. This finding suggests that farmers are orienting themselves towards the commercialized production of groundnuts. Access to market information, being involved in piece work jobs, yield per hectare and the proportion of total land allocated to the production of groundnuts had a positive and significant effect on marketed surplus. The positive average effects of marketed surplus on demand for improved varieties suggest that farmers that are inclined to intensify market participation value high yielding traits from improved varieties more than any other groundnut varietal attributes. The findings of the study suggest that demand for improved varieties among smallholders could increase if policy interventions could also focus on the challenges that smallholders encounter in the output market. In this case, increased crop productivity, engagement of smallholders in off-farm economic activities, and enhancing access to output market information are critical.

In other results, an interval Herfindahl-Hirschman Index (HHI) revealed the existence of a competitive structure in the local, district, and city groundnut markets. However, the Multivariate Probit (MVP) regression model showed more entry barriers in the local and city markets than in the district market. Such findings suggest that the existence of competitive market structures does not imply the absence of trader entry barriers into the markets. Other results of the MVP showed that experience in business and sole ownership of business positively influenced entry into the district and local markets, respectively. Market transaction costs and storage infrastructure negatively and positively influenced entry into local and city markets, respectively, while the quantity of produce transacted positively and negatively influenced entry into both local and city markets, respectively. Access to credit and informal credit sources positively and negatively influenced entry into city markets, respectively. Membership in informal trader' associations positively influenced entry into city markets. The findings of the study suggest that policy facilitation for the formation of formal trader associations and access to credit from formal financial institutions could enhance trader' participation in the city groundnut markets. Further, public-private partnership investment in storage facilities and public investment in road infrastructure is critical in reducing market transaction costs, which could enhance the participation of intermediary traders in the local and city groundnut markets.

The overall findings of the study attest to the need for policy support for an integrated smallholder groundnut seed system that would contribute to the growth and development of smallholder agriculture. Strategies that would enhance the adoption of improved varieties and minimize losses of indigenous germplasm are critical. In this vein, the marketed surplus has shown to be relevant to increase the demand for improved varieties among the smallholders. There is also a need for policy support in reducing constraints that prevent intermediary traders from enhancing their participation in the groundnut markets. In such a way, they would continue to render marketing services to smallholders, which otherwise could be costly if undertaken by themselves. One cross-cutting issue that merits attention for policy support is infrastructural development in improved road networks from crop production centers to the distribution of produce along the marketing chain of groundnuts.

DECLARATION 1: PLAGIARISM

I, Admire Katunga, declare that:

1. The research reported in this thesis, except where otherwise indicated or acknowledged, is my original work.
2. This thesis has not been submitted in full or in part for any degree or examination to any other university;
3. This thesis does not contain other persons' data, pictures, graphs or other information unless specifically acknowledged as being sourced from other persons;
4. This thesis does not contain other persons' writing unless specifically acknowledged as being sourced from other researchers. Where other written sources have been quoted, then:
 - a. Their words have been re-written, but the general information attributed to them has been referenced; or
 - b. Where their exact words have been used, their writing has been placed inside quotation marks and referenced.
5. This thesis does not contain text, graphics, or tables copied and pasted from the internet unless specifically acknowledged, and the sources are detailed in the references.

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Prof. Gerald Ortmann (Co-supervisor)

DECLARATION 2: PUBLICATIONS

The following papers derived from the thesis have been submitted and are under review:

Publication 1- Chapter 3 of this thesis

Katunga, A., E. Wale and G.F. Ortmann. Smallholders' variety replacement decisions: Implications for adoption of improved and conservation of conventional groundnut varieties in Malawi. Resubmitted: *Transactions of the Royal Society of South Africa*

Publication 2- Chapter 4 of this thesis

Katunga, A., E. Wale and G.F. Ortmann. Marketed surplus and demand for improved groundnut varieties: Empirical evidence from smallholders. Submitted and under review: *African Journal of Agriculture and Resource Economics*.

Publication 3- Chapter 5 of this thesis

Katunga, A., E. Wale and G.F. Ortmann. Market structure and entry barriers into groundnut markets: The case of intermediary traders. Revised and resubmitted: *Agrekon*.

Data analysis and write-up of the above publications were carried out by Admire Katunga with the technical advice and inputs from Prof. Edilegnaw Wale and Prof. Gerald Ortmann. All Figures and Tables were produced by the same unless referenced.

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CONFERENCE PAPER

Chapter 3 of the thesis was presented at the following conference:

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DEDICATION

I dedicate this work to the late Phillip Milanzi, my former primary school teacher, who, through his inspiration, I have managed to obtain this terminal degree. Your amazing encouragement gave me the foresight to look beyond merely attaining basic education. I will always remember you till we meet again in eternity (RIP).

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LIST OF ABBREVIATIONS

ADD	Agricultural Development Division
ADMARC	Agricultural Development Marketing Cooperation
AEDEC	Agricultural Extension Development Coordinator
ATE	Average Treatment Effect
ATET	Average Treatment Effect on the Treated
ATU	Average Treatment Effect on Untreated.
BNF	Biological Nitrogen Fixation
BVP	Bivariate Probit
CGIAR	Consultative Group for International Agricultural Research
CR4	4 firm Concentration Ratio
DAES	Department of Agricultural Extension Services
DARS	Department of Agricultural Research Services
EPAs	Extension Planning Areas
ESP	Endogenous Switching Probit
FAO	Food and Agricultural Organization
FAOSTAT	Food and Agricultural Organization Statistics
FGDs	Focus Group Discussions
FISP	Farm Input Subsidy Program
GDP	Gross Domestic Product
HHI	Herfindahl-Hirschman Index
IBM SPSS	IBM Statistical Package for Social Science
ICRISAT	International Crop Research in Semi-Arid Tropics
KIIs	Key informant Interviews
MAIWD	Ministry of Agriculture Irrigation and Water Development
MITC	Malawi Investment Trade Centre
MTE	Marginal Treatment Effect
MVP	Multivariate Probit
NAP	National Agriculture Policy
NARs	National Research Services

NASFAM	National Association of Smallholder Farmers of Malawi
NSP	National Seed Policy
SSA	Sub Saharan Africa
SSU	Seed Services Unit

CHAPTER 1

INTRODUCTION

1.1 Background

Agriculture is the hub of the Malawian economy. The sector contributes over a third of Gross Domestic Product (GDP) and generates over 80% of the export earnings of the country. It also offers self-employment opportunities to over 64% of the population of the country which is rural-based (Malawi-Government, 2017). The sector comprises of small scale and large scale producers (Banda *et al.*, 2014) who cultivate mainly food and cash crops, respectively. The main cash crop is tobacco, which contributes close to 40% of the GDP of the country from agriculture and more than 50% of total agricultural exports (FAO, 2014b), while maize is the main staple (Malawi-Government, 2012). Maize is cultivated widely by smallholders and occupies substantial areas of land cultivated to food crops. However, the production of tobacco and maize is relatively capital intensive. Large doses of expensive inorganic fertilizer are required for optimal yields. Most smallholders are resource poor and cannot afford it.

Furthermore, the competitiveness of tobacco on the international market is declining due to health risk-related issues (Geist *et al.*, 2008). In the absence of alternative cash crops, rural livelihoods, and the economy, in general, will be affected. Given this, the government of Malawi has been encouraging farmers to diversify the production of crops. A wide array of crops exists that has the potential to improve the welfare of farmers and increase the growth of the agricultural sector. Legumes, namely soya beans, common beans, pigeon peas, and groundnuts, are, therefore, perceived to be strategic crops to contribute to food and income security, increase in export earnings, and reduction of malnutrition in Malawi (Makoka, 2012).

Groundnut (*Arachis hypogaea*) is one of the legumes widely cultivated by smallholders in Malawi. It is mostly grown by women farmers (Tsusaka *et al.*, 2016b) and ranks second to maize in terms of land area cultivated to food crops. The crop adapts well to most agro-ecological conditions of the country. It contributes to food and income security among smallholder farm households in several ways. The crop is a relatively cheap source of vegetable protein and vitamins. It provides valuable protein, edible oil, fats, energy, minerals, and vitamins for both rural and urban dwellers (Simtowe *et al.*, 2010b).

For this reason, the National Agricultural Policy (NAP) promotes its increased production to enhance the nutritional status of Malawians (Malawi-Government, 2016a). As a legume, groundnut contributes to enhanced soil fertility through Biological Nitrogen Fixation (BNF). Residual nitrogen reduces the demand for inorganic fertilizers on other crops that are cultivated in rotation with it (Simtowe *et al.*, 2010b). This is an essential contribution of groundnuts to agricultural production in Malawi, considering that the majority of smallholders are cash-constrained to afford inorganic fertilizer. Groundnut is also rich in digestible crude protein, and, as such, it forms an essential component of livestock feed through groundnut haulm and seed cake (Simtowe *et al.*, 2010b). About 40% of the total production of groundnuts is sold on both domestic and export markets (Gourichon *et al.*, 2017). The export market comprises 15% of the total production of groundnut destined to regional markets of Tanzania, Kenya, and South Africa (FAO, 2014a). The increase in the exports of the crop makes it a potential complement to the agricultural export earnings of the country.

Both conventional and modern varieties of groundnuts are available in the production system. Chalimbana is the most commonly cultivated conventional variety, while CG7 is the most popular improved one. Other conventional varieties include Galumbwako, Kalisele, Katerera, and Gambia (Mulwa *et al.*, 2011), while the improved ones are Nsinjiro, Baka, and Kakoma (Siambi *et al.*, 2015). The seed systems for groundnuts comprise of informal and formal subsectors. Conventional seed varieties and recycled seed dominate the informal system (Nordhagen and Pascua, 2012). Public and private sector institutions, which include agro-dealers, government subsidy programs, farmer organizations, and non-governmental organizations, are the leading suppliers of modern seed varieties in the formal sector (Makoka, 2012; Siambi *et al.*, 2015). According to Derlagen and Phiri (2012), and using same field management practices, improved varieties of groundnuts have a yielding advantage of 60% compared to the conventional ones. Despite such a potential yield difference, conventional varieties have remained the mainstream of the seed sources of smallholders (Simtowe *et al.*, 2010b; Siambi *et al.*, 2015). However, farmers cultivate both groundnut varieties as a single crop or intercropped with other crops, such as cereals (Minde *et al.*, 2008).

The economic benefits that the crop offers can be realized with increased production of the crop. With improved varieties, the potential yield of groundnuts is 3000 Kg ha⁻¹, while the smallholders obtain yields of less than 1000 kg ha⁻¹ from the conventional varieties (Siambi *et al.*, 2015). This suggests that the current average yields of groundnuts under the smallholders are relatively low. Factors that are inherent in seed production, distribution channels, and output markets of the groundnut subsector contribute to its dismal performance (Minde *et al.*, 2008; Makoka, 2012). The key factors are the low utilization of improved varieties among the producers and the relatively low prices that the traders offer producers.

Low utilization of improved varieties emanates from inadequate access to quality seeds among the smallholders and that the seed system for legume crops in Malawi is underdeveloped (Makoka, 2012; Siambi *et al.*, 2015). Few commercial seed producers produce seed for legumes, including groundnuts, due to the narrow profit margins of the enterprise (Siambi *et al.*, 2015). The consequence of this is a shortage of supply of certified seed on the seed market, or that seed is expensive for smallholders to purchase. However, the government, in collaboration with some stakeholders, is implementing seed access support programs. Through these initiatives, some smallholders access seed through seed loans, buy it at subsidized prices or get it for free (Dorward *et al.*, 2008; Makoka, 2012; Siambi *et al.*, 2015). Some of the organisations and projects that facilitate access to certified groundnut seed among the smallholders include international agricultural research institutions, farmer' organizations, government projects, and programs, and non-governmental organizations. Because of budgetary constraints, not all the smallholders benefit from these initiatives. Consequently, this compels farmers to rely on low quality local and recycled seeds, which exacerbate the decline in production and productivity of the crop (Simtowe *et al.*, 2010a).

Low yields that smallholders obtain are also reflected at the national level. Between 1980 and 2000, the country recorded negative national average annual growth rates in both production and productivity (yield per hectare) (FAOSTAT, 2017). A similar scenario was also observed in the supply and demand for seed. Among other factors, Minde *et al.* (2008) attributed the decline to utilization of low yielding conventional varieties by farmers that dominated the groundnut production system. Other constraints that affected production are abiotic and biotic stresses, and

loss of the traditional groundnut export markets for the country (Simtowe *et al.*, 2010b; Derlagen and Phiri, 2012). However, the situation improved between 2001 and 2010 when average growth rates in production, productivity, and seed supply increased to record highs of 21%, 12% and 3%, respectively (FAOSTAT, 2017). In addition to expansion in land area cultivated to groundnuts, the introduction of improved varieties in the production system played a role (Siambi *et al.*, 2015). During the same period, seed supply and productivity also increased (FAOSTAT, 2017). This is a manifestation of the positive impact of the improved varieties on production. At the farm level, the increase in production means sufficient harvest for household consumption as well as for sale. An increase in the intensity of market participation among the producers is critical for enhanced commercialised production. Besides increased marketable surplus, commercialised crop production also entails the increased use of highly productive agricultural technologies which include improved crop varieties (Pingali and Rosegrant, 1995; Pingali, 1997). Further, increased crop production at the national level contributes to the growth of the economy through increased export earnings.

Before liberalizing agricultural grain markets, farmers in most developing countries had one market alternative to sell their produce (Kherallah *et al.*, 2000). In Malawi, between 1971 and 1987, the state-controlled Agricultural Development and Marketing Corporation (ADMARC) was the sole buyer of smallholder' agricultural produce (Chirwa *et al.*, 2005), which included groundnuts. The corporation controlled prices that farmers received for selling produce and were relatively low (Kherallah *et al.*, 2000). This suggests that the form of market structure that prevailed was not competitive. With liberalization, many private traders were allowed to participate in grain marketing. The traders included large and small scale intermediaries (Chirwa *et al.*, 2005). The expectation was that the participation of the many traders in the markets would create competition. Prices that farmers would get for selling produce were also expected to improve (Chirwa *et al.*, 2005). The general expectation was that market liberalisation would enhance the efficient functioning of both the input and product markets, which should benefit producers, traders as well as consumers.

Decades after market liberalization, agricultural output markets remain underdeveloped and inefficient (Coulter and Onumah, 2002; Swinnen *et al.*, 2010). The declining role of ADMARC in

grain marketing resulted in the closure of some of its rural markets, which were deemed to be too costly to operate (Chirwa *et al.*, 2005). This had implications on access to distant markets by smallholders (Nucifora, 2003). However, producers accuse the private traders that they offer relatively lower prices when purchasing produce at the farm gates (Pokhrel and Thapa, 2007). Low prices demotivate farmers to invest in improved agricultural technologies (Muratori, 2016). This consequently affects crop productivity (Osborne, 2004; Murphy, 2006), which reduces the quantities that farmers offer for sale. Reduced commercialisation drive among the smallholder affects the production of marketable surplus (Barrett, 2008), with its adverse effects reflected on the welfare of farmers (Mmbando *et al.*, 2015b) and the economy in general.

Notwithstanding their alleged exploitative marketing behaviour, intermediary traders remain a reliable source of market outlet for produce from smallholders (Mapila *et al.*, 2013). They buy produce from farmers at the farm gate and local markets and resell it to distant markets (FAO, 2014a). In so doing, they help reduce transaction costs that producers and other buyers would incur (Muratori, 2016). The participation of the intermediary traders in the markets has, therefore, implications for improved livelihoods of farmers (Mmbando, 2014) and efficient functioning of the markets.

1.2 Problem Statement and Justification

The performance of agriculture in terms of production and productivity in much of sub-Saharan Africa (SSA) lags behind that of other developing countries (Diao *et al.*, 2010). The majority of smallholders still face challenges to adequately access quality seed as a result of the underdeveloped seed system (Tripp and Rohrbach, 2001). The provision of free or subsidized seed by government and other donor projects (Makoka, 2012; Siambi *et al.*, 2015) has further affected the development of the commercial seed sector because production and multiplication of certified seed are done by few stakeholders. Due to budgetary constraints, only a few smallholders benefit from the seed support programs (Dorward *et al.*, 2008). The implication of this is that the majority of them continue to rely on low yielding conventional varieties as their primary source of seed (Monyo *et al.*, 2004; Simtowe *et al.*, 2010b).

Further, commercial seed producers also find it unprofitable to produce seed for crops that are self-pollinated such as groundnuts. This is because farmers re-produce them on the farm (Minot *et al.*,

2007). However, seed support programs are short term measures to improve access to quality seed among smallholders. Because of such unsustainability, uptake of high yielding improved varieties among the smallholders becomes inconsistent. Consequently, smallholder crop productivity remains stagnant or continues to decline, affecting production in the crop subsector. However, not all smallholders that use conventional varieties have difficulties in accessing the improved ones. Some smallholders prefer varietal attributes of the former (Waldman *et al.*, 2017). Despite being relatively low yielding, smallholders who value consumption, marketability, and drought tolerance attributes of conventional varieties (Ward *et al.*, 2014; Waldman *et al.*, 2016; Waldman *et al.*, 2017) continue cultivating them or replace the improved ones.

The other challenge that smallholders face is the problem of low marketed surplus. Low marketed surplus not only has implications for their welfare but also on the non-farming community. For example, currently, in Malawi, groundnut producers consume a relatively higher proportion of their harvest than what they sell (FAO, 2014a). The result of this is a low supply of food crops on the market. However, the genesis of this is that smallholders continue cultivating low yielding varieties (Simtowe *et al.*, 2010b). As indicated earlier, despite their inability to access improved varieties, farmers demand crop varieties with the attributes that they prefer. However, the heterogeneity of farmers reinforces their perception of the value that they attach to the different crop varietal attributes (Lunduka *et al.*, 2012). Farmers that are resource-poor choose varieties that address diverse needs for their basic survival (Wale and Chianu, 2015). For this category of farmers, the production of crops is purely for subsistence. Conversely, farmers that consider farming as their primary source of income and are inclined to produce marketable surplus demand high yielding improved varieties (Wale and Holm-Mueller, 2017). In such circumstances, the need to produce marketable surplus drives their choice of the high yielding varieties (Wale and Chianu, 2015).

Access to markets and market information also remains a challenge to a majority of smallholders. Most output markets that farmers sell produce to are far away from their homesteads (Fafchamps and Hill, 2005; Ouma *et al.*, 2010; Muratori, 2016). Such geographical dispersion of smallholders with the markets implies that they are devoid of access to market information (Ellis, 1996). As a consequence, market transaction costs in terms of search and transportation costs are increased,

ultimately reducing marketed surplus of smallholders (Alene *et al.*, 2008; Ouma *et al.*, 2010). Intermediary traders also encounter numerous constraints when distributing produce along the marketing chain. Most of the markets are inaccessible and uncompetitive, and in some cases, markets for certain agricultural products are missing (Dessaegn *et al.*, 1998; Chirwa *et al.*, 2005; Muratori, 2016).

In addition to distance, most rural road networks to urban markets are in a poor state. Traders incur more transportation costs to ship produce from purchase sources to the resell markets. According to Fafchamps and Gabre-Madhin (2006), transportation costs comprise a high proportion of market transaction costs in agricultural markets of developing countries. Market liberalisation allowed many private traders to participate in agricultural markets. However, the increase in market transaction costs restricts some traders from participating in specific markets. The types of market structures that exist, whether perfectly competitive or imperfectly competitive, is determined by the number of traders that are participating in the market and their respective market shares (Sun and Shao, 2009). In the absence of market competition, the marketing behaviour of the traders is viewed with suspicion. Producers allege that the traders offer lower prices when buying produce than the marketing margins they expropriate along the market chain of products (Jones *et al.*, 2002). Such low price results in a reduction of the market returns for smallholders' which has implications for their production decisions (Muratori, 2016) in terms of the quantities to produce.

If agriculture is to contribute to the economic development of sub-Saharan countries, just as it did with Asian countries, there is a need for a rapid change in the performance of the sector (Collier and Dercon, 2014b). Among others, such a change can take place if the majority of the smallholders have access to high yielding improved crop varieties and productive farm inputs through enhanced access to credit. Better access to markets and market information would also be critical in reducing market transaction costs that hinder smallholders from increasing marketed surplus. Access to public resources such as agricultural extension services and membership to farmers' organizations could also facilitate the adoption of improved technologies and link up farmers to output markets, respectively.

Further to this, a conducive environment must also exist in the output markets, so that chain actors receive fair shares of revenue generated along the supply chain. Policy efforts to facilitate sustainable access to improved crop varieties among the farmers require an understanding of variety replacement decisions and their implications for the adoption of improved varieties and conservation of the conventional ones. There are few studies done in sub-Saharan Africa that attempted to understand the determinants of seed variety replacement. For example, Wale (2012) examined factors that influenced smallholders to abandon traditional crop varieties in Ethiopia. Another study by Wale and Holm-Mueller (2017) explored views of farmers on the replacement of traditional varieties of crops in north-eastern Ethiopia. Finally, Wale and Chianu (2015) investigated the link between the demand for particular varieties and the value that farmers attach to specific varietal attributes. Only one study was conducted in Malawi, whose findings suggest that preference of farmers for a perennial (local) pigeon pea variety over an improved one was due to the value they attached to the traits of the former (Waldman *et al.*, 2017).

Empirical studies have also not adequately investigated the impact of marketed surplus on demand for improved crop technologies among smallholders in sub-Saharan African (SSA) countries. Nevertheless, a few empirical studies have determined factors that affect marketed surplus (Bardhan, 1970; Alene *et al.*, 2008; Baba *et al.*, 2010; Kraybill *et al.*, 2012; Zanello, 2012; Adenuga *et al.*, 2013; Ali *et al.*, 2014; Burke *et al.*, 2015a). Among other factors, market sources, market access, farmer organizations, and farm size were critical factors. None of the studies investigated the effect of piece work jobs on marketed surplus. Piece work jobs, known as *ganyu* in Malawi, is the most popular livelihood coping strategies among smallholders (Whiteside, 2000). It is also a form of off-farm income diversification activity that smallholders undertake. However, piece work jobs run in conflict with supply of labour in the field of smallholders. The reason is that the smallholders are engaged in piece work jobs during the peak period of labour demand in their fields. Understanding its effect on marketed surplus contributes to policy in formulating alternative income diversification activities for the smallholders that contribute to crop productivity and also the socio-economic development of their communities.

Available in the empirical literature is also evidence of various indicators of welfare among smallholder households in the SSA region that considered outcomes of interventions as continuous

variables (Asfaw *et al.*, 2012; Bezu *et al.*, 2014; Shiferaw *et al.*, 2014; Khonje *et al.*, 2015; Manda *et al.*, 2016; Manda *et al.*, 2018). Examples of the continuous outcome variables these studies focused on include crop income, consumption expenditure, maize yield, food surplus, and own crop consumption. Inquiry on such variables requires that farm households recall specific events that happened months or sometimes years in the past. In this case, it becomes a challenge, as smallholder farm households do not keep records of their daily undertakings. As a consequence, they may, in some cases, understate or overstate the situation leading to bias or measurement error (Beegle *et al.*, 2011) of the outcomes.

Few empirical studies have also determined the competitiveness of agricultural markets in SSA countries (Dessalegn *et al.*, 1998; Enibe *et al.*, 2008; Haliru and Ibitoye, 2014; Giroh *et al.*, 2010). The findings of the studies have suggested that either the markets are concentrated or perfectly competitive. These studies have used techniques that measure the market concentration of the largest traders operating in a market. Examples of such techniques include 4 firm or 8 firm concentration ratios and Gini coefficients. When using point estimate techniques, only information for the few largest traders that operate in a market is collected, which results in estimates of market concentration to be biased (Naldi and Flamini, 2014b).

Furthermore, the few studies that investigated the market participation of traders do not explicitly investigate entry barriers that traders encounter to participate in product markets. These include Fafchamps and Gabre-Madhin (2006) in Malawi and Benin; Fafchamps *et al.* (2005) in Malawi, Benin and Madagascar and Jagwe (2011) in Rwanda. The studies have relied on qualitative methods that do not indicate the statistical significance of the factors that influence the participation of traders in the markets.

Given these studies, empirical evidence is, therefore, not adequate in understanding the common factors that influence the replacement of both conventional and improved varieties. Lacking in the existing empirical literature is also knowledge of the perception of farmers of the relevance of the extension messages disseminated on their decisions to replace conventional and modern varieties of crops.

Also not adequately investigated by the empirical studies is the impact of marketed surplus on demand for improved crop technologies in SSA countries. Little is also known in the empirical literature on whether an imperfectly or a perfectly competitive market structure entails the presence or absence of entry barriers by intermediary traders in the markets.

The current study jointly determines factors that influence replacement decisions of conventional and improved groundnut varieties among smallholders in Malawi. Such information is vital to policy efforts in promoting crop variety diversity with a focus on areas that have the potential to increase adoption of improved varieties, while at the same time mitigating losses of indigenous crop germplasm. The current study contributes to the existing empirical literature on variety replacement by adding knowledge on the perceptions of farmers on the relevance of the extension services to the production of groundnuts in Malawi. The addition of such knowledge in the empirical literature is the novel aspect of the study. The contribution of the study to the empirical literature is its findings that contradict empirical evidence on the positive relationship of the education level of farmers and membership to farmer organizations and continued utilization of modern varieties.

The study also investigates the impact of marketed surplus on demand for improved varieties using the endogenous switching probit (ESP) technique. It also determines factors that affect marketed surplus. In the ESP, both selection and outcome variables are binaries. The current study is one of the few that consider marketed surplus as a selection variable while the demand for improved varieties as the outcome. Such consideration makes the current study to be unique compared to other related studies. The current study is also one of the few that treat both selection and outcome variables as dichotomous. However, Lokshin and Glinskaya (2009), Carrasco (2001), and Aakvik *et al.* (2000) conducted related studies in Nepal, Norway, and the United States, respectively. These countries are outside the SSA region. The findings of the current study will inform policy on the strategies that could enhance the increased marketed surplus of groundnuts, which could further trigger the demand for improved varieties.

Investigating whether an imperfectly or a perfectly competitive market structure entails the presence or absence of entry barriers by intermediary traders in the markets is essential in the following ways.

The information generated on market structure provides knowledge on the competitiveness of the market. Knowledge of the structure is vital for understanding the conduct of market players in terms of pricing strategy. Understanding the structure of the market is an input to know how income from crops is distributed to various players along the marketing chain. Policy mitigation measures on poverty alleviation and improved food security rely on knowledge of crop income distribution. The study also generates information useful to the agricultural market policy that ensures that output markets operate commensurate with market liberalization policies. The study also adds to the available methods in the empirical literature for SSA countries in general, in particular for Malawi, a robust technique, the interval estimate of the Herfindahl-Hirschman Index (HHI), for determining the structure of agricultural markets. The use of such a technique in measuring the concentration of agricultural markets is, therefore, another novel aspect of the current study. The study also adds information to the existing empirical literature on market participation of intermediary traders, which is critical for a detailed understanding of entry barriers confronting their participation in the product markets.

1.3 Research Objectives

The main objective of the study is to assess how the decisions that smallholders and intermediary traders make in the production and marketing chain affect the functioning of the groundnut subsector in Malawi. The specific objectives of the study are:

- a. To investigate factors that determine smallholders' replacement decisions of conventional and modern varieties of groundnuts.
- b. Assess the effects of the marketable surplus of groundnuts on-demand for improved varieties among smallholders.
- c. Determine market competitiveness and entry barriers into groundnut markets among intermediary traders.

1.4 A Brief Account of the Research Methodology: Issues of Cross-Cutting Nature

1.4.1 Context description of the study areas

This study has used data collected from farm household and trader surveys in some of the groundnut producing areas of central and northern Malawi, as shown in Figure 1.

Farm households in the three groundnut growing districts of Lilongwe, Kasungu, and Salima in the central region and those of Mzimba in the north participated in the study. For the market survey, traders in the four districts of Lilongwe, Mchinji, Kasungu and Salima in the central and one district, Mzimba, in northern Malawi, took part in the study. Apart from Salima, which lies in the low altitude zone of the country, the other districts lie in the mid-altitude. The central and northern regional districts that participated in the study account for 68% of the total groundnut production of the country (Malawi-Government, 2017). Apart from groundnuts, the farmers, in the study areas, also grow tobacco and cotton as cash crops, while they cultivate maize and rice, mainly for food.

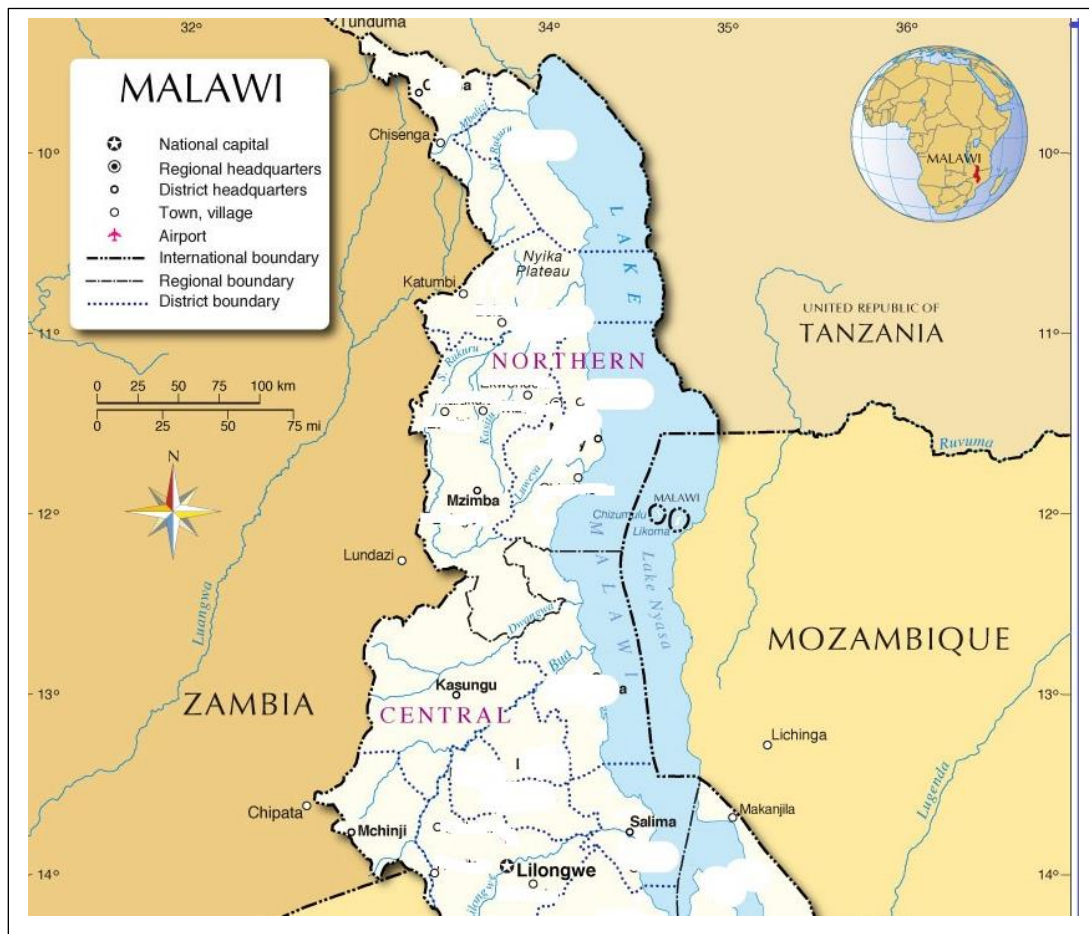


Figure 1: Part of the Map of Malawi showing Central and Northern Districts Study Sites.

Source: nationsonline.org, 1998-2013.

The study focused on groundnuts because it is one of the legumes that is being promoted by policymakers. Groundnut is perceived as a potential crop to contribute to sustainable food security and increased incomes among smallholder farm households in Malawi (Malawi-Government, 2011). Besides, it is the second most important income earner after tobacco, making it a potential complement to the export earnings of the country. It is also the most widely grown legume, mainly by smallholder women farmers (Tsusaka *et al.*, 2016a).

1.4.2 Distribution of participants in the study areas

A total of 416 farm households and 124 intermediary traders that participated in the study were distributed in the districts, as shown in Table 1. For the farm household survey, there were more female participants than males in all the districts. This shows that the production of groundnuts in Malawi is dominated by smallholder women farmers. For the trader' survey, only one female respondent participated in the study in all the five districts. This indicates that male traders dominate agricultural trading for crops such as groundnuts.

Table 1: Sample Distribution of Farm Households and Traders, Malawi

District	No. of Farm Households		No. of Intermediary Traders	
	Gender		Gender	
	Female	Male	Female	Male
Kasungu	93	49	0	26
Lilongwe	76	30	1	48
Mzimba	33	26	0	15
Salima	72	37	0	160
Mchinji	0	0	0	190
Total	274	142	1	123

Source: Farm Household and Market Survey Data (2017)

1.4.3 Description of the data collection process: sampling households and traders

The study used primary data collected in farm household and trader surveys in 2017. Primary data was preferred because it fits well with the specific research problems of the study (Hox and Boeije, 2005).

The study used a multistage sampling procedure to select the districts, Extension Planning Areas (EPAs), the trading centers, individual farm households, and traders that participated in the study. Firstly, the districts were purposively selected for their potential as groundnut growing areas. Secondly, the EPAs and trading centres were randomly selected. The trading centres were visited on designated market days, which vary from one trading center to the other. Such an arrangement ensured that the traders had an equal chance of being selected. The farmers were identified with the help of Agricultural Extension Development Coordinators (AEDEC) in the EPAs. Simple and systematic random sampling procedures were used to select farm households and traders, respectively. A total of 416 farm households and 124 intermediary traders participated in the study. Structured questionnaires were administered to the farm households and the traders by trained enumerators with the supervision of the researcher. Also, focus group discussions (FGDs) and key informant interviews (KIIs) were held with the farm households and agricultural extension officers, respectively.

Data collected in the farm household survey included socio-economic and demographic characteristics of the farm households, institutional factors, and biophysical factors. The data collected in the trader survey included characteristics of traders, market-related transaction costs, ownership of the business, storage infrastructure, institutional factors and financial sources of the business, the volume of produce traders handled in the 2015/16 marketing season, sources of purchase and reselling of the produce, and equipment and information communication facilities the traders possess and use. IBM SPSS software was employed for data entry and processing, and STATA 15 was used for data analysis.

1.4.4 Empirical methods of data analysis

As stated, this study endeavours to investigate how the decisions of smallholders and intermediary traders in the production and marketing chain of the groundnut subsector affect its functioning in central and northern Malawi. The response variables across the three specific objectives of the study are all binaries: smallholders' decisions to replace conventional and modern groundnut varieties; decisions to increase marketed surplus and demand for improved varieties of groundnuts; and decisions by intermediary traders to participate in the local, district and city groundnut markets. The analyses applied both descriptive and econometric approaches.

Percentages and averages were used in the descriptive statistical analyses. The econometric estimation techniques used include Bivariate Probit, Multivariate Probit, and Endogenous Switching Probit regression models. The selection of the models was based on a review of the literature.

1.5 Expected Research Outcomes

The study unveils two patterns of variety replacements of smallholders, which informs policy on demand for conventional and modern varieties of groundnut seed among smallholders. The study also contributes to the ongoing discussions on the importance of an integrated seed system, which is perceived to be a plausible option in meeting the seed needs of most smallholders. Crop breeders could use findings on variety replacement by developing varieties with varying attributes that farmers prefer. Non-governmental organizations could use findings on economic determinants of variety replacement by targeting farmers that should benefit from seed support programs of the improved varieties.

Further, the study reveals that smallholders with marketed surplus demand improved varieties of groundnuts. Such knowledge is essential for policy to formulate strategies that address the challenges that smallholders encounter in their effort to increase marketed surplus, which would trigger their demand for improved varieties. The non-farming community, who are consumers of the food crops, should also find information on determinants of marketed surplus useful as it has implications for the availability of food supplies on the market.

Finally, the study reveals structural forms of groundnut markets which inform policy on the extent of competitiveness of the markets. Policymakers could use the information on the market structure to facilitate an enabling environment for the creation of a competitive market structure from which all market players would benefit. These market actors include producers, traders, and final consumers. Information on the market structure that exists has implications for the quantities that commodity producers produce. Information on market entry barriers has implications for the participation of intermediary traders in the market who are responsible for distributing produce along the marketing chain. Consumers would also find the outcome of this research useful because the extent of market competitiveness has a bearing on the cost of food, which affects their welfare.

1.6 Outline of the Thesis Structure

The remaining five chapters of the thesis are organized as follows. Chapter 2 presents the literature review, which starts with an overview of the groundnut subsector. The overview focuses on the discussion of various chain actors that are involved in implementing different activities in this sector. The activities include the development of groundnut varieties to the production and distribution of grain along the marketing chain. The chapter also defines and describes key concepts that have been used in the thesis. The definition of the concepts is followed by a literature review of the three thematic areas of the study. The literature review in thematic areas 1 and 2 dwell on the discussion of the determinants that influence smallholders' production and marketing decisions in the crop subsector. In the thematic area, 3 focus is on the degree of market concentration for various agricultural commodities when different concentration indices are used to determine the market structure. A brief review of the market participation of traders is also conducted.

Chapter 3 investigates the determinants of replacement decisions of conventional and improved groundnut varieties among smallholders. A bivariate probit (BVP) regression model has been used due to the mutual inclusiveness of the replacement decisions. Chapter 4 assesses the impact of marketed surplus on-demand for improved varieties among smallholder groundnut producers. An endogenous switching probit (ESP) regression model is applied because both the response variables in the selection and outcome equations are binaries.

Chapter 5 determines concentration and entry barriers into groundnut markets among intermediary traders. The markets, which include the local, district, and city markets, are the ones in which intermediary traders sold groundnuts in 2015/16. The chapter applies an interval estimation of the Herfindahl-Hirschman Index (HHI) and multivariate probit (MVP) model. Conclusions, policy recommendations, and directions for future research are provided in the last chapter. The chapter starts with a summary of the objectives of the study and the different models that have been used to achieve the objectives. The conclusion presents key issues that are drawn from the findings of each of the study objectives. Finally, the chapter highlights the limitation of the study before suggesting areas for future research.

CHAPTER 2

CROP VARIETY REPLACEMENT, MARKETED SURPLUS AND CONCENTRATION OF PRODUCT MARKETS: A LITERATURE REVIEW

2.1 Introduction

This chapter conducts a review of the literature on three thematic areas of the study. These are replacement decisions of crop varieties by smallholders, marketed surplus and demand for improved varieties among smallholders, market structure, and entry barriers into product markets. Understanding the variety replacement decisions of smallholders is essential in generating information on preferences and demand for crop varieties. Such information would contribute to policy formulation on strategies to enhance the adoption of high yielding varieties while maintaining landraces deemed useful for future crop development. Assessing the impact of the marketed surplus decisions on-demand for improved varieties informs policy on the strategies that could enhance increased marketable surplus, which triggers the demand for improved varieties among farmers. Determining the market structure and entry barriers into product markets by intermediary traders is relevant to policy formulation for appropriate strategies that facilitate the creation of a competitive market environment.

The rest of the chapter proceeds as follows. Section 2.2 defines and describes the concepts and terms used in the study. An overview of the roles that various actors play in the groundnut subsector in Malawi is presented in section 2.3. In Section 2.4, a review of the determinants of variety replacement is conducted. Section 2.5 presents a review of the determinants of the marketed surplus of crops among smallholders. Market concentration indices that are used to determine the structure of markets and a brief account of market participation of traders are reviewed in section 2.6. The last section of the chapter gives a summary.

2.2 Definition of Concepts and Terminologies

2.2.1 Smallholders: definition and characterization

The term smallholder farmer is used interchangeably with that of peasant farmers or small-scale farmers. In this case, the smallholders could be characterized by the assets owned, livelihood dependence, and their poverty status. In line with these descriptions, Narayanan and Gulati (2002) and Orr and Mwale (2001) describe smallholders as a category of farm households that own an average of fewer than 0.5 hectares of land to cultivate crops. Peasant farm households can also be described by the nature of diversity in economic activities that sustain their livelihoods. According to this approach, Ellis (1993) indicates that, apart from farming activities, peasants are also engaged in non-farming activities.

Furthermore, smallholders are also said to be associated with low levels of total crop productivity (Van der Ploeg, 2014). Mwangi and Kariuki (2015), therefore, attribute low crop production among the smallholders to the use of rudimentary agricultural technologies. Due to the low yields, smallholders are also less likely to increase their intensity of market participation, hence affecting the commercialisation of the crop subsector (Collier and Dercon, 2014a). Low crop yields, coupled with limited commercialisation are linked to smallholder farm households with high poverty incidences (Diao *et al.*, 2010).

Because of these characteristics, smallholders in Malawi are not exceptional. They own less than 0.5 hectares of land under which they cultivate a diverse number of food and cash crops (Malawi-Government, 2005). Groundnut productivity is also relatively low, with yields obtained by the smallholders that are below the potential levels (Siambi *et al.*, 2015). One of the underlying reasons for low productivity is that the smallholder continues to utilize low productive crop technologies, such as conventional varieties of groundnuts (Simtowe *et al.*, 2010b). With such low yields, it is not surprising to see low orientation towards commercialisation of the subsector. For example, Derlagen and Phiri (2012) observe that much of the groundnuts that smallholders produce are consumed by themselves with little to offer to the market. By using various indicators of welfare, Minde *et al.* (2008) report that the dependence of the smallholder on agriculture leads them to be in a vicious cycle of poverty.

2.2.2 *Improved and conventional crop varieties*

Improved varieties, also known as modern varieties and hybrids, refer to ‘any plant materials that are developed and produced by the formal plant breeding program’ (Morris *et al.*, 1999). Conversely, conventional varieties, also known as local, traditional, unimproved, or landraces, are seeds that are re-produced by farmers themselves and distributed by the informal seed system (Almekinders and Louwaars, 2002). In Malawi, conventional varieties of groundnuts are relatively low yielding (Derlagen and Phiri, 2012). Despite this, traditional or local varieties are equally important in meeting seed requirements of smallholders in most sub-Saharan African countries (Almekinders *et al.*, 1994; Almekinders and Louwaars, 2002; Simtowe *et al.*, 2010b; Louwaars *et al.*, 2013). The terms local and improved seeds are also synonymous with informal and formal seed systems, respectively. According to Almekinders and Louwaars (2002) and Louwaars and Marrewijk (1996), local seeds are produced by the informal seed system, whereas the formal seed system dominates the production of improved seeds. The difference between informal and formal seed systems is on quality control of the seed during the production process (Malawi-Government, 2016b). Production of seed in the informal sub-sector is as part of the usual crop production process. Farmers select seed from the grain that they harvest. In the formal subsector, seed production is done in isolation of other crops and is subjected to rigorous processes of field inspections, germination and purity tests, and certification (Louwaars *et al.*, 2013).

2.2.3 Crop variety replacement

The term variety replacement must not be confused with seed replacement. The latter refers to the cultivation of new seed of the same crop variety in which a farmer has been growing for two or more years. On the other hand, the planting of a new variety of the same crop is known as variety replacement (Brennan and Byerlee, 1991; Heisey and Brennan, 1991; Zeven, 1999). In the former, a farmer can replace old seed with new seed without replacing the variety (Krishna *et al.*, 2014), while in the latter, replacement of crop varieties also means seed replacement. It is the latter case, which is the focus of this study. By replacing conventional varieties with modern ones, farmers are essentially adopting the latter. However, adoption may take place with or without any varieties being replaced. Related concepts include the partial and full variety of replacements. The former means the cultivation of improved and conventional varieties side by side. In the latter case, a farmer completely abandons the old seed variety by replacing it with a new one (Wale, 2012).

However, variety replacement may take either direction, improved replacing conventional ones, or *vice versa*. When the latter happens, farmers are said to have dis-adopted the improved varieties and revert to the cultivation of the conventional ones.

2.2.4 *Marketable surplus and marketed surplus*

The terms marketable surplus and marketed surplus are sometimes used interchangeably, which in the process are confused as if they mean the same thing. The similarity of the two is that both describe the residual that is left from total production. However, Patnaik (1975) considers marketable surplus as the produce that is available for sale, while the marketed surplus is referred to the actual quantities of produce that is sold (Govere *et al.*, 1999; Strasberg *et al.*, 1999; Chirwa, 2009). Such a description of the terms applies to food crops that farm households cultivate for their consumption while they sell the remainder. Besides consumption, farm households also use the harvested grain for seed. This is true for self-pollinated food crops, such as groundnuts. Of interest in this study is the marketed surplus, which finds its way into the markets. For example, Derlagen and Phiri (2012) observe that marketed surplus for groundnuts in Malawi is about 40% of total production. It generates 25% of agricultural cash incomes (Minde *et al.*, 2008), which suggests that the marketed surplus contributes to the income security of the producers (Derlagen and Phiri, 2012). To the non-farming community, the marketed surplus is the source from which it gets its food requirements.

2.2.5 *Intermediary traders*

Intermediary traders also referred to as middlemen, are traders that purchase produce from farmers at the farm gate and help to distribute it along the marketing chain (Pokhrel and Thapa, 2007). Other terms commonly used are mobile traders or vendors (Mapila *et al.*, 2013). In the case of groundnut markets in Malawi, the intermediary traders are categorized into the small scale and large scale (Simtowe *et al.*, 2010b). While the small-scale traders conduct their trade in the nearby rural markets, large scale traders cover a wider area, which includes a district or, at times, a region and cities. Besides the area of coverage, other factors that distinguish the two is heterogeneity in the capital and physical assets they possess, and volume of produce they handle in a marketing season.

By purchasing produce from the smallholders, intermediary traders provide vital marketing services (Pokhrel and Thapa, 2007). These marketing services include transporting, storage, and selling the produce to distant markets, which would otherwise be costly to the producers (Shiferaw and Teklewold, 2007; Muratori, 2016). In this case, intermediary traders are essential players in the marketing chain of agricultural commodities.

2.2.6 Market concentration

Market concentration refers to the relative size distribution of buyers or sellers in a market. It includes the number and relative strength of buyers and sellers and degree of collusion among market players, level and forms of competition, the extent of product differentiation, ease of entry and exit of the market (Sheldon and Sperling, 2003). The degree of concentration of the market determines the type of structure that prevails in the market environment. According to Sexton (2013), the dominance of one or a few individual firms in a market entails the existence of an imperfectly competitive market structure. Conversely, in a perfectly competitive market structure, there is no single firm or market player that dominates the market (Parkin, 2008). However, Sexton (2013) outlines three conditions that must hold in a perfectly competitive market structure. These are the existence of a small number of market players relative to the size of the market, goods that are sold must be homogenous and that all market players must have equal access to market information. Equal access to market information enables firms to enter (exit) the industry when they perceive the business environment to be conducive (harsh). However, it is argued that the features of a perfectly competitive market structure do not exist in the real world (Besank and Braeutigam, 2008; Sexton, 2013). They only form a basis in which to compare with other market models (Sexton, 2013).

2.2.7 Marketing margins

The term marketing margin refers to the difference between the buying and selling price of a commodity expressed as a proportion of the selling price (Pokhrel and Thapa, 2007; Achike and Anzaku, 2010). Market margin is also known as price margin. When all market transaction costs are considered, the net market margin is obtained.

Market margins are commonly used tools for analyzing how a market system performs, which implies that they show how efficient or inefficient market systems are (Achike and Anzaku, 2010). From the point of view of intermediary traders, relatively high market margins entail good profitability of the enterprise. A market channel in which the intermediary trader earns a relatively high market margin would be assumed to be a high-value market.

On the contrary, when a trader earns relatively high market margins, it is suggested that the intermediary traders are exploiting commodity producers (Ellis, 1996). This suggests that the traders would be offering lower prices to commodity producers than what the farmers would receive if they sold the produce directly to consumers. However, Dessalegn *et al.* (1998) argue that a positive relationship exists between market concentration and gross marketing margins. The implication is that market players that control relatively more market shares are also likely to expropriate more market margins. However, Scott (1995) cautions of interpreting such a relationship in the absence of other factors that may affect market concentration and market margins, for example, market entry barriers or economies of scale in transportation.

2.3 Chain Actors in Groundnut Subsector in Malawi

The groundnuts subsector in Malawi comprises various stakeholders in public and private sectors who include plant breeders, seed production regulators, seed producers, and suppliers, farmers, and traders. The roles that these various actors play and the activities that they implement are shown in Figure 2 and detailed in the subsequent subsections.

2.3.1 Groundnut seed variety development

In Malawi, seed development is carried out by collaborative efforts of the national research institutions (NARs) and international research institutions (e.g., CGIAR centers). For the past three decades, the research institutions have released several improved groundnut varieties that are suitable for cultivation in different agro-ecological regions of the groundnut growing areas in Malawi (Siambi *et al.*, 2015). The improved varieties are superior in yielding potential by over 60% compared to the conventional ones (Derlagen and Phiri, 2012).

2.3.2 Production and distribution of certified seed

Unlike in cross-pollinated seed production, commercial seed producers play a minimal role in the production and distribution of seed for self-pollinated crops (Minot *et al.*, 2007), such as groundnuts. This is because farmers recycle the seed, which renders the seed production enterprise unprofitable. Consequently, this results in the shortage of supply of certified seed of the improved varieties on the formal seed market. To increase the availability of improved groundnut seed, national and international research institutions produce breeder and foundation seed (Minde *et al.*, 2008; Siambi *et al.*, 2015).

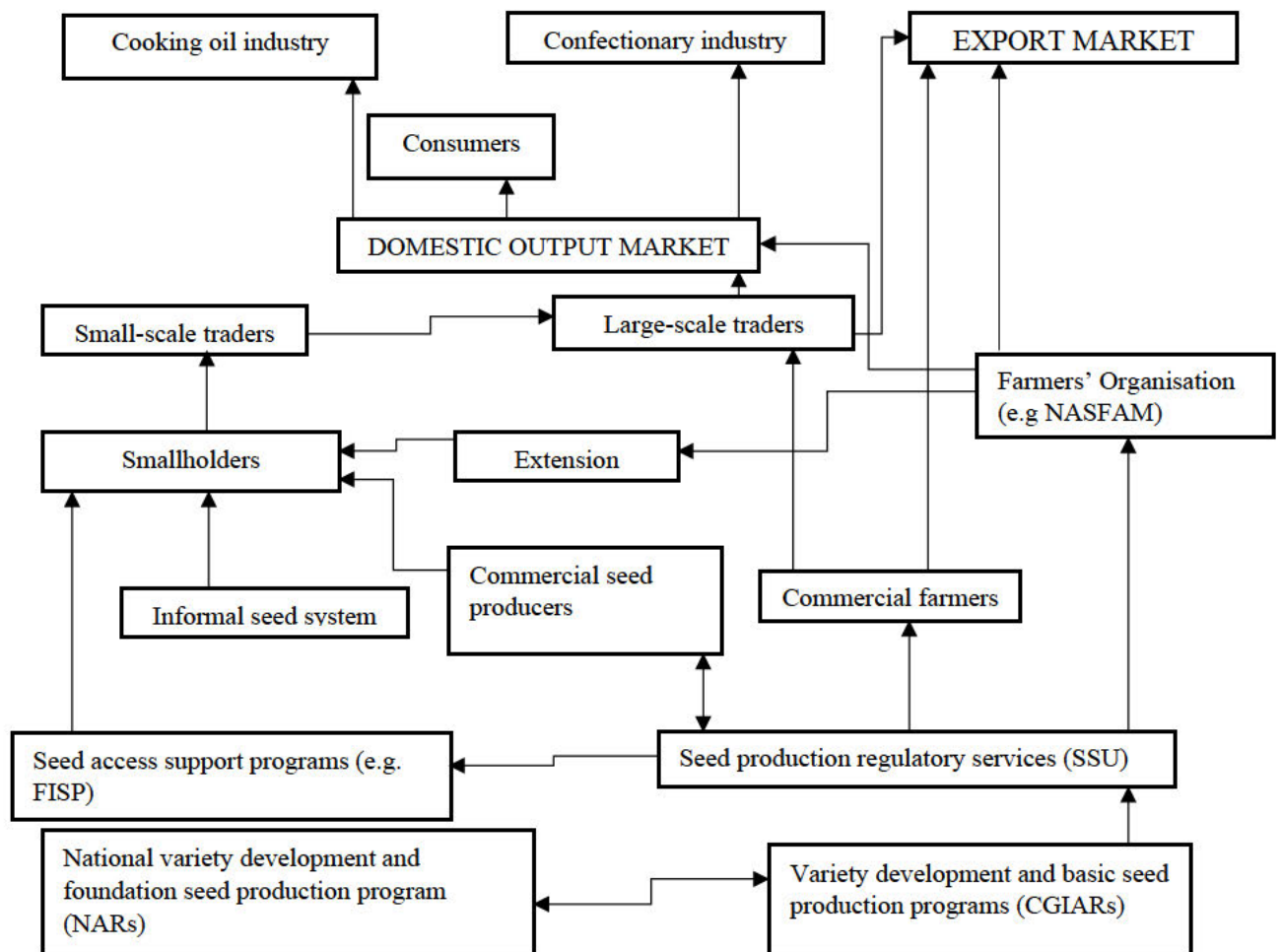


Figure 2: Chain Actors in the Groundnut Subsector. Source: Makoka (2012), with the modification of the researcher.

Using the foundation seed, the research institutions, in particular, the International Crop Research Institute for Semi-Arid Tropics (ICRISAT) and the Department of Agricultural Research Services (DARS), facilitate the production of basic seed (Siambi *et al.*, 2015). Individual farmers and farmers' associations are contracted out to multiply certified seed, which is used to produce grain. The seed reaches farmers through farm input subsidy program (FISP) from the government and sold directly to individual farmers through seed agro-dealer networks (Makoka, 2012). To build capacity in seed multiplication and increase access to as many smallholders as possible, ICRISAT through farmer organizations, such as the National Association of Smallholder Farmers of Malawi (NASFAM), implements seed bank loan schemes. Selected farmers receive seed for multiplication through a 'pass on program.' After harvest, the farmers payback to the seed bank one to two parts of the seed they got in the initial year.

With the help of government extension agents, the recovered seed benefits other farmers in the surrounding communities and villages. Through both the FISP and the seed bank loan schemes, the adoption of improved varieties among the beneficiaries increased from 20% to 90% between 2010 to 2012 (Siambi *et al.*, 2015).

2.3.3 *Demand for and supply of certified groundnut seed*

The demand for and supply of certified seed for grain legume crops, such as groundnuts, fluctuate from time to time (Nakhumwa and Kaudzu, 2013). Few commercial seed producers produce certified seed for these crops because farmers reproduce their own. This renders the seed production enterprise unprofitable (Nakhumwa and Kaudzu, 2013). Due to the reduction in demand for certified seed by farmers, commercial seed producers respond by cutting down production. This affects the supply of certified seed of improved varieties in the formal seed distribution channel in subsequent seasons. The farm input subsidy program (FISP) that government implements (Chibwana *et al.*, 2010; Ricker-Gilbert *et al.*, 2013; Siambi *et al.*, 2015) creates short term increased supply of certified seed (Jayne and Rashid, 2013). With budgetary constraints, policy intervention strategies, such as FISP, are not sustainable in enhancing access to improved seed varieties among the smallholders.

2.3.4 *National policy regulating seed production and marketing*

Generally, the seed industry in Malawi comprises formal and informal subsectors (Zidana *et al.*, 2012). The formal system produces and distributes seeds for modern varieties of crops. The production of seed goes through rigorous processes of inspection and certification. The National Seed Policy (NSP) guides operations of the seed industry while the Seed Act regulates the production of seed for all crops, which includes groundnuts (Malawi-Government, 2016b). The Seed Services Unit (SSU) of the Ministry of Agriculture Irrigation and Water Development (MAIWD) facilitates the seed regulatory activities. The activities include registration of seed producers and regular field inspections during seed production. The SSU also conducts purity and germination tests on seed samples in order to certify seed viability. Further, the SSU trains agro-seed dealers on the packaging, storage, and distribution of the seed. Noncompliance with the established seed regulatory protocols renders the seed to be declared invalid and not suitable for distribution to seed users (Malawi-Government, 2016b).

In the informal subsector, the production of seed is not regulated. Farmers reproduce the seed in the same way they produce grain. For these reasons, the NSP considers seed produced by the informal subsector to be illegitimate while that from the formal sector as a valid one (Wolff, 2004). Smallholders are, however, custodians of indigenous germplasm, which is a critical input in the formal plant breeding programs (Almekinders *et al.*, 1994). Increased crop production, sustenance of crop diversity, and conservation of indigenous germplasm require complementarity between the informal and formal seed systems (Halewood, 2016). In the case of Malawi, ignoring the importance of the informal seed system contradicts with other sectoral policies. For example, the National Agricultural Policy (NAP) endeavours to promote farmers' participation in seed development, production, and the distribution chain (Malawi-Government, 2016a). Efforts by the NSP to urge for the enactment of farmers' rights legislation (Malawi-Government, 2016b) will only be meaningful if the current NSP legitimizes seed produced by the informal system.

2.3.5 *Groundnut product market structure and value chain actors*

Before liberalising agricultural grain markets between 1971 and 1987, the Agricultural Development and Marketing Cooperation (ADMARC) had a state-sanctioned monopoly in the buying and selling of agricultural grain produce in Malawi (Kherallah *et al.*, 2000). With liberalisation, many private traders participate in the groundnut product markets. Grain traders include large and small-scale intermediate buyers, farmers, agro-processors, and exporters. Smallholders sell grain to small scale intermediate buyers, consumers in the domestic market, and the National Association of Smallholder Farmers of Malawi (NASFAM). Commercial grain producers sell groundnuts to processors in the domestic and export markets. However, small scale intermediate buyers resell to large scale buyers who, in turn, resell it to agro-processors and the export market. NASFAM, in turn, resell groundnuts they buy from smallholders to processors and the export market. The domestic market absorbs a higher percentage of groundnuts that are produced in the country.

According to the Malawi Investment Trade Centre (2017), the confectionery and oil production industries absorbed about 16% and 52%, respectively of the total groundnut that sold on the domestic markets in 2017. The remainder, 32%, was utilized by housed either roasted or as a recipe in making meals. However, the confectionery and oil making industries prefer Chalimbana and CG7, respectively. The demand for these two varieties is manifested in the land area allocated to their cultivation. A five year (2014/15 to 2018/19) aggregated agricultural crop production estimates shows that Chalimbana and CG7 occupied about 41% and 54% of the total land area cultivated to groundnuts, respectively (Malawi-Government, 2019). Such a revelation suggests that the two varieties are highly demanded by the agro-processing industries.

2.4 Drivers of Conventional Variety Replacement in the Context of Smallholders

Replacement of crop varieties is essential to sustain increased yield and reduce yield deterioration (Brennan and Byerlee, 1991). The empirical literature attributes climate change and agro-ecological conditions, economic and institutional factors as key in influencing smallholders' decisions to replace crop varieties (Brennan and Byerlee, 1991; Morris *et al.*, 1999; Verma and Sidhu, 2009; Nordhagen and Pascua, 2012; Wale, 2012; Wale and Chianu, 2015; Wale and Holm-Mueller, 2017).

2.4.1 *Climate change and agro-ecological factors*

Climate change-related factors have been observed to influence farmers' decisions to replace one variety for another. One study by Nordhagen and Pascua (2012) demonstrated that during severe drought conditions, farmers use seed varieties purchased from the local markets, which is a domain for conventional varieties. In this case, the conventional varieties are perceived to be relatively tolerant to abiotic stresses (Asrat *et al.*, 2010). Opting to use conventional varieties during drought conditions implies that farm households are risk-averse. Considering that modern crop varieties are relatively expensive, farmers would instead use the conventional varieties which they acquire relatively cheaply in the local markets. The association of ecological conditions to farmers' decisions to replacement of crop varieties is also echoed by Wale and Yalew (2007). Their study links farmers' risk attitudes to the preference for crops with varietal attributes that are adaptable to local ecological conditions. However, the findings of these studies seem to suggest that conventional varieties are more resilient to harsh weather conditions than the modern, improved ones. These findings may, however, not be generalized. Currently, plant breeding programs are responding to the effects of climate change by developing improved varieties that are high yielding as well as tolerant to drought conditions. For example, CG7, a popular improved groundnut variety in Malawi, was in addition to its high yielding trait bred for drought tolerance (Minde *et al.*, 2008; Siambi *et al.*, 2015).

Not only would environmental factors influence the decision to replace seed varieties but also the rate of replacement. To this end, Brennan and Byerlee (1991) proposed a measure, a weighted average age, to compare variety replacement of wheat in countries with different agro-ecological conditions. The study found that variety replacement is faster in low rainfall areas than high rainfall areas. Prevalence of leaf rust disease in low rainfall areas, where the production of crops is done mostly by irrigation, was the reason given for faster variety replacement. However, such findings must be considered with caution. This is because the ecological conditions that are conducive to the prevalence of leaf rust disease (Ali *et al.*, 2017) also exist in most tropical regions where crop production is mostly rain-fed.

2.4.2 *Production orientation and economic factors*

To increase farm incomes, farmers choose to replace low yielding varieties with the ones that are relatively high yielding. Thus, the demand for high yielding improved varieties could emanate from farmers' need to produce a marketable surplus (Barrett, 2008). Findings by Wale and Chianu (2015) suggest that commercial and subsistence-oriented farmers display different patterns of seed varietal replacement. Similarly, Wale (2012) explains that preference for varieties with high-yielding and marketability attributes influence farmers' decision to abandon conventional varieties. Supporting the findings by Wale and Chianu (2015) and Wale (2012) are findings by Singh and Morris (1997) that demonstrate a positive association between the high rate of replacement of modern maize varieties and commercialized crop production.

Further findings by Singh and Morris (1997) suggest a positive relationship between the cultivation of unimproved maize varieties and the production of crops for household consumption. While studies by Wale and Chianu (2015), Wale (2012) and Singh and Morris (1997) demonstrate such a positive association between replacement of conventional varieties and market orientation, subsistence farmers may benefit from highly productive food crop varieties. It must be noted that farmers replace conventional with improved varieties to increase crop productivity (Brennan and Byerlee, 1991; Heisey and Brennan, 1991). Decreasing landholding size (Jayne *et al.*, 2010) and the increase in population requires cultivation of high yielding crop varieties to meet food demand for household consumption.

Smallholders' heterogeneity, in terms of their economic status, also influences decisions on a varietal replacement. The findings by Asrat *et al.* (2010) suggest that small scale farmers with low household asset values prefer seed varieties that are stable in yield and tolerant to environmental stresses. Conventional varieties are associated with these attributes (Wale and Yalew, 2007; Nordhagen and Pascua, 2012). Similarly, large scale farmers with high asset values would prefer high yielding varieties. The relationship between farm households' resource endowment and choice of variety replacement is further affirmed by Wale and Holm-Mueller (2017) in north-eastern Ethiopia. The findings of their study suggest that resource-poor farmers who depend on conventional varieties are more concerned with replacement and loss of conventional varieties. Thus, preference for different varietal attributes, as indicated here, plays an essential role in the replacement choices of seed varieties.

These findings support the assertion that preference for varietal attributes, from which farmers derive utility, influence the decision to replace conventional and improved varieties (Lunduka *et al.*, 2012).

In addition to determining factors that influence the decision to replace crop varieties, researchers are also interested to understand the rate of varietal replacement. Varietal turnover has impacts on plant breeding programs, degree of varietal diversification over time (Brennan and Byerlee, 1991), and adoption of the improved ones. The findings of some studies suggest that the frequency of seed recycling has implications for the rate of seed variety replacement. The farmers that recycle seed frequently take time to replace old varieties with new ones. For example, Morris *et al.* (1999) demonstrated that the rate of variety replacement was low among farmers that frequently recycle seed. In addition to the frequency of recycling seed, Verma and Sidhu (2009) attribute the rate of seed variety replacement to the category of farmers. The results of their study indicated that the rate of seed variety replacement was high, moderate, and low among large, medium, and small-scale farmers, respectively. Considering that most seed requirements from smallholders come from the informal seed system (Almekinders and Louwaars, 2002; Lipper *et al.*, 2010), knowledge of seed sources is important in understanding varietal turnover.

A related study by Almekinders *et al.* (1994) observed a direct relationship between the type of crop varieties cultivated and the rate of seed replacement. The results of their study showed a high rate of seed replacement among farmers that cultivated modern or improved varieties of maize and beans. To substantiate this finding, Singh and Morris (1997) suggest that farmers that cultivate modern maize varieties replace seed every year, whereas the replacement rate is low among those that plant unimproved varieties. Besides having preferences for varietal attributes, the low rate of seed replacement among farmers that cultivate unimproved varieties could be, among others, due to economic reasons. Findings by Asrat *et al.* (2010) may help to explain the direct relationship between the rate of seed replacement and type of crop variety that farmers cultivate. It can, therefore, be argued that the level of asset holding endowment that dictates the type of crop variety that farmers cultivate, modern or unimproved, also explains the rate of seed replacement. In this case, farmers with more asset holding values can afford to replace seed more frequently than those with less (Asrat *et al.*, 2010). Because of this, an explanation about the rate of seed replacement and type of crop variety cannot be understood in isolation of economic factors.

2.4.3 Institutional factors

Institutional factors, such as access to credit, are important drivers in accelerating seed variety change. Findings by Krishna *et al.* (2014) suggest that farmers that have inadequate access to credit replace wheat varieties less frequently than those that adequately access credit. Similar findings are also echoed by Simtowe and Zeller (2006), where credit access is seen as an avenue for the adoption of improved maize varieties. It should be noted that by adopting modern varieties, farmers are essentially abandoning conventional varieties. In the study by Simtowe and Zeller (2006), credit influences the adoption of modern varieties in two ways. In the first place, farmers can afford the modern crop varieties which they procure from commercialized seed dealers. Secondly, farmers obtain high yields from hybrid varieties when they use complementary inputs such as fertilizer. Fertilizers are relatively expensive for some smallholders to afford. Only when they have access to credit to meet the cost of fertilizer will they also be able to replace conventional varieties with the improved ones. However, not all crops require the use of complementary inputs, such as inorganic fertilizer. The current study is a case in point where, in Malawi, smallholders cultivate groundnuts without fertilizer because, as a legume, the crop has the potential to fix in the soil its own nitrogen (Mpeperekhi *et al.*, 2000). In this circumstance, credit access is required only to purchase certified seed.

Not only would the improved varieties replace the conventional ones, but a reverse order may also take place where farmers revert to cultivate the latter by abandoning the former. Despite research and extension promotion of improved varieties, conventional crop varieties remain popular among farmers. In the case of groundnuts in Malawi, the conventional variety Chalimbana, albeit being relatively low yielding, is preferred for its consumption and local market attributes. This may influence farmers' decisions to revert to the cultivation of the conventional varieties or continue cultivating them by not adopting the improved ones.

Smallholders' preference for conventional varieties over relatively high yielding improved ones could be explained by natural phenomena of imprinting and anchoring. According to Ariely (2008), some smallholders are imprinted from birth and become attached to the conventional variety because it is the only one that they are aware of.

Their preference for the conventional variety is reinforced by their perception of other attributes; for example, yield stability, being relatively tastier or pest and disease tolerant. These are the attributes that the smallholders become anchored to (Ariely, 2008). This implies that smallholders' decisions to revert to conventional varieties are based on the attributes that they perceive to be more appealing. The decisions by the smallholders to revert to conventional varieties could, therefore, be considered as irrational behaviour. This is inconsistent with the expectation of neoclassical economics of profit maximization (Opaluch and Sergerson, 1989). Because of the differences in the production orientation between the smallholders and large-scale producers (Wale and Yalew, 2007), it is not surprising to see the former preferring low yielding varieties despite the availability of the high yielding ones. Any policy interventions that are designed to enhance crop productivity should, therefore, take into consideration the “irrational” decision making of the smallholders.

Due to the scarcity of empirical evidence on reverse replacement of improved varieties with the conventional, this review makes use of empirical evidence from adoption studies. Olalekan and Simeon (2015) suggest that the further away is the farm household to the markets, the more likely that improved varieties would be dis-adopted. Distance between markets and farm households increases transportation costs in shipping complementary farm inputs and crop harvests from and to markets. This explains why farmers may dis-adopt improved crops that are associated with the increased cost of production, for example, in the form of increased costs of complementary farm inputs, such as hybrid maize and fertilizer (Simtowe, 2006). Further, Tura *et al.* (2010) suggest that determinants of adoption of technologies and continued use of the technologies are not the same. While total farm size was found to influence the adoption of technologies, the study found that the size of land allocated to a particular crop variety influenced its continued use.

The existing empirical literature also highlights the importance of extension contacts and its frequency on the likelihood that farmers would adopt improved agricultural technologies (Mariano *et al.*, 2012; Abebe *et al.*, 2013; Shiferaw *et al.*, 2014; Danso-Abbeam *et al.*, 2017). One important aspect of agricultural extension that has occasionally received less attention is farmers' perception of the relevance of the extension services on replacement decisions of crop varieties.

Nevertheless, Elias *et al.* (2016) investigated the determinants of farmers' satisfaction with the extension system in north-west Ethiopia. Their findings give some insights on how policy could enhance the effectiveness of extension messages delivered to farmers. However, their findings are too general such that they do not provide a detailed understanding of the relationship between farmers' perception of extension messages and uptake of particular technologies. According to Lunduka *et al.* (2012), farmers' value of technologies emanates from their attributes, for example, the marketability of a crop variety. They would, therefore, become satisfied with extension messages that address their particular problem, for instance, market information.

Realizing this gap in the empirical literature, the current study endeavours to demonstrate that when farmers perceive the extension messages delivered to them to be relevant to their production problems of groundnuts, they would be willing to abandon the conventional variety for the modern one. In this view, the current study uses a variable on farmers' perception of the quality of extension message to determine its influence on the replacement of conventional varieties of groundnuts. This variable has rarely been used in this way in previous empirical studies.

Furthermore, none of the reviewed studies demonstrated the existence of common factors that influence the replacement of both conventional and improved varieties. This suggests that the existing empirical studies applied econometric techniques that are not capable of unveiling such findings, for example, probit or logit regression models. The current study, therefore, employs a bivariate probit model, which assumes that the decisions of farmers to replace crop varieties are mutually inclusive (Green, 2012). In this view, the current study jointly estimates the two regression equations, the decision to replace conventional and modern varieties. Finally, the current study also demonstrates a contradiction with existing empirical evidence that institutional and human capital factors, for example, membership of farmer organizations and education level of the farmer, are positively associated with the replacement of modern varieties.

2.5 Marketed Surplus in the Context of African Smallholder Crop Production

The intensity to participate in the market implies an increase in marketed surplus. The marketed surplus is an avenue through which smallholder transition from subsistence to commercialized production of crops takes place.

Increased marketed surplus affords producers with the much-needed cash to purchase high productive farm inputs (Alene *et al.*, 2000), such as improved crop varieties. With the increased income generated from increased marketed surplus, farmers' welfare is improved (Ouma *et al.*, 2010; Mmbando *et al.*, 2015a). By increasing marketed surplus, producers help to distribute commodities in the markets through which the non-farming community gets their supplies. Information on the determinants of the marketed surplus is important in formulating agricultural policy strategies to achieve the desired growth in food crop production (Goyal and Berg, 2004). Existing empirical studies highlight some push and pull factors that influence the decision of crop producers on the quantity of produce that they sell in the market. These factors include prices of commodities, institutional factors, farm household characteristics, post-harvest practices and farm household production assets (Bardhan, 1970; Medani, 1975; Rao, 1989; Goyal and Berg, 2004; Azam *et al.*, 2012; Kraybill *et al.*, 2012; Adenuga *et al.*, 2013; Edmeades, 2006).

2.5.1 *The price of commodities*

The price of commodities is a precursor that induces the intensity of market participation (Ingabire *et al.*, 2017). Previous empirical literature focused on the response of market surplus on changes in the price of food crops that farmers sell (Bardhan, 1970; Medani, 1975; Chinn, 1976; Rao, 1989; Goyal and Berg, 2004). Decades ago, debate raged on how marketed surplus responds to changes in the price of food commodities in two periods, the short and the long run. Rao (1989) observed that the marketed surplus was positively associated with price in the short run, while in the long run, a negative relationship existed between the two. As the negative relationship sets, the intensity to participate in the market becomes less elastic to price increases (Azam *et al.*, 2012). Supporting the notion of a long run inverse relationship between marketed surplus and price are Chauhan and Chhabra (2005) and Mapila *et al.* (2013). They point out that most subsistence farmers have little produce to sell when the price rises later in the marketing season because they sell much of their produce soon after harvest.

Further, Medani (1975) considers that the long term relationship between marketed surplus and price is based on the production orientation of the smallholders and takes an inverted U shaped.

He argues that in subsistence production, smallholders are concerned with satisfying their basic needs. Once the necessities have been satisfied, producers have no incentive to increase the intensity to participate in the market (Medani, 1975). This implies that marketed surplus would increase up to the point when the households perceive that their needs for cash income have been reached. In this case, any further increase in the market price would, therefore, not be expected to influence them to increase marketed surplus. However, the explanation by Medani (1975) contradicts with some features of the smallholder. For example, Ellis (1993) points out that the smallholder is engaged in other diverse non-farming economic activities, suggesting that its economic pursuit is beyond merely satisfying basic needs.

In this circumstance, the failure of marketed surplus to respond to the increase in price would suggest that other income sources act as a disincentive for the marketed surplus to increase with an increase in price. Furthermore, according to Van der Ploeg (2014), the total production of the smallholder is very low. In this case, any reduction in marketed surplus when price increases suggest that they have inadequate quantities to sell.

Contrary to Azam *et al.* (2012) and Rao (1989), a different approach is taken by Chinn (1976), who argues that price elasticity of total marketed surplus is positive in both the short run and long run. The only difference from Chinn's (1976) observation is the magnitude in the response of marketed surplus. According to Chinn (1976), in the short run, changes in the marketed surplus are less responsive than they are in the long run despite a similar unit change in the price. In this circumstance, the price elasticity of marketed surplus is more pronounced in the long run than in the short run. This means that when price increases, farmers would be induced to sell a higher proportion of their produce. However, in the long run, a unit increase in price would result in more than a unit proportionate change in marketed surplus (Chinn, 1976). This observation suggests that producers increase marketed surplus later in the marketing season. The explanation of this could be related to the increase in the supply of commodities and the relatively low prices of the same. In the short run, producers would sell little quantities of produce with the expectation to sell more later when price increases. As time elapses, producers become cash-constrained. Even if the price had not changed, the desperation for cash would influence them to sell more in the long run.

2.5.2 Institutional factors

The preceding discussions suggest that policymakers were compelled to use price-related strategies to increase marketed surplus. In response to information that was generated by the various empirical studies, governments in the developing countries established price bands to entice producers into increasing marketed surplus (Kherallah *et al.*, 2000). This was done with the realization that an increase in marketed surplus would benefit not only producers but also the non-farming consumers. However, just ‘getting prices right’ was not sufficient enough to improve the efficient functioning of markets, with its effect reflected in the increase in marketed surplus. The sudden change in policy target was due to the conflicting findings of the earlier studies on the role of prices. Later the focus of policy was on ‘getting the institutions right’ (Barret and Mutambatsere, 2008). The interest of researchers was now on understanding the role of types of markets and collective marketing in influencing smallholders’ decisions to increase marketed surplus (Kraybill *et al.*, 2012; Burke *et al.*, 2015a).

Markets are recognised for their role in absorbing smallholder crop harvests. The quantity of produce that smallholders dispose of to the markets depends on the condition of payment buyers offer. Burke *et al.* (2015b), therefore, observe that marketed surplus increase among farmers that sell their agricultural commodities to informal markets. Their findings suggest that farmers are induced by immediate cash payments that informal markets make. In most developing countries, informal output markets comprise revolving intermediary traders. The traders offer cash terms condition of payment when buying produce. Because the smallholders are cash-constrained, especially soon after the harvest (Mapila *et al.*, 2013), they dispose of relatively large quantities of produce to the market to satisfy their immediate cash needs. Moreover, buyers of produce in the formal market require that they inspect the produce for quality before completing the transaction (Shiferaw *et al.*, 2007; Shiferaw and Teklewold, 2007). This is probably another reason that influences smallholders to opt for informal markets to sell their marketed surplus.

Farmer organizations facilitate the collective marketing of produce among their members. In this regard, Alene *et al.* (2008) suggest that selling of agricultural produce, through farmer organizations, has a significant effect on the quantities that are supplied by the producer to the

market. Their study demonstrated that market participants that belonged to a maize marketing group were able to supply 56% more maize than non-members.

Similarly, Kraybill *et al.* (2012) support the importance of collective marketing in increasing the marketed surplus of agricultural commodities. The findings by Kraybill *et al.* (2012), therefore, underpin the importance of collective marketing in enabling producers to enjoy economies of scale in transporting produce to markets. This is an essential aspect of smallholder agriculture in developing countries, considering the small quantities of produce that they offer for sale (Shiferaw *et al.*, 2007; Shiferaw and Teklewold, 2007). By reducing transportation costs that producers will incur if they sell produce as individuals, collective marketing contributes to increased market returns.

2.5.3 *Market transaction-related factors*

Market transaction-related factors are important challenges whose effect on marketed surplus should not be underrated. The empirical literature cites access to markets, access to market information and utilization of information communication technology (ICT) tools, such as mobile phones and radio as some of the transaction costs related factors that influence the decisions of crop producers to increase marketed surplus (Alene *et al.*, 2008; Ouma *et al.*, 2010; Zanello, 2012). Alene *et al.* (2008) suggest that the quantity of produce that sellers supply to the market declines the farther away are the homesteads to the markets. This implies that producers incur increased cost of transporting produce to distant markets. In this case, smallholders are less likely to increase marketed surplus or will opt to sell produce at the farm gate, which offers them lower prices. In another study, Ouma *et al.* (2010) demonstrate that the longer the time that sellers take to reach markets, the smaller the quantity of produce they supply.

Besides market access, the effect of transaction costs on marketed surplus may take the form of access to market information. Apart from the extension agents, farmers access market information through ICT tools, such as mobile phones and radios. Zanello (2012) reveals that mobile phones have a positive and significant effect on the quantities of produce that farmers sell. Conversely, other results of their study establish a negative relationship between access to information through

radio and marketed surplus. The difference in the effect of the two ICT tools on marketed surplus suggests that mobile phones are relatively more flexible when it comes to accessing market information than radios. This could be because the former is easily carried by the farmers wherever they go, unlike radios, which are kept at home. Furthermore, radio programs broadcast information at designated times of the day or week, whereas market information is circulated through mobile phones at any time.

2.5.4 Farm household characteristics, post-harvest practices, and production assets

Empirical studies consider demographic factors, post-harvest practices, attributes of crop varieties, and household production assets as important in influencing producers' decisions on marketed surplus (Goyal and Berg, 2004; Baba *et al.*, 2010; Adenuga *et al.*, 2013; Edmeades, 2006). Adenuga *et al.* (2013) demonstrate that the size of the household and post-harvest crop losses have adverse effects on marketed surplus. Similar conclusions on the inverse relationship between the level of household consumption and postharvest losses and marketed surplus were reached by Baba *et al.* (2010). These findings attest to the assertion that to sustain an increased marketed surplus; households should increase production to suffice their consumption needs as well as for the market (Bardhan, 1970). In this case, the use of high yielding improved crop varieties becomes the option. The finding of a negative effect of post-harvest losses on marketed surplus suggests the need for farm households to follow post-harvest practices that minimize such losses.

Attributes of crop varieties have also been observed to influence marketed surplus. The importance of variety attributes, such as high yielding crop varieties in increasing marketed surplus, is echoed by Chinn (1976). This suggests that the utilization of high yielding varieties increase average yields. Because production would increase, the marketed surplus is also expected to increase. Considering that access to such varieties among the smallholders remains a challenge (Shiferaw *et al.*, 2008), policy efforts to enhance marketed surplus should also be complemented with strategies to enhance access of the same.

Further, Edmeades (2006) demonstrates that cooking quality and marketability attributes of food crops affect marketed surplus. The findings of her study suggest that when households prefer consumption attributes, such as cooking quality, the marketed surplus will decrease. Similarly, a fall in farmgate price was observed to influence farm households to decrease marketed surplus.

These findings underscore the need for policy to formulate strategies that facilitate smallholders to sell produce to market centers that offer better prices than at the farmgate.

One of the farm household's assets that is critical in affecting marketed surplus is the land area for cultivation of crops. On this note, Goyal and Berg (2004) suggest that the increase in marketed surplus is due to an increase in production through expanding land area cultivated to crops. Expanding land area for the cultivation of crops is not feasible due to limited land size that smallholders possess (Orr and Mwale, 2001; Narayanan and Gulati, 2002). However, the marketed surplus could increase with increased crop productivity. For this to be achieved, enhanced access to high yielding improved varieties should remain the focus of policy strategy. Furthermore, land could be reallocated from crops whose market prospects are dwindling to the production of crops that have the potential to increase both food and income security.

The preceding review presents insights on the factors that influence smallholders' decisions on marketed surplus. However, the current study adds a variable whose influence on smallholders' production decisions has not been adequately investigated by existing empirical studies. According to Ellis (1998), engagement in income diversification activities, such as piece work jobs, is one of the essential features of smallholder farm households. The current study, therefore, uses the variable on the engagement of the smallholder in piece work jobs, which is a common occurrence in the Malawian smallholder context (Whiteside, 2000). The addition of this variable is the contribution that the study makes to the empirical literature on determinants of marketed surplus under smallholder agriculture.

2.6 Market Structure and Entry Barriers in Product Markets

Empirical studies have used various indices to measure market concentration in order to determine the structure of markets that prevail from time to time. The magnitude of concentration indicates whether the market is perfectly or imperfectly competitive. According to Haji (2014), market players are free to enter or exit in perfectly competitive markets, whereas in imperfectly competitive markets, they encounter some entry barriers. The most popular indices include Gini coefficients, 4 firm concentration ratios (CR₄), and Herfindahl-Hirschman Indices (HHI). According to Nauenberg *et al.* (2004), except for the Gini coefficient, the other indices are used

when information on market shares for the firms is not complete. Usually, only information on market shares of the largest firms is required. However, Naldi and Flamini (2014b) argue that the results of such indices yield biased estimates of the degree of market concentration. Studies that have used limited information on market shares of firms, for example, Nauenberg *et al.* (2004), claim that it is difficult to collect data for all firms that operate in an industry. Despite such limitations, the indices still provide a good picture of market structure forms that exist.

While Gini coefficients and CR₄ indices have commonly been applied to measure the concentration of agricultural markets (Dessalegn *et al.*, 1998; Enibe *et al.*, 2008; Haliru and Ibitoye, 2014), the HHI has been used widely in the health, communication and civil aviation industries in developed countries (Nauenberg *et al.*, 1997; Nauenberg *et al.*, 2004; Naldi and Flamini, 2014b). According to Naldi and Flamini (2014a), the use of the HHI requires information on market shares for all players in an industry. In the context of agricultural traders in developing countries, such information is difficult to collect. This is because of the large number of traders that are involved in the marketing of agricultural commodities that are not registered with the relevant authorities.

2.6.1 Point estimates of market concentration

To determine the degree of inequality along different stages of the grain market in Ethiopia, Dessalegn *et al.* (1998) applied the Gini coefficient and CR₄ indices. Estimates from the Gini coefficients showed that wholesale grain marketing was concentrated in the few hands of merchants. Similarly, the application of the CR₄ index also confirmed a high degree of market concentration among the four largest grain traders in the wholesale market. These findings suggest that where grain markets are highly concentrated, barriers exist in terms of transportation costs. Such barriers have the effect of hampering entry to distant markets by traders that handle small quantities of produce. The finding of a similar degree of concentration, by the Gini coefficients and the CR₄, in the grain market of Ethiopia at the wholesale level (Dessalegn *et al.*, 1998), suggests that one of the indices can be applied as a substitute for the other. This is because market information for the latter is relatively easier to obtain than that of the former. To compute the Gini coefficient, one needs to know the number of market players and total revenue generated in the

market chain. In the latter, only information for the four largest firms or traders with their respective market shares is only that is required.

Some empirical evidence has shown that the degree of market concentration varies with the level of the market along the marketing chain. Using the Gini coefficient, Enibe *et al.* (2008) revealed the existence of a relatively low degree of concentration in the retail market for bananas while at the wholesale level, concentration was relatively higher. These findings suggest that banana traders freely participated in the retail market than in the wholesale market. This implies the presence of relatively more market entry barriers in the latter market. Participation in the wholesale market requires that traders transact in relatively large quantities of products. Adequate financial capital and storage space are, therefore, critical. Most intermediary traders in SSA have low financial capital, and they also lack adequate access to credit facilities (Atieno, 2001; Fafchamps and Gabre-Madhin, 2006). In this case, the retail becomes the market level in which many traders find it easy to participate. This leaves the wholesale market to be participated in by few traders making it relatively concentrated.

Applying a Gini coefficient, Giroh *et al.* (2010) suggest that inequality in the revenue generated along a market chain is associated with the degree of market concentration. In their study, the market for rubber was observed to be concentrated among a few market players. As a consequence, the revenue generated along the market chain was not equally distributed. Differences in investment risk that players were prepared to take was said to be the reason for the inequality in the distribution of revenue among the players. This suggests that market players who take more investment risks expropriate more revenue than the risk-averse ones.

Contrary to the findings by Giroh *et al.* (2010), Haliru and Ibitoye (2014) reveal conflicting results between market concentration and revenue distribution along the gum arabic market in Nigeria. The finding of a low degree of concentration in the gum arabic market would suggest that revenue generated in the market would be distributed proportionally among the traders. Instead, the study observed that few traders expropriated a substantial proportion of the revenue generated. Their findings contradict with those of Dessalegn *et al.* (1998) that in concentrated markets, the few traders that participate in them expropriate relatively high market margins. The findings by Haliru

and Ibitoye (2014), therefore, imply that the relationship between market concentration and market returns depends on the market stage that traders transact. Their finding is supported by Khan *et al.* (2005), who observed that retailers earned higher marketing margins than wholesalers and commission agents in the vegetable markets in Pakistan. It is, therefore, imperative that the analysis of the relationship between market concentration and marketing margins should take cognizance of the stages in the market channels traders are conducting their business.

2.6.2 Interval estimates of market concentration

To obtain unbiased estimates of market concentration, Naldi and Flamini (2014b) used an interval estimate of the HHI to measure market concentration in the telecommunication industry. The study used data for the ten largest mobile phone manufacturers whose market shares were known. Computing lower and upper bounds on which the HHI intervals hinge upon, the study found the concentration of markets of the firms in the mobile phone industry to be negligible. These findings suggest the prevalence of a competitive market structure in the mobile phone industry. Such an industry is expected to have fewer entry barriers than when some elements of monopoly exist. There is, therefore, a need for more empirical evidence as to whether there are few or no entry barriers in a perfectly competitive market structure.

Efforts to improve estimates of market concentration using the HHI, in the absence of full information on the number and market shares of firms, have led researchers to apply techniques from combinatorics and the maximum likelihood estimator (MLE). Nauenberg *et al.* (2004) and Nauenberg *et al.* (1997) claim that utilization of combinatorics and the MLE yields better estimates of the HHI than what can be obtained when CR_4 and CR_8 indices are applied, even without complete information (Nauenberg *et al.*, 1997; Nauenberg *et al.*, 2004). To this end, findings by Nauenberg *et al.* (2004) and Nauenberg *et al.* (1997) suggest that the application of the two estimation techniques in the HHI improves proxy measurement of market concentration.

To further ascertain the accuracy of different indices that measure market concentration, Naldi and Flamini (2014a) compared estimates of CR_4 and those of HHI. The difference between the two indices is that the application of the former requires information only of the top four largest firms, while in the latter, full information for all firms in the industry must be known.

Their study suggests the lack of a monotonic relationship between estimates for the CR₄ and those of HHI. The study concludes that the application of the two indices may not substitute each other.

2.6.3 *Market participation of intermediary traders*

Intermediary traders are a reliable source of market outlet for smallholders' produce (Mapila *et al.*, 2013). They buy produce from farmers at the farm gate and local markets and resell it to distant markets (FAO, 2014a). In so doing, they help reduce transportation costs that the producers and other buyers would incur (Muratori, 2016). The participation of the intermediary traders in the markets has, therefore, implications for the efficient functioning of the markets and improved livelihoods of the farmers (Mmbando, 2014). Few empirical studies have explicitly investigated the determinants of participation in the agriculture markets by intermediary traders. These include Fafchamps and Gabre-Madhin (2006) in Malawi and Benin; Fafchamps *et al.* (2005) in Malawi, Benin, and Madagascar and Jagwe (2011) in Rwanda. Technological, institutional, and market transaction-related factors were observed to be critical in enhancing the efficient functioning of agricultural markets in these countries.

These studies qualitatively determined entry barriers that traders encounter in participating in the agricultural markets. Although findings of the qualitative methods are informative on the nature of market entry barriers, they do not indicate the direction of their influence and the statistical significance. The current study closes the gap that exists in the empirical literature by determining market competitiveness and investigating entry barriers into the local, district, and city markets for groundnuts among intermediary traders in Malawi. A multivariate probit model that is applied is capable of jointly estimating participation decisions (Green, 2012) of intermediary traders in market channels. It also indicates the direction and significance of the determining factors to market participation. Further, little is known in the empirical literature on whether an imperfectly or a perfectly competitive market structure entails the presence or absence of market entry barriers in the market for intermediary traders.

2.7 **Summary**

The chapter presents literature reviews based on three thematic areas of the study on the production and marketing decisions of smallholders and intermediary traders of groundnuts in central and northern Malawi. The chapter first presents an overview of the groundnut subsector in Malawi. The focus is on the production and marketing activities undertaken by various actors in the subsector. Later, the chapter defines terms and concepts that are key in understating the thematic areas of the study. The chapter goes on to review empirical evidence on the determinants of variety replacement decisions, determinants of a marketed surplus of agricultural produce, and structure of the product market. Besides empirical evidence from SSA, the review on the structure of product markets has also studied evidence from other countries outside SSA. This was necessary because the interval HHI, which is a robust technique in measuring market concentration, has not been used in determining the structure of agricultural product markets in SSA. Common in the first two thematic areas is the role of socio-economic, ecological, and institutional factors in influencing the decisions of smallholders in their quest to maximize utility. In the following empirical chapters, research analytical and empirical estimation procedures are discussed, empirical findings are presented and discussed, and summaries of the empirical chapters are given to achieve the three research objectives of this study.

CHAPTER 3

SMALLHOLDERS' VARIETY REPLACEMENT DECISIONS: IMPLICATIONS FOR ADOPTION OF IMPROVED AND CONSERVATION OF CONVENTIONAL GROUNDNUT VARIETIES

3.1 Introduction

This chapter investigates the determinants of replacement decisions of conventional and improved groundnut varieties among smallholders. The Bivariate Probit is applied to analyse the replacement decisions. The findings give policy directions on the focus areas in promoting utilization of improved groundnut varieties and conservation of conventional ones among the smallholders

The remaining part of the chapter proceeds as follows: Section 3.2 gives the analytical framework. The definition of the variables used in the chapter study is given in section 3.3. The presentation and discussion of the empirical results are done in section 3.4. The last section presents a summary.

3.2 Analytical Framework

The study follows a dynamic model of adoption of innovations based on random utility theory by Manski (1977). The focus is to understand farmers' replacement decisions of improved and conventional varieties of groundnuts. In the dynamic model, not only would a farmer decide to adopt (or not) an innovation, but when he/she dis-adopts it, he/she may revert to the conventional one. According to the random utility theory, the adoption and dis-adoption decision-making process is made by comparing the utilities gained from the two innovations. The farmer would adopt the one which yields the highest utility (Manski, 1977) at a particular point in time. Assume the two innovations, improved and conventional, are denoted by n and t and their expected utilities by U_n and U_t , respectively. By comparing their expected utility, the farmer decides to adopt the former if $U_n > U_t$ and dis-adopt and revert to the latter if $U_t > U_n$. Further, assume the utility of a farm household for adopting the new and conventional innovations for a given vector of socio-economic factors (X) is denoted by $U_{n,t}(X)$. The utility of adoption is, therefore, defined as a linear function of either of the innovations as follows:

$$U_{n,t} = XB_{n,t} + E_{n,t} \quad (3.1)$$

Where $B_{n,t}$ and $E_{n,t}$ are response coefficients and random disturbances on the adoption of the innovations, respectively. The decision to replace groundnut varieties is a binary one and could be estimated by a probit model, which is expressed as:

$$P(Y = 1|X) = F(XB) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{XB} e^{-\frac{(XB)^2}{2}} dx \quad (3.2)$$

The decision by farmers on whether or not to replace conventional and modern groundnut varieties is dependent on each other. The interdependence of crop variety replacement decisions is due to constraints in the land available for cultivation of crops and farmers' risk attitudes towards the crop varieties that have different agronomic and market attributes (Tsusaka *et al.*, 2016a). In this case, the covariates of the error terms that emanate from such an interdependent decision will be correlated. According to Green (2012), a bivariate probit regression model is appropriate for such interdependent decisions. Generally, the two-equation model is specified as:

$$y_1^* = X_1'\beta_1 + \varepsilon_1 \text{ and } y_2^* = X_2'\beta_2 + \varepsilon_2 \quad (3.3)$$

In the bivariate probit, model outcomes are specified as:

$$y_1 = 1 \text{ if } y_1^* > 0 \text{ and } y_1 = 0 \text{ if } y_1^* \leq 0 \quad (3.4)$$

$$y_2 = 1 \text{ if } y_2^* > 0 \text{ and } y_2 = 0 \text{ if } y_2^* \leq 0 \quad (3.5)$$

The bivariate probit model assumes that $(\varepsilon_1, \varepsilon_2)$ are drawn from a standard bivariate normal distribution with zero means, unit variance, and correlation coefficient (ρ).

3.3 Definition of Variables

3.3.1 Dependent variables

The dependent variables used in the study are binary ones that define the decision on whether farmers in the production time of groundnuts ever replaced conventional with modern groundnut varieties and *vice versa*.

The replacement of groundnut varieties was coded 1 and 0 otherwise. Farmers were asked whether, in the previous three years (2015/16; 2014/15; 2013/14), they had replaced one groundnut variety with the other.

3.3.2 *Independent variables*

The variables used in the study are described in Table 2. The empirical literature cites farm household characteristics, institutional factors, economic and biophysical variables as determinants of farmers' crop variety replacement decisions and adoption and dis-adoption (Wale, 2011; Wale, 2012; Fisher *et al.*, 2015; Danso-Abbeam *et al.*, 2017).

Gender, experience in groundnut production, education level, and family size were farm household-specific characteristics used in the study. It has been reported that men have more advantages than women when it comes to accessing modern farm inputs (Ragasa, 2012). Farmers that are more experienced in the production of particular crops can evaluate benefits that accrue from adopting modern agricultural technologies (Mariano *et al.*, 2012; Wale, 2012). It is expected that as the education level of a farmer increases, he/she more quickly process information about technologies when they are made available (Asfaw and Admassie, 2004). Large family size implies an increase in demand for greater crop harvest to satisfy food and income needs for the household (Feleke *et al.*, 2005). Modern crop varieties are better options to meet such a demand.

Status of rural roads is one of the transportation infrastructure variables included in the study. Better roads are expected to positively influence the adoption of modern agricultural technologies (Feder *et al.*, 1985) by enabling more access to farm inputs markets. This implies that farmers located in areas with poor roads incur more transportation costs to access modern technologies. This leaves them with conventional crop technologies, as their only option, which they acquire in local markets close to their homes (Lipper *et al.*, 2010).

Institutional factors included in the models are membership of farmers in farmer organisations, perception of farmers on the relevance of extension services, and (in) adequate access to quality seed. Farmer organizations promote the use of modern agricultural technologies (Olalekan and Simeon, 2015).

Extension agents also easily reach out to farmers that belong to farmer organizations. In this circumstance, it is expected that farmers' organisations will positively and negatively influence the replacement of conventional and modern varieties, respectively.

Table 2: Definition of Variables used in Smallholder Groundnut Variety Replacement

Variable	Definition	Variety Replacement Regime	
		Conventional	Modern
		Expected Sign	
GENDRES	1 if the respondent is male, 0 otherwise	Positive	Uncertain
EXP	Years in groundnut production	Positive	Uncertain
EDULRES	Level of education of the respondent	Positive	Uncertain
HHSZE	Size of farm household	Positive	Negative
GNUTHA	Land size (hectares) cultivated with groundnuts	Positive	Uncertain
LVEUNIT	Number of animals owned by household converted to tropical livestock units	Positive	Positive
GNTPURP	1 if dual production of groundnuts, 0 otherwise	Positive	Positive
RODST	1 for poor rural road status, 0 otherwise	Negative	Positive
DRTEFFECT	1 if farm household has ever been affected by drought, 0 otherwise	Positive	Positive
CHASSD	1 if farmer faces challenges to access quality seed, 0 otherwise	Negative	Positive
FORG	1 if farm household head belongs to farmer organization, 0 otherwise	Positive	Negative
QLTYEXT	1 if farmer perceives extension services relevant, 0 otherwise	Positive	Negative

Source: Farm Household Survey Data (2017); n=Total sample size

The satisfaction of farmers with the information delivered to them by extension services is a necessary condition for the adoption of modern technologies (Elias *et al.*, 2016).

Farmers that feel the extension messages to be relevant to their groundnut production would most likely adopt modern varieties. Adequate access to quality groundnut seed among most farmers in Malawi remains a challenge (Simtowe *et al.*, 2010b; Nakhumwa and Kaudzu, 2013). The seeds are in short supply in the markets, or the markets are inaccessible. In this case, conventional varieties and recycled seeds become an alternative option. It is, therefore, expected that the variable on inadequate access to quality seed to have negative and positive influences on the replacement of conventional and modern varieties, respectively.

Economic variables included in the study are the land for cultivation of groundnuts, the number of animals owned by the farm household, and the dual-purpose production of groundnuts. Land size is expected to have a positive and negative influence on the replacement of conventional and modern groundnut varieties, respectively. Farmers that have access to large land area are more likely to abandon conventional varieties for modern varieties (Wale, 2012). This implies that large land size makes farmers less vulnerable to the risk of trying new agricultural technologies (Mariano *et al.*, 2012). Animals owned and the dual purpose of production is expected to have positive effects in the replacement of conventional and modern varieties. Livestock is a source of wealth for farm households. Apart from being utilized for food, livestock is a source of income and draught power for the household. Farm households would sell some of their livestock to purchase farm inputs. Farmers that produce groundnuts for dual purposes, food and income, demand high yielding modern varieties to produce more marketable surplus (Barrett, 2008).

One biophysical factor used in the models is drought conditions. Rain-fed crop production is affected by drought (Ochieng *et al.*, 2016). Conventional varieties of groundnuts are relatively less tolerant of dry spells. To counteract the effects of drought, researchers have developed drought-tolerant modern groundnut varieties (Minde *et al.*, 2008; Siambi *et al.*, 2015; Tsusaka *et al.*, 2016a). The expected sign for farmers that indicated to have been affected by drought conditions on replacement of conventional varieties is positive while it is negative for replacement of modern varieties. Because conventional groundnut varieties have consumption and local market demand (Tsusaka *et al.*, 2016a), some farmers would be willing to replace modern varieties for them. The empirical model for the factors expected to influence the replacement of groundnut varieties is specified in equation (3.6).

$$\begin{aligned}
Y_{ij} = & \beta_0 + \beta_1 GENDRES + \beta_2 EXP + \beta_3 EXPSQD + \beta_4 EDULRES \\
& + \beta_5 HHSZE + \beta_6 RODST + \beta_7 FORG + \beta_8 QLTTEXT \\
& + \beta_9 CHASSD + \beta_{10} GNUTHA + \beta_{11} LVEUNIT + \beta_{12} GNTPURP \\
& + \beta_{13} DRTEFFECT + \varepsilon_{ij}
\end{aligned} \tag{3.6}$$

Where Y_{ij} and ε_{ij} represent crop variety replacement and error terms, respectively. Regarding subscripts ij , i for farmers where $i = 1, 2, 3 \dots n$ and j designates groundnut variety where $j = 1, 2$.

3.4 Empirical Results and Discussion

3.4.1 Socio-economic characteristics of groundnut smallholders

Descriptive statistics of the variables used in the replacement of groundnut varieties are presented in Table 3. A relatively small proportion (34%) of the respondents of sampled farm households were male farmers. This finding is consistent with Tsusaka *et al.* (2016b), who pointed women farmers dominate the production of groundnuts. The average years of experience in groundnut production and education level of the farmers were about 8 and 5 years, respectively. Despite that, on average, farmers seem to be literate; the majority of them had relatively low education levels. About 78% of the farmers did not attain education level beyond grade 4, and 46% were illiterate. Farm households allocated, on average, half a hectare to groundnut production. This supports data by FAOSTAT (2017), which shows that land area for cultivation of groundnuts has been increasing over the years. The majority of smallholders (82%) indicated producing groundnuts for dual purposes, that is, for food and cash income. A small proportion of the farm households (14%) resided in areas with poor road networks, which are impassable during the rainy season. About 89% of the farmers reported having inadequate access to quality groundnut seeds. The majority of farm households (78%) also reported being happy with the extension messages being disseminated.

Table 3: Socio-economic Characteristics of Smallholder Groundnut Producers (n=4160)

Variable	Min	Max	Mean	Std.Dev
GENDRES	0	1	0.341	0.475
EXP	1	37	7.800	7.274
EXPSQD	1	1369	113.632	213.380
EDULRES	0	13	5.149	3.585
HHSZE	1	11	5.189	1.608
GNUTHA	0.1	2.43	0.455	0.410
LVEUNIT	0	17.5	0.633	1.524
GNTPURP	0	1	0.822	0.383
RODST	0	1	0.142	0.349
DRTEFFECT	0	1	0.829	0.377
CHASSD	0	1	0.889	0.314
FORG	0	1	0.438	0.497
QLTYEXT	0	1	0.781	0.414

Source: Farm Household Survey Data (2017); n=Total sample size

3.4.2 Demand for Improved Varieties by Gender and Age groups of the Smallholders

Gender and age of the smallholders are some of the household characteristics that have a significant influence in the decisions of the smallholders to adopt improved agricultural technologies (Danso-Abbeam *et al.*, 2017; Abebe *et al.*., 2013). Male headed smallholder households have an advantage over their female counterparts in the access of highly productive farm inputs, which include modern agricultural technologies (Ragasa, 2012). In the current study, smallholders, that indicated to have replaced conventional varieties with improved ones in 2016/17, were deemed to have expressed demand for the same. The descriptive statistics in Table 4 show that a higher percentage of women farmers than males replaced the former with the latter. These results are consistent with the observation by Tsusaka *et al.* (2016) that in Malawi, groundnut production is dominated by women farmers. This finding suggests that women farmers are more likely to benefit more from modern varieties of groundnuts whenever they are introduced in the production system from time to time.

Table 4: Demand for Improved Varieties by Gender of Smallholders (n=416)

Gender of the Smallholder	% of Smallholders
Female	69
Male	31

Source: Farm Household Survey Data (2017); n=Total sample size

Other descriptive statistics in Table 5 indicates that a higher percentage of farm household heads in the age groups of above thirty years and below seventy replaced conventional with modern varieties of groundnuts. The descriptives result also show that there were fewer smallholders in the age groups of below thirty and above seventy years that replaced conventional with modern varieties. These results, therefore, suggest that smallholders that are in the age groups of above thirty and below seventy are also more likely to be more experienced in the production of groundnuts. Consistent with the observations by Mariano *et al.* (2012) and Wale (2012), farmers that are more experienced in the production of particular crops can evaluate benefits that accrue from adopting modern agricultural technologies. It is in this view that below and above certain age groups, for example, thirty and seventy years, the farmers would have less motivation to demand highly productive farm inputs.

Table 5: Demand for Improved Varieties of Groundnuts by Age group of the Smallholders (n=416)

Age group (Years)	% of Smallholders
20-29	8.08
30-39	20.20
40-49	30.30
50-59	22.22
60-69	18.18
70-79	1.01

Source: Farm Household Survey Data (2017); n=Total sample size

3.4.3 Groundnut varieties cultivated by farm households in the study areas

Results of the FGDs and KIIs revealed that farmers in Lilongwe and Kasungu districts cultivate the conventional varieties Chalimbana and Kalisele, in Salima, they cultivate Chalimbana and Galumbwako. For improved varieties, farmers in Lilongwe and Kasungu cultivate CG7, Nsijiro, and Chitala while in Salima, they cultivate CG7, Chitala, and JL24.

The situation is different in the Mzimba district, where farmers mostly cultivate the conventional varieties Chalimbana and Kalisele. Improved varieties, for example, CG7, are rarely cultivated in the district.

3.4.4 Groundnut variety replacement decisions

Table 6 indicates the replacement decisions of groundnut varieties. About 41% of the farm households reported having replaced conventional varieties, while about 23% replaced modern varieties. By replacing the conventional variety with the modern one, farmers would be presumed to have adopted the latter. The relatively low percentage of farmers that replaced conventional varieties with modern ones suggests that farmers have not entirely abandoned the former for the latter.

Table 6: Replacement of Conventional and Modern Groundnut Varieties (n=416)

Variety replacement decision	Replacement (%)	Non-replacement (%)
Conventional varieties	41.3	58.7
Modern varieties	22.6	77.4

Source: Farm Household Survey Data (2017); n=Total sample size

A similar observation was made by Simtowe *et al.* (2010). Seed scarcity and increase in the cost of seed for modern varieties were the reasons that farmers cited for the decision to replace modern with conventional varieties (Table 7). The other reason could be that farmers attach more value to the attributes of conventional varieties, which they perceive to be absent in the modern varieties. For example, desirable consumption attributes of the conventional varieties were one of the reasons that farmers gave to replace modern varieties.

3.4.5 Farm household level preference for varietal attributes

The reasons why farm households replace groundnut varieties are presented in Tables 7 and 8. Most farm households indicated that they replaced conventional varieties with improved ones because the former are relatively low yielding.

Table 7: Reasons for Replacing Conventional with Modern Varieties (n=416)

Reasons for Variety Replacement	% of Responses
Modern varieties are high yielding	24.3
Modern varieties have high market demand	2.6
The seed for conventional varieties is scarce	4.8
Conventional varieties have a low resistance to diseases	9.6
Total	41.3

Source: Farm Household Survey Data (2017); n=Total sample size

Apart from the yielding trait, other reasons for replacement of conventional with modern varieties included low market demand, scarcity of seed, and low resistance to pests and diseases of the former. For farm households that replaced modern varieties, scarcity of seed and increase in the cost of the seed were the main reasons. Consumption and marketability attributes of the conventional varieties were the other reasons that farmers indicated to replace the modern varieties. Further, smallholders may replace modern varieties with the conventional ones because of their preference for some agronomic attributes that are absent in the former. In a related study, Waldman *et al.* (2017) observed that smallholders in Malawi opted to cultivate perennial pigeon pea crop, which is a conventional variety, for the improved one. Increased biomass and capacity to fix nutrients in the soil of the former were the reasons for their preference over the improved pigeon pea variety.

Table 8: Reasons for Replacing Modern with Conventional Varieties

Reasons for Variety Replacement	% of Responses
The seed for modern varieties is scarce	7.2
The seed for modern varieties is expensive	7.9
Conventional varieties have good taste	4.1
Conventional varieties have high market demand	3.4
Total	22.6

Source: Farm Household Survey Data (2017)

3.4.6 Probability of variety replacement

The probability of variety replacement is depicted by the mean values in Table 9. The probability that a farmer would replace groundnut varieties was three times lower than the probability of not replacing them. Similarly, the probability of maintaining modern varieties was almost three times that of maintaining conventional ones.

Table 9: Probability of Variety Replacement

Variety Replacement	Mean
The probability that a farmer would replace groundnut varieties	0.168(0.094)
Probability of maintaining modern varieties	0.246(0.112)
Probability of maintaining conventional varieties	0.068(0.046)
Probability of not replacing varieties	0.518(0.160)

Source: Output from the data analysis; Note: Figures in parenthesis are standard deviations

3.4.7 The results of the bivariate probit model

The results of the bivariate probit regression estimates of the decisions to replace varieties are reported in Table 10. The estimated chi-squared test is statistically significant at the 1% level ($p > 0.000$). This indicates that, jointly, the explanatory variables influenced smallholder' decisions to replace conventional and improved groundnuts. The estimate of ρ (correlation of the errors) that maximized the bivariate probit function is significantly different from zero at a 1% level. This suggests that the random disturbances in the groundnut variety replacement decisions of smallholders are affected by similar random shocks. This implies that the decisions to replace varieties are statistically not independent. This indicates a very strong positive association between the unobservable covariates in the two equations of the groundnut variety replacement decisions. Any attempts to estimate the two equations separately would yield inefficient parameter estimates (Green, 2012).

3.4.8 Determinants of replacement of conventional groundnut varieties

From the thirteen variables used in the study, only rural road status turned to be negative and significantly influenced the probability of replacing conventional varieties. Conversely, farmers' perception of extension services, land for cultivation of groundnuts and production of groundnuts for food and income positively influence the probability of replacing conventional varieties. The probability of replacing conventional varieties decreased by about 89% for farm households located in areas where rural road infrastructure is poor. Most rural roads in Malawi are impassable during the rainy season, which is the critical time when farm inputs are delivered to farmers. Poor roads increase transportation and other market transaction costs of supplying the inputs, which include crop seeds. Consequently, input prices are raised such that most smallholders may not afford them. Because of the inability to access the input markets, farmers would be less willing to replace the conventional varieties with improved ones. Farmers acquire the conventional varieties of groundnuts through purchase in local markets, farmer to farmer seed exchange, and from their saving of crop harvest. The current finding agrees with Ogada *et al.* (2014), who found a negative association between poor road conditions and uptake of improved maize varieties among farmers in Kenya.

Farmers' perception of the relevance of extension services to the production needs of groundnuts was significant at the 1% level, and the likelihood that they would replace conventional varieties increased by 37%. Not all extension messages meet the needs to solve farmers' agricultural problems. Some are specific, while others are generally applicable to agricultural production. However, farmers would participate in agricultural extension meetings and be willing to use extension information if they feel the extension messages would meet their particular farming problems. Also, they may sacrifice any financial resources they may have to purchase the required farm inputs. In a related study, Elias *et al.* (2016) found that perceived economic return, regular extension contact, family size, and off-farm income determined farmers' satisfaction with extension services delivered to them in western Ethiopia.

The likelihood that farmers would replace conventional varieties increased by about 54% for a unit increase in land allocated to groundnut cultivation. According to Mariano *et al.* (2012), farmers that have more land for cultivation of crops are less vulnerable to the risk of trying new agricultural technologies.

However, Kristjanson *et al.* (2005) found indeterminate results with decreasing and increasing the likelihood of adoption of improved cowpeas with an increase in land size in Nigeria. However, with decreasing size land, farmers ideally may want to adopt high-yielding crop varieties to realize increased yield per unit area of land. The current study, therefore, suggests that the association between land size and replacement of varieties will vary with farmers' variety preferences. If farmers prefer conventional varieties to the modern ones, then as land size increases, more of the latter will be replaced than the former. The opposite would be true when the household's preference is for modern varieties.

Table 10: Bivariate Probit Estimates of Replacement of Groundnut Varieties (n=416)

Variable	Replacement of conventional varieties		Replacement of modern varieties	
	Marginal effects	Z-Score	Marginal effects	Z-Score
GENDRES	-0.014(0.142)	-0.10	0.034(0.154)	0.22
EXP	0.037(0.030)	1.26	0.062**(0.032)	1.95
EXPSQD	-0.001(0.001)	-0.84	-0.002(0.001)	-1.57
EDULRESP	-0.007(0.019)	-0.35	0.058*** (0.020)	2.83
HHSZE	0.037(0.042)	0.90	-0.027(0.045)	-0.61
LIVSUNIT	-0.029(0.052)	-0.57	0.028(0.053)	0.53
GNUTHA	0.535** (0.231)	2.32	0.064(0.250)	0.26
GNUTPURP	0.618*** (0.176)	3.50	0.466** (0.203)	2.3
RODST	-0.890*** (0.218)	-4.08	-0.357(0.227)	-1.57
DRTEFFECT	0.263(0.183)	1.44	-0.152(0.192)	-0.79
CHASSD	0.120(0.211)	0.57	0.438* (0.247)	1.77
FORG	0.101(0.141)	0.72	0.458*** (0.154)	2.98
QTLYEXT	0.373** (0.176)	2.12	-0.066(0.195)	-0.34

Observations: 416 Wald chi2(26) = 72.00; Prob > chi2 = 0.000

athrho .621*** (0.102) rho 0.560 (0.070)

LR test of rho=0; Chi2(1) = 43.105; Prob > Chi2=0.000

***, ** and * denotes significance at 1%, 5% and 10%, respectively.

Figures in parentheses are standard errors. All figures rounded to 3 decimal points except Z scores.

Source: Farm Household Survey Data (2017); n=Total sample size

As hypothesized, the production of groundnuts for food and income positively influenced the likelihood of conventional variety replacement at 1% significant level. The probability of conventional variety replacement for farmers that cultivated groundnuts for the dual purpose of production increased by about 62%. Farmers demand high yielding improved food crop varieties for subsistence production as well as for the market. The positive influence of the dual-purpose production of groundnuts on the likelihood of variety replacement is in line with the national policy objective of promoting increased production of groundnuts in Malawi (Malawi-Government, 2011; Malawi-Government, 2016a).

Furthermore, Makoka (2012) reported that groundnut is one of the legumes that have the potential to increase agricultural incomes and sustain the nutritional needs of rural farm households in Malawi. The use of high yielding improved groundnut varieties is one of the options to increase the production of the crop. In these circumstances, the dual purpose of the production of groundnuts should indeed influence farmers' replacement decisions of low yielding conventional crop varieties.

3.4.9 Determinants of replacement of modern groundnut varieties

Five variables positively influenced the replacement of modern varieties of groundnuts. These variables are the education level of the respondent, experience in the production of groundnuts, membership of farmer organization, inadequate access to quality seed, and dual production purpose of groundnuts. A one-year increase in education level and experience of the farmer in the production of groundnuts increased the likelihood of replacing modern groundnut varieties by about 6%, respectively. The finding that the education level of the farmers was positively associated with the replacement of modern groundnut varieties is in contrast to empirical evidence. Farmers with high levels of education would quickly assess the economic benefits that different technologies would bring before deciding on the one to adopt or dis-adopt (Asfaw and Admassie, 2004; Lawal *et al.*, 2004). Other studies by Supaporn *et al.* (2013), Diiro *et al.* (2015) and Gebresilassie and Bekele (2015) found a positive association between the education level of the farm household head and adoption of agricultural technologies in north-eastern Thailand, Uganda and northern Ethiopia, respectively.

The finding of the current study suggests that better-educated farmers may have diverse sources of income, such that farming could not be their primary source of livelihoods. They would want to cultivate a crop that would give them just enough harvest for consumption and not for sale.

Similarly, a one-year increase in the experience of the farmer in the production of groundnuts increased the likelihood of replacing modern groundnut varieties by about 6%. The finding of the current study of a positive association between experience in production and replacement of modern groundnut varieties contradicts findings by Wale (2012). In his study, experience in farming was observed to be positively associated with the number of conventional varieties that farmers abandoned in Ethiopia. However, Acheampong *et al.* (2016) and Olalekan and Simeon (2015) found no evidence of a positive relationship between experience and discontinued use of improved agricultural production and crop technologies in Ghana and Nigeria, respectively. The findings of the current study suggest that, with experience, farmers would quickly assess the demand for different varieties of crops and choose to cultivate the one they hope would be marketable. This might influence some farmers to shift from the cultivation of modern varieties. This explanation is supported by Tsusaka *et al.* (2016a), who reported that conventional varieties of groundnuts are preferred by the local market for making snacks in Malawi.

The production of groundnuts for food and income increased the probability of replacement of modern varieties by 47%. Such a finding is an unexpected result because farmers that cultivate a crop for dual purposes require high-yielding varieties to produce enough for home consumption and marketable surplus. However, an explanation of the current finding could be that farmers may not consider high yield as the only attribute to influence their choice of crop variety at a particular point in time (Wale and Yalew, 2007). Instead, they would want to cultivate a crop mainly for household consumption and the remainder for the local market. This explanation is supported by results in Table 8, where farmers indicated preference for consumption and marketability attributes as the reason for replacing modern varieties with conventional ones.

Other results showed that membership of farmer organizations increased the probability of replacing modern varieties by 46%.

Contrary to the expectation, the current study found membership of farmer organisations to be positively related to the replacement of modern groundnut varieties. For example, Kristjanson *et al.* (2005) found that membership to farmer groups positively influenced the continued use of modern cowpea varieties in the dry savanna region of Nigeria. However, by replacing modern groundnut varieties, farmers are essentially dis-adopting them. This is unexpected considering that most farmer organizations promote the use of improved agricultural technologies (Caviglia-Harris, 2003; Wollni *et al.*, 2008; Olalekan and Simeon, 2015). The findings of the current study suggest that when farmers belong to a group of common interests, they share information on other aspects of crop enterprises. For example, if the information that farmers share is on the market demand for a conventional crop variety, they may decide to cultivate more of it than the modern one. In this case, it is the farmers' perception of the importance of the conventional variety to their livelihood, which influences the replacement of modern varieties. This implies that farmers' social networks are strong enough to override the influence that organisations have on the adoption of modern varieties.

Furthermore, the probability of replacing modern groundnut varieties, for farmers that indicated to have inadequate access to good quality seed, increased by 44%. The results that inadequate access to quality seed positively influenced replacement of modern groundnut varieties supports the findings by Shiferaw *et al.* (2008). Their study established that differences in adoption and intensity of adoption of improved seed varieties among different regions in Tanzania were associated with differences in the extent of seed access among the farmers. As reported by some writers, continued usage of low-yielding conventional varieties of groundnuts in Malawi, is because most farmers face challenges in accessing the improved ones (Simtowe *et al.*, 2010b; Makoka, 2012; Nakhumwa and Kaudzu, 2013).

3.5 Summary

The purpose of this chapter was to determine the factors that influenced the probability that smallholders replaced conventional and improved varieties of groundnuts in Malawi. A bivariate probit (BVP) model was used because the decisions to replace the two varieties were not mutually exclusive. Similar socio-economic, institutional, infrastructure, and biophysical factors were used in both the two equations.

The results of this chapter indicate that despite the availability of modern varieties of groundnut in the production system, farmers have not entirely abandoned the conventional ones. The study also found that once farmers have replaced conventional varieties with modern ones, few revert to the former. The results of the estimates of the BVP showed that the probability that smallholders would replace conventional and improved varieties was three times less the probability that they would not replace them.

On the other hand, the probability of maintaining improved varieties was three times higher the probability that they would continue cultivating conventional varieties. In terms of gender and age group, the descriptive statistics have shown that a higher proportion of women than male smallholders and those that were above thirty but not more than seventy years replaced the conventional with improved varieties of groundnuts. In other results, land allocated to the production of groundnuts, production of groundnut for food and income and farmers' perception of the quality of extension messages delivered to them positively influenced the replacement of conventional varieties. However, poor road networks negatively influenced the replacement of the same. On the other hand, the education level of the farmer, experience in the production of groundnuts, membership to farmer organization and inadequate access to quality seed had a positive influence on farmers' replacement decisions of modern varieties with conventional ones. However, the finding of the positive association between the education level of farmers and membership of farmer organization and replacement of modern groundnut varieties conflict with empirical evidence from similar studies.

CHAPTER 4

SMALLHOLDER MARKETED SURPLUS AND DEMAND FOR IMPROVED GROUNDNUT VARIETIES: EMPIRICAL EVIDENCE

4.1 Introduction

This chapter assesses the effects of smallholder marketed surplus of groundnuts on demand for improved varieties among the smallholders. The Endogenous Switching Probit (ESP) is employed to determine the factors that affect the marketed surplus. The findings suggest the need for policy to focus on factors in the output market that constrain smallholder farmers in demanding improved groundnuts varieties that have the potential to increase crop productivity.

The rest of the chapter proceeds as follows: Section 4.2 gives an overview of the ESP model. The definition of variables is presented in section 4.3. Results and discussion are presented in section 4.4. Section 4.5 gives a summary.

4.2 Empirical Model Estimation Procedure

The study adopts an Endogenous Switching Probit (ESP) model to investigate the impact of marketed surplus on farmers' demand for improved varieties of groundnuts in central and northern Malawi. The ESP controls for endogeneity biases in treatment effect frameworks (Lokshin and Sajaia, 2011). Other econometric models that control for endogeneity biases include Heckman's two-step, double hurdle, endogenous switch regression, and conditional mixed process (Cragg, 1971; Heckman 1979; Roodman, 2009). The difference between the ESP and the other models is that the former is appropriate in modelling decisions where both the selection and outcome response variables are binaries (Carrasco, 2001; Lokshin and Glinskaya, 2009; Lokshin and Sajaia, 2011). In the latter, only the treatment response variable is binary, while that of the outcome is continuous. Inquiry on continuous variables requires that farm households recall specific events that happened months or sometimes years in the past. This becomes a challenge, as smallholder farm households do not keep records of their daily undertakings. As a consequence, they may, in some cases, understate or overstate the situation leading to bias or measurement error (Beegle *et al.*, 2011) of the outcomes.

Let MP_i denote a binary variable taking 1 for smallholders with a marketed surplus, 0 otherwise. Similarly, DI_i is also a binary with 1 indicating smallholders' demand for improved varieties and 0 otherwise. The selection and outcome equations are, in turn, specified in equations (1) and (2).

$$MP_i = 1 \text{ if } \gamma Z_i + \mu_i > 0; MP_i = 0 \text{ if } \gamma Z_i + \mu_i \leq 0 \quad (4.1)$$

$$DI_{1i}^* = \alpha_1 X_{1i} + \varepsilon_{1i}; DI_{1i} = I(DI_{1i}^* > 0); DI_{0i}^* = \alpha_0 X_{0i} + \varepsilon_{0i}$$

$$DI_{0i} = I(DI_{0i}^* > 0) \quad (4.2)$$

$$DI_i \text{ is observable when } DI_i = DI_{1i} \text{ if } MP_i = 1;$$

$$DI_i = DI_{0i} \text{ if } MP_i = 0, \quad (4.3)$$

Where DI_{1i}^* and DI_{0i}^* are the latent variables that determine the binary outcomes DI_1 and DI_0 , X_1 and X_0 are vectors of weakly exogenous variables, Z is a vector of variables that determine a switch between and α_0 γ are vectors of parameters; and μ_i , ε_{1i} and ε_{0i} are the error terms. The observed demand for improved varieties DI_i is a dichotomous realization of DI_i^* if the farmer has no marketed surplus.

The assumption that is made in this type of model is that farmers' decision to demand improved varieties is endogenous to having marketed surplus. Some unobservable characteristics that influence the probability that a farmer would have marketed surplus could also influence the decision to demand improved varieties or not. Neglecting this endogeneity in the unobservable covariates in both treatment and outcome regression equations is likely to yield biased estimates of the impact of marketed surplus on the decision to demand improved varieties. This problem is overcome with the use of instrumental variables in the selection equation (Makate *et al.*, 2016). A falsification test is conducted on the probit regression of the outcome equation to identify the right instrumental variables. The insignificant p -value of the chi-squared is an indication that the variables are the right instruments to be used in the selection equation but not in the outcome.

A post estimation is conducted to find parameters that measure the effects of the treatment variables on the desired outcome (Heckman and Vytlačil, 2000). In this paper marketed surplus of groundnuts is the treatment or selection variable. The demand for improved varieties of groundnuts is the outcome variable.

The post estimation parameters of the ESP include average treatment effect (ATE), which is the average effect of marketed surplus for groundnuts on-demand for improved varieties for a smallholder selected at random from the population. On the other hand, the average treatment effect on the treated (ATET) estimates the effect of marketed surplus on-demand for improved varieties for smallholders with the marketed surplus. The effect of farmers with no marketed surplus on-demand for improved varieties is estimated by the average treatment effect on untreated (ATU). However, the average marginal treatment effect (MTE) describes the effect of smallholders that are in the margin of indifference. Such smallholders are indifferent as to whether to increase marketed surplus or not. More details of the ESP model are provided by Lokshin and Sajaia (2011) and Aakvik *et al.* (2000).

Estimation of the parameters that indicate the impact of marketed surplus on-demand for improved varieties proceeds with determining factors that affect marketed surplus. Denote the marketed surplus as $MP_i = Q_i - X'_i$, where MP_i is a marketed surplus, Q_i is the total household output, X_i is a vector of household consumption which includes part of the harvest used as seed and given away as gifts. In autarky, nothing is traded, $MP = 0 \forall_i \in$ not traded. However, when the farmer sells part of the harvest, then $MP_i > 0 \forall_i \in$ is traded. Then the selection equation with its determinants is given as,

$$\begin{aligned}
 MP_i = & \alpha_0 + \alpha_1 AGERESS + \alpha_2 AGERESSQD + \alpha_3 PCWORK + \alpha_4 OXCART \\
 & + \alpha_5 PGNUTHA + \alpha_6 YIELD + \alpha_7 SEEDCOST + \alpha_8 OUTPUTMARK \\
 & + \alpha_9 MOBP + \alpha_{10} SEEDLOAN + \alpha_{11} EXT + \alpha_{12} SEEDMULT \\
 & + \alpha_{13} PRDBUYERS + \alpha_{14} RODST + \alpha_{15} DISTMARK + \varepsilon_i \quad (4.4)
 \end{aligned}$$

Where all the variables are as defined in Table 1 and ε_i are the unobservable covariate.

4.3 Definition of Variables

The definitions of the variables used in the study are presented in Table 11. Dependent variables comprised a selection variable, marketed surplus, (MP) and an outcome variable, demand for improved varieties, (DI).

In the former case, farm households were asked to indicate, in local measurements, how much of the crop they harvested in 2015/16 that they sold. This, according to Patnaik (1975), is the marketed surplus. The marketed surplus was then converted as the proportion of the total harvest. Because it is the produce that was sold, such proportion indicates the household's commercialization index (Govere *et al.*, 1999; Strasberg *et al.*, 1999; Chirwa, 2009). According to Strasberg *et al.* (1999) and Govere *et al.* (1999), a commercialization index of close to 0 means that the farm household is producing the crop purely for subsistence while the index close to 1 means that the household production is oriented towards the market. In this study, all values that were equal and above 0.5 were considered to be close to 1 and considered to be marketed surplus. Smallholders' whose commercialization index was below 0.5 was considered to be close to zero and considered to have no marketed surplus. A binary variable was generated for marketed surplus with 1 and 0 otherwise. For the outcome variable, farmers who indicated to have replaced conventional varieties with improved ones in 2016/17 were considered to have expressed demand for the same. Consequently, the variable was coded 1 for the demand, 0 otherwise.

Explanatory variables hypothesized to explain a marketed surplus of groundnuts were identified based on past empirical work (Alene *et al.*, 2008; Zanello, 2012; Adenuga *et al.*, 2013; Burke *et al.*, 2015a). The variables included in this paper are age and age squared of the respondent, farm household engagement in piece work jobs, farm household ownership of oxcarts, the proportion of land cultivated with groundnuts, yield per hectare of groundnut harvested, cost of seed per hectare, access to output market information, possession of a mobile phone, access to seed loans, access to extension services, farm households that resides in areas with certified seed multiplication activities, mobile grain trader as the primary buyer of produce, farm households that resides in areas with poor road network to the central district business centers and time take for farm household to reach nearest output markets.

4.3.1 *Socio-economic characteristics*

Farmers' age (AGERESS and AGERESSQD) is expected to have a nonlinear relationship with a marketed surplus. Young farmers are more inclined to increase marketed surplus than older ones (Gebremedhin and Jaleta, 2010).

Involvement in piece work jobs (PCWORK), known as ‘ganyu’ in Malawi, is a form of an income diversification strategy for farm households (Ellis, 1998). However, Whiteside (2000) pointed out that *ganyu* is counterproductive to household productivity as it competes with the household’s demand for labor. Because *ganyu* contributes to low households’ crop productivity marketed surplus is also expected to decline. Oxcart is the most used means of transporting inputs and produce to and from the market in some of the rural areas of SSA countries. It is, therefore, expected that farm household that own oxcarts (OXCART) to enhance the intensity of participation in the markets as sellers or buyers.

Households productive assets, such as the proportion of land allocated for the cultivation of crops (PGNUTHA) is expected to increase production, hence increase in the marketed surplus (Goyal and Berg, 2004). An increase in yield per hectare of land (YIELD) increases marketed surplus through an increase in the production of marketable surplus. The seed for modern varieties, especially, groundnuts, are costly. Their supply is low because private traders consider the enterprise to have narrow profit margins (Minde *et al.*, 2008; Siambi *et al.*, 2015). This makes their demand fall with an increase in the cost (SEEDCOST). The decline in the demand for certified seed reduces crop productivity, hence negatively affects marketable and marketed surplus.

4.3.2 *Market access related factors*

Farmers that have access to output market information (OUTPUTMARKT) are more likely to have marketed surplus due to the prospects of finding buyers that offer better prices. Farmers that possess mobile phones (MOBP) are able to link with many prospective buyers of produce (Aker, 2010; Aker, 2011; Zanello, 2012), hence leading to an increase in marketed surplus.

4.3.3 *Institution factors*

Mobile grain buyers (PRDBUYERS) are the informal market sources to which smallholders sell produce. Crop producers claim that such grain buyers cheat them by using unstandardized weighing scales and offer lower prices (Pokhrel and Thapa, 2007). Groundnut producers whose main buyers are mobile traders are less inclined to increase marketed surplus. Agricultural extension agents (EXT) enables farm households to have access to market information of their produce.

Contacts with extension agents are, therefore, expected to positively affect marketed surplus (Bahta and Bauer, 2012.).

Table 11: Definition of Variables

<i>Dependent Variables</i>	Measurement	Expected Sign
Demand for Improved Varieties (DI)	1=Smallholder demand for improved groundnut varieties	
Marketed Surplus (MP)	1=Smallholder with marketed surplus	
<i>Independent Variables</i>		
<i>Socio-economic Characteristics</i>		
AGERES	Age of the farmer in years	Positive
AGERESSQD	Age squared of the farmers in years	Negative
PCWORK	1=Household involved in piece work jobs	Negative
OXCART	1=Household owns an oxcart	Positive
PGNUTHA	The proportion of land planted with groundnuts	Positive
YIELD	The yield of groundnuts in kg ha-1	Positive
SEEDCOST	Cost of seed per hectare (Malawi Kwacha; MK730=1US\$)	Negative
<i>Market Access</i>		
OUTPUTMAKINFOR	1= Smallholder' access to market information	Positive
MOBP	1=Household possess a mobile phone	Positive
<i>Institutional Factors</i>		
SEEDLOAN	1=Household has access to seed loan	Positive
EXTS	1=Household has access to extension services	Positive
SEEDMULT	1=Household is located in areas with seed multiplication activities	Positive
PRDBUYERS	1=Smallholder sold produce to mobile grain buyers	Negative
<i>Transaction Costs Factors</i>		
RODST	1=Households resides in areas with poor road network	Negative
DISTMARKT	Time, in minutes, taken to reach the nearest market	Negative

Source: Farm Household Survey (2017); n=Total sample size

Most smallholder farmers cannot afford modern seed varieties. To ease their access, some farmer organizations offer seed loans (SEEDLOAN) to farmers. Access to seed loans is expected to increase production through farmers' access to viable seed, hence would increase marketed surplus (Mmbando *et al.*, 2015a).

4.3.4 Market transaction cost factors

Poor road networks (RODST) increase transportation costs to bring produce to markets. Not only would producers transportation costs increase with poor road condition, but also produce buyers. As a consequence, the marketed surplus would decline. Similarly, smallholders that take a long time to reach markets (DISTMARKT) are also less likely to increase marketed surplus due to the increase in transportation costs.

4.4 Empirical Results and Discussion

4.4.1 Descriptive statistics

Descriptive statistics of the variables used in the analysis are presented in Table 12. About 74% of the smallholders had marketed surplus of groundnuts while 41% demanded improved varieties of groundnuts. The mean age of the farmers was about 46 years, and about 43% of them engaged in piece work jobs. A relatively high percentage of smallholders that engaged in piece work jobs indicates its importance as a livelihood coping strategy (Whiteside, 2000) as well as income diversification among rural households (Ellis, 1998). A moderate percentage of the smallholders (31%) possessed oxcarts, which they mostly use to transport farm inputs and produce from and to markets.

The average land allocated to the cultivation of groundnuts was 0.33 ha, while the average yield realized was about 890 kg ha⁻¹. The allocation of 0.33 ha of land to the cultivation of groundnuts against the mean landholding size of 1.5 ha is a clear indication that smallholders also perceive the crop to be a potential cash crop. Above 50% of farmers in the study, areas possessed mobile phones and also had access to market information from different sources. On average, the farmers take one and a half hours to travel to the nearest output market. The descriptives on the status of rural roads and time the smallholder take to reach markers implies that the smallholder incurs more transportation costs, which could affect marketed surplus.

Table 12: Socio-economic Characteristics of Smallholder Groundnut Producers (n=416)

<i>Dependent Variables</i>	Mean	Std. Dev.	Min	Max
Demand for Improved Varieties	0.411	0.493	0	1
Marketed Surplus	0.738	0.440	0	1
<i>Independent Variables</i>				
<i>Socio-economic Characteristics</i>				
AGERES	45.957	12.869	20	82
AGERESSQD	2277.231	1243.837	400	6724
PCWORK	0.433	0.496	0	1
OXCART	0.306	0.251	0	1
PGNUTHA	0.333	0.323	0.025	6.075
YIELD	892.429	537.049	49.180	2926.829
SEEDCOST	8.042	4.591	-4.605	11.711
<i>Market Access</i>				
OUTPUTMAKINFOR	0.596	0.491	0	1
MOBP	0.548	0.498	0	1
<i>Institutional Factors</i>				
SEEDLOAN	0.180	0.385	0	1
EXTS	0.841	0.366	0	1
SEEDMULT	0.632	0.483	0	1
PRDBUYERS	0.974	0.160	0	1
<i>Transaction Costs Factors</i>				
RODST	0.142	0.349	0	1
DISTMARKT	1.498	3.754	-4.605	5.991

Source: Farm Household Survey Data (2017); n=Total sample size

A small percentage of the farmers (18%) had access to seed loans, while the majority (84%) had access to extension services. The small percentage of farmers that have access to seed loans shows that the majority of them still face challenges to access the quality seed.

The percentage of the farmers that resided in areas with certified groundnut seed multiplication activities was 63%, and the majority of them (97%) sold their produce to mobile grain buyers. Fourteen percent of the farmers resided in areas where road network to central district business centers is poor.

4.4.2 Farm household utilization of groundnut harvested in 2015/16

Farm household utilization of groundnut they harvested in the 2015/16 growing season is presented in Table 13. The mean productivity (yield per hectare) of the groundnut was about 890 kg ha⁻¹. This is slightly above what was previously reported (Simtowe *et al.*, 2010b; Siambi *et al.*, 2015). Farm households' average commercialization index, which is the marketed surplus, was found 0.58. The mean consumption and seed recycling indices were at 0.24 and 0.18, respectively. The marketed surplus, as indicated by the household commercialization index (HCI), was higher than what previous empirical literature observed (FAO, 2014a). The increase in the marketed surplus could be explained by the change in the market orientation of the farmers.

Table 13: Utilization of Groundnut Produced by Smallholders in the Study Areas (n = 416)

Quantity of Groundnut	Min.	Max.	Mean	Std. Dev.
Total Production (kgs)	15.00	2500.00	402.820	376.077
Productivity (kg ha ⁻¹)	49.18	2926.83	892.429	537.049
Marketed Surplus	0.00	1.00	0.580	0.270
Seed Index	0.00	1.00	0.180	0.156
Consumption Index	0.00	1.00	0.240	0.216

Source: Farm Household Survey (2017); n= Total sample size

Previously farm households consumed much of the produce themselves than what would be sold (FAO, 2014a). With the poor performance of tobacco on the market, the main cash crop of the country, farmers are now taking groundnuts to be a cash income earner.

4.4.3 Effect of marketed surplus on demand for improved varieties

The effects of the marketed surplus on demand for improved varieties of groundnuts are presented in Table 14. Parameters that summarize the effect of marketed surplus on demand for improved varieties appear in column 1 of the Table while their mean effects are in column 3. The results in Table 14 show that the marketed surplus had positive effects on increasing demand for improved groundnut varieties. The average effect of marketed surplus (ATET) on the probability that smallholders demanded improved varieties increased by 40%. Conversely, for smallholders that did not have marketed surplus (ATU), the probability of demand for improved varieties declined by 14%.

Table 14: Effect of Marketed Surplus on Demand for Improved Varieties

Variable	Obs.	Mean	Std. Dev.	Min	Max
ATET	307	0.407	0.185	-0.980	0.783
ATU	108	-0.141	0.292	-0.904	0.332
ATE	416	0.264	0.195	-0.980	0.759
MTE	100	0.295	0.043	0.224	0.372

Source: Output from data analysis

Furthermore, the average effect of marketed surplus on the probability of demand for improved groundnuts varieties among smallholders that were in the margin of increasing marketed surplus (MTE) increased by 26%. The average effect of marketed surplus on the probability of demand for improved varieties among smallholders picked at random in the population (ATE) increased by about 30%. The positive average effects of marketed surplus on-demand for improved varieties suggest that farmers that produced marketed surplus they value yield traits more than any other attribute from the improved varieties. Similar observations were also made by (Wale and Holm-Mueller, 2017), where farmers that earn their income, mainly from crop production, prefer improved crop varieties to conventional. In the same vein, Derlagen and Phiri (2012) indicated that improved varieties of groundnuts are superior in yield to conventional varieties by over 60 %. Thus, smallholders that are inclined to produce a marketable surplus to enhance the intensity of the participation in the market would demand improved varieties.

4.4.4 Estimates of endogenous switching probit regression

The estimated results for the ESP of the equations of marketed surplus and improved groundnut varieties are presented in Table 15. The results show that the Wald chi-squared is highly significant, suggesting the joint explanatory power of independent variables on the response variables in the selection and outcome equations. The estimates of the rhos that indicate the correlation among the errors are significantly different from zero at about 5% level. This suggests that the random disturbances in the groundnut marketed surplus and the demand for improved varieties decisions are affected in the opposite direction by random shocks. This implies that the decision of smallholders on marketed surplus and demand for improved varieties are dependent on each other. The null hypothesis for the independence of the unobserved covariates in the two equations is rejected. This indicates that the unobservable covariates in the selection and outcomes equations are associated, hence the need to estimate the two equations jointly.

4.4.5 Determinants of marketed surplus for groundnuts

In the treatment effect framework, only determinants of the selection equation are relevant. In this study, the factors that determined marketed surplus are henceforth reported in Table 15. Out of the 15 variables, four were found to affect farmers' decisions to increase marketed surplus significantly. The proportion of land allocated to the production of groundnuts, yield per hectare of groundnuts, farm household involvement in piece work jobs, and access to market information. The proportion of land allocated to the production of groundnuts was positive and significantly affected the marketed surplus.

Between 2010 and 2014, when the land area for the production of groundnut increased by an average of 2.4% per year, production followed a similar trend and increased by an average of 2.2% per year (FAOSTAT, 2017). The increase in production entails that smallholders would have sufficient quantities for household consumption as well as for sale. However, expansion in the land area allocated to the production of groundnuts, at the national level, reflected the same at the farmer level. This could be that producers reduced land allocated to other crops to make it available for cultivation of groundnuts (FAO, 2014b). Such a decision could have emanated from the need to increase the production of marketed surplus. Malawi Government also perceives groundnuts and other legume crops as strategic to contribute to the country's export earnings (Makoka, 2012).

Table 15: Estimates of Determinants of Marketed Surplus of Groundnuts (n=416)

Variables	Coef.	Std. Err	Z Score	P >Z
CONSTANT	-1.846	1.086	-1.700	0.089
Socio-economic factors				
AGERESP	0.019	0.041	0.460	0.643
AGERESPSQD	0.000	0.000	-0.650	0.514
PCWORK	0.353**	0.155	2.270	0.023
OXCART	0.383	0.374	1.020	0.306
PGNUTHA	2.105***	0.584	3.610	0.000
YIELD	0.001***	0.000	6.800	0.000
SEEDCOST	0.015	0.017	0.890	0.376
Market access factors				
OUTPUTMAKTINFOR	0.242*	0.136	1.780	0.075
MOBP	0.165	0.158	1.050	0.294
DISTRICT_DUMM	-0.101	0.261	-0.390	0.697
DISTMARKT	0.012	0.021	0.580	0.561
Institution factors				
PRDBUYERS	0.081	0.397	0.200	0.838
SEEDLOAN	-0.273	0.202	-1.350	0.177
EXTS	-0.037	0.212	-0.170	0.862
SEEDMULT	0.152	0.195	0.780	0.435
Number of Observations: 416		Wald Chi2(15)=80.5		
Log likelihood =-434.765		Prob>Chi2=0.000		
/athrho1		0.422(0.977)		
/athrho0		-13.043(506.626)		
Rho1		0.399(0.821)		
Rho0		-1.000(9.50e-09)		
Likelihood Ratio test of Independent equations rho1=rho0=0				
Chi2(2)=5.69		Prob> Chi2=0.058		
*, **, *** : Significance at 10%, 5%, 1%				

Source: Farm Household Survey Data (2017), n=Total sample size

For this reason, the government is promoting diversified production of such crops (Malawi-Government, 2016a). Similar findings of the positive effect of land area cultivated on crops and marketed surplus were observed by Goyal and Berg (2004) in Haryana State of India and Chinn (1976) among paddy rice farmers in Taiwan.

Related to the proportion of land for production of groundnuts on its effect on marketed surplus is yield per hectare of groundnuts. The yield of groundnuts had a positive and significant effect on market surplus.

In Malawi, groundnut is an important source of food and income. For farm households to increase their market participation, hence marketed surplus, an increase in crop productivity is necessary (Barrett, 2008). This is because an increase in crop productivity also implies an increase in production as well. Everything constant, increase in marketable surplus would translate to an increase in marketed surplus.

Involvement in piece work jobs, ‘ganyu’ was found to be positive and significantly affected marketed surplus. The findings of the current study on the positive effects of piece work jobs and the increased marketed surplus are unexpected. This is because by undertaking the piece work jobs, availability of labor at their farms is reduced, thus negatively affecting their own production, hence reduced the marketed surplus. Furthermore, income that farm households receive from piece work jobs is used to fill the gap in food shortage of the household between the food storage period and the next harvest (Ralitza *et al.*, 2010). In this case, it cannot, therefore, be available to increase household crop productivity through the purchase of productive farm inputs.

Moreover, the wages that households earn when they undertake piece works jobs are always low (Ralitza *et al.*, 2010), making such income not available for investment on the farm. However, the finding of the current study suggests that farm households undertook the piece work jobs to use their proceeds to procure farm inputs. Instead of being paid cash, farm households would opt to be paid in kind in terms of seed. In addition, the households might have undertaken the piece work jobs in such a way that it never affected the availability of labour on their own farm. For example, some members of the households might have been engaged in the piece work jobs while others would be working on the households’ farm.

Access to market information was positive and significant on its effect on marketed surplus. In Malawi, farmers access market information from different sources, namely, extension agents, farmer organizations, fellow farmers, and buyers of produce. The first two are examples of formal sources of information, while the others are informal ones. It would be, therefore, expected that farmers with access to various sources of information to increase marketed because of the reduction in search costs. Without accessing information from these sources, farm households would incur search costs in finding the market of their produce through personal visits to the markets.

Similarly, findings by Omiti *et al.* (2009) suggest that access to both informal and formal sources of market information on the output market increases the intensity of market participation, hence marketed surplus among smallholders in peri-urban areas of Kenya.

4.5 Summary

This chapter employed the Endogenous Switching Probit model to assess the effect of marketed surplus on demand for improved varieties of groundnuts by smallholder groundnut farmers in Malawi. The ESP model was preferred to other econometrics models, such as the endogenous switching regression because both the selection and outcome equations had their response variables that were binary. The results of the study showed that increased marketed surplus had a positive impact on the demand for improved varieties among the smallholders. The results of the ESP showed that marketed surplus had a positive effect on demand for improved varieties. The average treatment effect for farmers with a marketed surplus (ATET) on the probability that smallholders demanded improved varieties increased by 40%.

Conversely, the average treatment effect on the untreated (ATU), for smallholders that did not have marketed surplus, on the probability that they demanded improved varieties declined by 14%. The positive average effects of marketed surplus on demand for improved varieties suggest that farmers that are inclined to intensify market participation value high yielding traits from improved varieties more than any other groundnut's varietal attributes. The increase in the number of farmers with marketed surplus and the relatively high proportion of those that demanded improved varieties is a manifestation of the positive effect of the former on the latter. The findings of the study suggest that the increase in demand for improved varieties among smallholders could be achieved if policy interventions also focus on the challenges that smallholders encounter in the output market so as to increase marketed surplus. Other findings suggest that increased crop productivity, engagement of smallholders in off-farm economic activities, and enhancing access to output market information are critical for the marketed surplus to trigger demand for improved groundnut varieties.

CHAPTER 5

MARKET STRUCTURE AND ENTRY BARRIERS TO GROUNDNUT MARKETS: THE CASE OF INTERMEDIARY TRADERS

5.1 Introduction

This chapter presents the structure of groundnut markets in Malawi for intermediary traders. It also investigates the entry barriers into the local, district, and city markets for the traders as sellers. Interval estimation of the Herfindahl-Hirschman Index (HHI) is used to determine market structure while the Multivariate Probit is applied to investigate the entry barriers. Findings give insights on how competitive the groundnut market is.

The rest of the chapter proceeds as follows: Section 5.2 gives the material and methods employed in the study, which include the analytical framework in subsection 5.2.1. The description of the variables is given in section 5.3. Results and discussion are presented in section 5.4, followed by a summary in the final section.

5.2 Analytical Framework

The study adopted a market structure conduct and performance (SCP) paradigm, which is based on industrial economics (Bain, 1951). In the SCP model, S, C, and P are market structure, conduct for market players, and performance of the market, respectively. The SCP model postulates a causal effect relationship among the three variables of the market (Kambhampati, 1996). Each of the variables is a function of the other two thus, $S = f(C, P)$; $C = f(S, P)$; $P = f(S, C)$ (Delorme Jr *et al.*, 2002). In the SCP model, the structure is, among others, measured by the concentration of markets. The conduct of market players defines strategies that they use to counteract the actions of their competitors, whereas the performance of the market describes the profits that accrue to the markets (Tung *et al.* 2010).

Following Tung *et al.* (2010), Bosena *et al.* (2011) and Delorme *et al.* (2002), the current study proxied the structure, conduct, and performance of the markets as the degree of concentration, entry barriers and marketing margins, respectively. It is generally asserted that marketing margins are directly related to the degree of market concentration (Hall *et al.* 1979; Kalirajan 1993; Dessalegn *et al.* 1998). This assertion suggests that traders earn relatively higher marketing margins in relatively concentrated markets than in relatively low concentrated markets (Bakucs and Fertő, 2005). Further, markets with more entry barriers are also more likely to be relatively concentrated. It is also on this premise that one would expect to find traders that participate in markets with relatively more market entry barriers to earn relatively high marketing margins (Mann 1966). To understand how the variables in the SCP model relate to each other, existing studies applied simultaneous equations (Delorme Jr *et al.*, 2002; Tung *et al.*, 2010; Funke *et al.*, 2012). In the current study, computed estimates of the individual variables of the SCP were used to evaluate the competitiveness of groundnut markets for intermediary traders.

5.2.1 Market concentration

Market concentration is a measure that is used to determine the structure of the market, whether perfectly competitive or imperfectly competitive. The common approach used to measure the concentration of markets is the Gini coefficient (Enibe *et al.*, 2008; Haliru and Ibitoye, 2014). Other techniques include 4 firm or 8 firm concentration ratios (Sisk, 2018). However, except for Gini coefficient, the 4 firm or 8 firm concentration ratios are point estimation measurements and tend to ignore information on market shares for smaller traders. Generally, information for traders that operate in agricultural markets in developing countries is difficult to collect because a majority of them are not registered. This renders outcomes of the market structure to be biased (Naldi and Flamini, 2014b). To circumvent such a bias, the use of interval estimation of the Herfindahl-Hirschman Index (HHI) is now being promoted. The interval HHI estimate has been widely used in empirical studies of health services, telecommunication, transportation, and civil aviation industries in developed countries (Nauenberg *et al.* 2004; Naldi and Flamini 2014a; Naldi and Flamini 2014b). Rarely has the interval estimation of the HHI been applied to empirical studies of agricultural markets in developing countries.

According to Naldi and Flamini (2014a), the use of the interval HHI requires complete information on market share for all players in an industry. In the context of agricultural traders in developing countries, such information is difficult to collect. This is due to a large number of traders that are involved in agricultural marketing as a result of liberalisation of the sector (Chirwa *et al.*, 2005). The interval estimation of the HHI accounts for information of all the market players while the point estimates account for the few largest players. For this reason, the interval estimation of the HHI was considered to be suitable for this study. Its use in the current study, therefore, adds to the empirical literature a robust measure of the structure of agricultural markets. Following Naldi and Flamini (2014b), the interval estimation of the HHI is illustrated by first specifying its point estimate.

$$HHI = \sum_{i=1}^m a_{ij}^2 \quad (5.1)$$

Where

a_{ij} = the market share of groundnuts for buyer i of the category j ; $i = 1, 2, \dots, m$ and $j = 1, 2$

m = the number of largest buyers (firms) in the groundnut market, whose information on market share is readily available. Consequently, the ratio of the market share of groundnuts for each buyer (q_i) to the total quantity transacted in the market (Q) is computed as;

$$a_i = \frac{q_i}{Q} \quad (5.2)$$

The point estimate of the HHI lies between 0 and 1 such that HHI values approaching zero is an indication that the market is competitive while closer to one indicates a market characterized by imperfect competition. It is important to note that the expression in equality (1) represents the HHI for the m largest traders. To avoid the biased estimates from the point estimate, this study used uses an interval estimate of the HHI. Before computing lower and upper bounds in which the interval estimates hinge on, a residual R is first computed.

$$R = 1 - \sum_{i=1}^m a_i \quad (5.3)$$

The residual gives approximate information of the market share for the i^{th} trader excluded in the point estimate of the HHI. The appropriate lower and upper bounds used are determined by comparing R with the smallest market share S_m of the largest trader. If $R \leq S_m$, use is made of the lower bound interval, which is specified as:

$$HHI_{LB} > \sum_{i=1}^m a_i^2 + (1 - \sum_{i=1}^m a_i)^2 * \left(\frac{1}{N-m}\right) \quad (5.4)$$

Where N is the total number of traders in the market, and m is the number of traders with the largest shares. The second term on the right-hand side represents the minimum residual sum of squares for market shares of the smallest firms. Subscript LB stands for the lower bound. Similarly, the upper bound interval of the HHI is defined by adding the point estimate of the HHI with maximum value residual sum of squares of market shares. This is specified as:

$$HHI_{UB} < \sum_{i=1}^m a_i^2 + (1 - \sum_{i=1}^m a_i)^2 \quad (5.5)$$

The use of equality (5) to compute the upper bound is only applicable if $R \leq S_m$. But if $R > S_m$, a different residual market share is calculated as $Q = [R/S_m]$ and the upper bound interval becomes,

$$HHI < \sum_{i=1}^m a_i^2 + S_m^2 Q + (1 - \sum_{i=1}^m S_i - S_m Q)^2 \quad (5.6)$$

According to Naldi and Flamini (2014b), the decision rule of the interval estimation of the HHI is that values that are less than 0.01 indicate negligible competition in the market. An HHI of between 0.01 and 0.15 shows the absence of market concentration, while values between 0.15 and 0.25 depict moderate concentration, and values of greater than 0.25 indicate a strong concentration. This implies that when the markets are concentrated, it indicates the presence of an imperfectly competitive market, while the absence of concentration shows the existence of perfectly competitive markets.

5.2.2 Marketing margin

Intermediate traders are driven by the profit motive to participate in a marketing channel that offers relatively high profits. Such a profit is presented as a marketing margin which following Bakucs and Fertő (2005) is expressed as:

$$P^S = P^B + M \quad (5.7)$$

where P^S is the selling price of produce at the disposal markets and P^B is the buying price at the source market, and M is the marketing margin, which is the difference between the selling and buying price.

Market margins represent the costs of transport, storage, and search costs, among others. Marketing margin is composed of an absolute amount and a percentage mark-up of the selling price.

$$M = a + b * P^S, \text{ where } a \geq 0 \text{ and } 0 \leq b < 1 \quad (5.8)$$

In a perfectly competitive market structure where markets are no concentrated $b = 0$; therefore, M will be constant, a , which equals marginal cost. Conversely, if the market is concentrated, the market margin is pushed above the marginal cost by b percent of the selling price, where $0 \leq b < 1$. Subtracting equation (5.8) in (5.7) obtains.

$$P^S = a + b * P^S + P^B \quad (5.9)$$

$$P^S = \frac{1}{1-b} a + \frac{1}{1-b} P^B \quad (5.10)$$

If the market is perfectly competitive, and $b = 0$, equation (5.10) is reduced to $P^S = a + P^B$, and thus $M = a$.

It is generally asserted that marketing margins are directly related to the degree of market concentration (Dessalegn *et al.*, 1998). This suggests that market margins are relatively larger in concentrated markets than in markets where concentration is low (Bakucs and Fertő, 2005).

5.2.3 Market entry barriers

Trader' heterogeneity in financial endowments, access to markets, business ownership, business experience, and ownership of storage facilities exert different influences on their entry into markets as sellers of commodities. A market channel in which traders find difficulties to enter entails that traders incur relatively large market transaction costs. This consequently affects marketing margins that they would expropriate. This suggests that when market margins are relatively high, it is expected that the market would be concentrated. This implies that only a few traders that participate in concentrated markets expropriate the high marketing margins. Conversely, when many traders participate in a market, it indicates that marketing margins and market transaction costs are both relatively low. This is because the participation of many traders entails that the market is perfectly competitive. It should, therefore, be expected that in a market with high marketing margins and a high degree of market concentration, trade entry barriers would exist.

Multivariate probit model

The difference in the market transaction costs and marketing margins that exists in different market channels entails that the decision by the traders to participate in those markets is mutually not exclusive. This implies that there exist unobservable factors that may positively or negatively relate to each other and influence entry into the markets. A multivariate probit model is, therefore, appropriate to estimate the decisions of intermediary traders to participate in one or all three market channels. This requires that the error covariances of the equations should be correlated and statistically significant (Green, 2012). Thus, intermediary traders' decisions on whether to participate in a particular market may be described by the following latent variable model:

$$y_i^* = x_i' \beta + \mu_i^* \quad (5.11)$$

Where $y_i = 1$ if $y_i^* > 0$ and $y_i = 0$ if otherwise, x_i' is the vector of explanatory variables that influence the trader to participate in the market; and μ_i^* is the error term. In addition to the results associated with each variable of interest for the joint decisions, an estimate of interrelatedness (error covariance) of the decisions is obtained. A significant covariance estimate suggests that the decisions are interrelated. When using the standard binomial probit approach for an individual binary dependent variable, it is assumed that the error terms are distributed along with the standard normal distribution. This assumption implies that the decisions are related, which is expressed as:

$$Cov(\mu_1, \mu_2, \mu_3) = 0 \quad (5.12)$$

where $Cov(\mu_1, \mu_2, \mu_3) = 0$ is the covariance of the error terms, μ_1 , μ_2 and μ_3 . However, if the covariance of the error terms is non-zero, the results generated by the independently estimated probit equations will be biased. A parameter of key interest in the estimate is the covariance among the error terms. When this covariance estimate is significantly different from zero, it confirms the existence of some relationship among the three equations that are explained by the independent variables. The empirical specification of the multivariate probit model for the entry determinants into local, district, and city markets by groundnut traders is specified as:

$$Y_{ij} = \alpha_0 + \alpha_1 BUSEXP + \alpha_2 BUSOWN + \alpha_3 CREDACC + \alpha_4 CREDACCSO \\ + \alpha_5 MOBP + \alpha_6 QTY SOLD + \alpha_7 STOGFACIL + \alpha_8 TRADASS$$

$$+\alpha_9\text{LOGMARKSERCK} + \varepsilon_{ij} \quad (5.13)$$

Where Y_{ij} is trader i market participation in the market j and $i = 1, 2, 3, \dots, n$ and $j = 1, 2, 3, n$ and j are the number of traders and markets, respectively, and ε_{ij} are unobservable covariates for the equations in the multivariate probit model.

5.3 Description of Variables

The variables used in the study were identified through the literature review and are defined in Table 16. The dependent variables comprised binaries of intermediary trader' participation in local, district, and city markets as sellers of groundnuts. Intermediary traders are a category of produce buyers that purchase groundnuts from farmers in their homesteads and local markets to resell it to other buyers along the marketing chain (Simtowe *et al.*, 2010b). The markets are also known in the empirical literature as primary, secondary and tertiary markets, respectively (Shiferaw *et al.*, 2007; Shiferaw and Teklewold, 2007). The decision of the traders to participate in the three marketing channels were coded 1 for participation and 0 otherwise.

After the traders procure produce from either farm gate or at a local market, they would sell it at the local, district or city markets. Local markets are rural spot markets that convene weekly in designated places. Most of these markets are located in areas that are far from urban areas of the country. District markets are located in the central district's business centres. Before transporting grain to the district market traders make prior arrangements for delivery with the prospective buyers. Agents for the buyers inspect the produce for quality at the produce' assembling points. The traders also get information on the quantity of produce the buyers are looking, and the price they are offering.

City markets are also located far from the local and district markets. Like the district market, buyers of produce at a city market include agro-processors and grain exporters. Traders may only transport produce to the city markets upon prior arrangement with the prospective buyers. Depending on the terms and conditions of the transaction, buyers may use their transport to collect produce or traders may deliver it to buyers.

Table 16: Definition of Variables Used in Groundnut Marketing

Variable	Definition	Expected sign		
		Marketing Channel		
		Local market	District market	City market
<i>Trader characteristics</i>				
BUSEXP	Years trader has been in grain trading business	Uncertain	Uncertain	Uncertain
BUSOWN	1 if trader owns the grain trading business, 0 otherwise	Positive	Positive	Positive
QTY SOLD	1 if a trader sells less than and equal to 10 tons of groundnut per year, 0 otherwise	Positive	Positive	Positive
<i>Institution factors</i>				
CREDACC	1 if trader has access to any credit facility, 0 otherwise	Positive	Positive	Positive
CREDACCSO	1 if trader' credit source is informal, 0 otherwise	Positive	Positive	Positive
TRADASS	1 if trader belongs to informal trade association, 0 otherwise	Positive	Positive	Positive
<i>Market transaction factors</i>				
MARKSERC	Market search costs incurred by trader (in Malawi Kwacha: 1 USD = 730 MWK) converted in logs	Negative	Negative	Negative
MOBP	1 if trader uses mobile phone to access market information, 0 otherwise	Positive	Positive	Positive
<i>Market infrastructure</i>				
STOGFACIL	1 if trader has storage facility, 0 otherwise	Positive	Positive	Positive
<i>Market channels</i>				
RESLOMAK	1 if a trader sells produce at the local market, 0 otherwise			
RESDIMAK	1 if a trader sells produce at district market, 0 otherwise			
RESCIMAK	1 if a trader sells produce at the city market, 0 otherwise			

Source: Market Survey Data (2017)

The explanatory variables used in the study include those related to trader' characteristics, institutional factors, market transaction costs, access to information and communication services, and storage infrastructure.

The variables that were used are defined in Table 16. These variables include those related to trader's characteristics, institutional factors, market transaction costs, access to information and communication services, and storage infrastructure. These factors may exert positive or negative influences on the market participation of the intermediary traders.

5.3.1 Trader characteristics

Experience in grain trading is a trader characteristic that equips traders with information on the quantity, quality, and price that produce buyers are looking for and offering, respectively. Thus, with repeated transactions, the trader becomes aware of the quantity and quality of grain that buyers are looking for (Tadesse and Shively, 2013). Traders that operate grain businesses as sole owners have the flexibility to decide which market to sell to. Unlike a joint business venture, a sole proprietor has the disadvantage of having a small financial capital base. To minimise transportation and other market transaction costs, traders that handle less than or equal to 10 tons of groundnuts a year would be expected to sell it in nearby local markets compared to distant ones.

5.3.2 Institutional factors

Credit access supplements entrepreneurs' own financial capital (Atieno, 2001). Most small business enterprises lack the collateral which formal money lending institutions demand (Adera, 1995). Because of the lack of collateral, the traders often turn to informal money lenders. Although informal credit sources charge higher interest rates, they still remain traders' most reliable credit sources. It is expected that traders that have access to informal credit sources are more likely to participate in all three markets. Trader associations facilitate a link for the traders to sell their produce. Through the associations, traders are encouraged to make savings for reinvesting in the business (Beck *et al.*, 2017). In some cases, the associations facilitate collective transportation of produce to distant markets. In so doing, the traders enjoy economies of scale in transporting grain.

5.3.3 Market transaction factors

Market search costs define the costs traders incur when searching for market information. Traders that sell produce to distantly located markets in the districts and cities incur more costs in search of market information than traders that sell in the local markets (Muratori, 2016). An increase in market search costs would reduce the likelihood of their participation in the markets (Barret, 1997). The use of cell phones in accessing markets contributes to the reduction in search costs for markets that are widely dispersed from one another (Aker, 2008). Traders that use cell phones can reach out to as many markets as possible and also sell larger quantities of produce.

5.3.4 Market infrastructure

Storage facilities are a market infrastructure that enables traders to stock an adequate quantity of grain before selling them out to markets over future periods (Femenia, 2015). Traders that sell to distant markets and handle a large volume of stocks may require their storage facilities to reduce the costs of hiring them.

5.4 Empirical Results and Discussion

5.4.1 Descriptive statistics

Descriptive statistics of the variables used in the study are reported in Table 17. Only a few intermediary traders had access to credit whose main sources were private money lenders, friends, relatives, and financial institutions. In a similar study, Fafchamps *et al.* (2005) found that most agricultural traders lacked adequate access to formal credit sources in Malawi and Benin. Few intermediary traders reported belonging to an informal traders' association. This may be explained by the nature of intermediary traders' businesses (Mapila *et al.*, 2013). Most traders also handled relatively small quantities of produce in the 2015/16 marketing season. This could be due to a lack of adequate financial resources. The percentage of responses for the traders that sold produce at local and city markets were almost the same and relatively fewer compared to those that sold at the district market. The differences in the traders' participation between local, city and district markets suggest the existence of more entry barriers in the local and city markets than the district.

Table 17: Socio-economic Characteristics of Intermediary Groundnut Traders (n=124)

Variable	Mean	Std.Dev	Min.	Max.
<i>Trader characteristics</i>				
BUSEXP	6.476	4.396	1	19
BUSOWN	0.726	0.448	0	1
QTY SOLD	0.427	0.497	0	1
<i>Institution factors</i>				
CREDACC	0.185	0.390	0	
CREDACCSO	0.161	0.369	0	1
TRADASS	0.113	0.318	0	1
<i>Market transaction factors</i>				
MARKSERC	7850.403	14325.110	100	100000
MOBP	0.847	0.362	0	1
<i>Market infrastructure</i>				
STOFACIL	0.169	0.377	0	1
<i>Market channels</i>				
RELOMARK	0.387	0.489	0	1
REDISMARK	0.597	0.493	0	1
RECIMARK	0.395	0.491	0	1

Source: Market Survey Data (2017); n=Total sample size

5.4.2 Interval estimates of the HHI and market concentration

The results of the interval estimate of the HHI are presented in Table 18. The table also reports the percentage of produce transacted in each market, the average marketing margin, and the percentage of market transaction costs the traders incurred in each market. Since the computed residual, R , satisfied the condition that $R > S_m$, use was made of equation (5.6) to compute the upper bound of the interval estimation of the HHI. The lower bound interval was computed following equation (5.4). The results of the interval estimates of the HHI suggest the prevalence of an almost perfectly competitive structure in all the three groundnut markets.

This is indicated by the absence of concentration in all three markets. This suggests that there was no one trader that controlled the market for groundnuts. The HHI results also show that as the traders moved from the local market to sell in the district and city markets, the magnitude of competitiveness decreased. This is shown by the increasing value of the interval estimate of the HHI. This suggests that some market entry barriers set in as the traders moved from the local to district and city markets. This is expected because by moving produce from the local markets to the other markets, traders incurred more market transaction costs, such as transportation costs. Transportation costs are one of the non-price barriers that can affect the number of traders that participate in the market and hence affect the intensity of trade flow (Hillberry and Hummels, 2008). In absolute terms, traders that participated in the district and city markets incurred relatively higher market transaction costs compared to those in the local market (Table 18). This finding is also consistent with the increase in the magnitude of the interval estimate of the HHI from the local to the district and city markets.

Table 18: Market Concentration, Marketing Margin and Produce Transacted

Market	Market concentration	Average. market margin (%)	% of produce transacted	Average market transaction costs (%)
Local	0.043 < HHI < 0.057	13.34	8.5	12
District	0.077 < HHI < 0.085	13.04	55.4	40
City	0.086 < HHI < 0.095	19.04	36.0	48

Source: Market Survey Data (2017)

Furthermore, traders that participated in the district market transacted a relatively higher percentage of groundnuts compared to the city and the local markets. The higher percentage of produce transacted in the district market also corresponds to the frequency of participation in that market compared to the other two markets. These findings suggest that the traders found it relatively easier to participate in the district market than the local and city market. This is because the district markets are strategically located in the city markets and the surrounding rural areas. Such being the case, buyers from the city and producers found it cost-effective to buy and sell produce to and from the district market, respectively.

Key informant interviews with the traders also revealed that the traders sell groundnuts in all the three markets using standard weighing scales, in Kgs. Much of the groundnuts that the traders sell in the markets is shelled. Some of them traders said they also sell negligible quantities of unshelled groundnuts at the local market. This suggests that much of the groundnuts that buyers demanded, which the traders transacted in three markets were shelled (Table 18).

Traders that participated in the city market earned about 6% average marketing margins more than those that participated in the local and district markets. The local and district markets which have similar but relatively low average marketing margins also have relatively low values of the interval estimate of the HHI. This finding is, therefore, consistent with the purported causal relationship between structure and market performance in the SCP paradigm (Hall et al. 1979; Kalirajan 1993). This finding is also supported by Dessalegn *et al.* (1998) and Bakucs and Fertő (2005) observations that marketing margins are directly related to market concentration. This implies that relatively less competitive markets, for example, the city market, are also likely to have relatively more entry barriers. Traders would, therefore, find it relatively easier to sell produce at the district than the city market.

5.4.3 *Estimates of the multivariate probit regression*

The estimates of the multivariate probit regression for trader market participation are reported in Table 19. The estimated Wald chi-squared test is highly statistically significant, indicating that the multivariate probit model is fully explained by all the explanatory variables used in the model. Because estimates of the coefficients and marginal effects were the same, only the latter and their associated standard errors, Z scores, and p values are reported in this paper. The correlation of error terms in the three market participating equations are also reported in Table 19. The likelihood ratio test shows that the null hypothesis for the independence of the participation equations is rejected at a high significance level. This indicates a very strong association of the unobserved covariates affecting trader's market participation decisions. This justified the joint estimation of the three market participation equations, hence the use of a multivariate probit model (Green, 2012).

Determinants of participation of traders in the markets

From the nine variables used, four variables influenced the probability of trader' participation in the local market, one in the district, while the likelihood of city market participation was associated with six variables. These findings suggest that traders found the local and city markets difficult to enter than the district market. These findings are supported by the results of the percentage of produce transacted in Table 18, where the single-entry barrier in the district's market was associated with the high percentage of produce that was transacted. Conversely, the relatively low percentage of produce that was sold in the local and city markets reflected the greater entry barriers that were observed in these markets.

Entry barriers in the local market

The coefficient estimates for ownership of a business as a sole trader increased the probability that traders would participate in the local market. Compared to other forms of business ownership, sole proprietorship has the disadvantage of having limited access to financial capital (Nguyen, 2001). Such limited financial capital makes the operational at the local market level ideal. Furthermore, the descriptives in Table 17 show that only a few traders had access to credit. Moreover, the main source of the credit was informal money lenders who usually charge higher interest rates. Lack of credit worsens the ability of the traders to get adequate financial capital for the day to day business operations. Due to the limited financial capital, the traders also handled small quantities of produce in a year. This is reflected in the increase in the probability of then traders with less than ten tonnes of grain in a year to participate in the local market. Selling such a small quantity of produce to district or city markets could not be cost-effective in terms of transportation. In this regard, the local market was an ideal destination for the traders that transacted in small quantities of produce.

Local markets are rural spot markets that convene weekly in designated places. This entails that intermediary traders would incur more markets transactions costs in the form of market search costs and transportation to access market information and sell produce. The results of the study, therefore, revealed that market search costs decreased the probability that traders would participate in the local market. Most buyers of produce are distantly located to where intermediary traders assemble produce. They incur more transaction costs to purchase produce from the local market (Muratori, 2016). Under these circumstances, the intermediary traders would continue looking for

other buyers, hence increasing market search costs. Ownership of storage facilities decreased the likelihood of trader' participation in the local market. Participation in the local market was associated with small quantities of produce that traders handled in a year (see Table 18). Traders may not require storing such small quantities of produce for a long time before they sell them out. This suggests that owning a storage facility would, therefore, be costly for the traders. Instead of owning storage facilities, the traders may use some space in their homes to store produce for a short while before selling it out. On the contrary, Enibe *et al.* (2008) suggested that the participation of middlemen in the banana market in Anambra State, Nigeria made it necessary to use storage facilities.

Entry barrier in the district market

Business experience positively and significantly increased the likelihood of traders' participation in the district market. Prospective large grain buyers reside in cities. With experience, intermediary traders would establish networks and build trust with them through repeated transactions (Tadesse and Shively, 2013). Moreover, experience in grain trading enables the traders to link up with their colleagues in order to pool transport together when transporting produce from purchases sources to the district markets. In doing so, the traders benefit from economies of scale in transportation. Similarly, a positive association was observed between trader participation and business experience of a banana market in rural Rwanda (Jagwe, 2011). The finding of the current study suggests that the district market is relatively more competitive. This means that traders incur less market transaction costs to participate in the market. This is also consistent with the large proportion of produce that was transacted and the high percentage of intermediary traders that participated in the market (Table 17). The explanation of the findings of the current study is the strategic location of the district market with sellers and buyers of produce.

There are good road networks that connect the districts to the cities in the study areas. Most large grain buyers, such as exporters and processors, are located in the city. With good roads, the buyers incur fewer costs to transport produce from the district to the city. Further, the district market is surrounded by many rural areas. This means that producers would sell their produce at the district market of intermediary traders would purchase produce from farm households homesteads.

Table 19: Marginal Effects of Trader Entry Barriers into Groundnut Markets (n=124)

VARIABLE	Marg.Effects	Std. Err.	Z	P>Z
Local Market				
BUSEXP	0.007	0.031	0.22	0.824
TRADASS	0.416	0.444	0.94	0.349
BUSOWN	0.608*	0.323	1.88	0.060
LOGMARKSERC	-0.376***	0.126	-2.99	0.003
CREDACC	-3.149	3.242	-0.97	0.331
CREDACCSO	3.752	3.275	1.15	0.252
MOBP	0.118	0.376	0.32	0.753
QTY SOLD	1.156***	0.283	4.08	0.000
STOFACIL	-0.771*	0.404	-1.91	0.056
District Market				
BUSEXP	0.050*	0.029	1.72	0.086
TRADASS	-0.109	0.362	-0.30	0.764
BUSOWN	-0.203	0.274	-0.74	0.459
LOGMARKSERC	-0.058	0.097	-0.60	0.551
CREDACC	0.596	0.955	0.62	0.532
CREDACCSO	-1.010	0.999	-1.01	0.312
MOBP	0.382	0.326	1.17	0.241
QTY SOLD	-0.386	0.240	-1.61	0.108
STOFACIL	-0.163	0.315	-0.52	0.604
City Market				
BUSEXP	-0.001	0.031	-0.05	0.962
TRADASS	0.910**	0.418	2.18	0.029
BUSOWN	-0.371	0.291	-1.27	0.203
LOGMARKSERC	0.363***	0.113	3.21	0.001
CREDACC	1.597**	0.768	2.08	0.038
CREDACCSO	-1.618*	0.849	-1.90	0.057
MOBP	-0.229	0.339	-0.68	0.499
QTY SOLD	-0.612**	0.277	-2.21	0.027
STOFACIL	1.154***	0.397	2.91	0.004
Number of Obs.	= 124	Wald chi2(27)	= 67.18	
Log likelihood	= -186.05294	Prob > chi2	= 0.000	
Likelihood ratio test of rho21=rho31=rho32=0; Chi2(3)=33.876; Prob>Chi=0.000				
*, **, *** : Significance at 10%, 5%, 1%				

Source: Market Survey Data (2017); n= Total sample size

Both of them would use cheaper means of transporting produce, such as bicycles and oxcarts. The strategic location of the district market to the city and the rural areas could also help explain the higher proportion of produce transacted and the relatively larger percentage of participants in the market.

Entry barriers in the city markets

Transaction of the quantity of the produce of fewer than 10 tons a year negatively and significantly influenced entry into the city market. The city markets are located distant from the purchase sources and assembling of produce before it sold. Participating in the city markets for the traders with little quantities of produce would mean that they incur relatively more transportation and other market transaction costs. Market search costs increased the probability for the traders to participate in the city market. This is unexpected results because, generally, market search costs are negatively associated with market participation (Alene *et al.*, 2008). This implies that as traders encounter increased market search costs, they are less likely to participate in that market.

However, the findings of the current study suggest that the relatively high marketing margin that traders in the city markets expropriate (Table 18) act as incentives for their participation in the market. This could explain the positive association observed between market search costs and traders' participation in the city market. Access to credit increased the probability of participating in the city markets. Having credit access enables traders that participate in distant markets such as the city to procure large quantities of produce. Credit access also helps traders to meet market transaction costs when transacting in such distant markets. On the contrary, Jagwe (2011) found no association of credit access and participation of traders in the banana market in Rwanda. The estimates for the source of credit from the informal money lenders decreased the likelihood of trader participation in the city markets. Informal money lenders charge high-interest rates, which may reduce traders' profit. This may compel the traders to obtain small amounts of credits, which might not be sufficient in supplementing their financial capital. In a related study, Ali *et al.* (2014) also found that rural households in Rwanda who had limited access to credit from formal markets to be less likely to participate in non-agricultural economic activities.

Membership to informal trader associations increased the likelihood of traders' participation in the city market. The trader's associations are formed by some of the traders, and membership is involuntary. Members of the associations share information on markets in which they could earn high marketing margins profits. In some cases, the members would lend money to each other, which helps in increasing the financial capital of their business. On the contrary, Jagwe (2011) found that trader associations were not related to participation in the banana market among the traders in Rwanda. The finding of the current study suggests that informal associations that traders form on their own are critical in participation in markets that are associated with increased market transaction costs.

In other results, ownership of storage facilities increased the likelihood that traders would participate in the city market. The distant location of city markets from purchase and assembly points for produce requires that the traders should accumulate large quantities of produce. To reduce the cost of hiring storage space, its storage facility becomes cost-effective. In Table 16, it was observed that a higher percentage of produce was transacted in the city market than the local. Such finding underscores the importance of own storage facility of traders with large quantities of produce. Similar findings were also reported by Enibe *et al.* (2008) in which participation of middlemen in the banana market in Anambra State, Nigeria made it necessary to use storage facilities. However, their study was not explicit on the type of relationship that existed between ownership of the storage facilities and market participation.

5.5 Summary

In this chapter, an interval Herfindahl-Hirschman Index and multivariate probit model were used to analyse the structure and investigate entry barriers into the local, district, and city markets for groundnuts by intermediary traders in central and northern Malawi. As opposed to other point techniques for determining the market structure, such as Gini coefficients and 4 firm concentration ratios, the interval HHI yields unbiased results. It accounts for information on market share for all small firms that the point estimates tend to ignore. The results of the study showed that the district market had a higher proportion and percentage of traders that participated and produce that was transacted in the market, respectively. The interval estimate of the HHI revealed a competitive structure for all the three groundnut markets.

The number of traders that participated in either market was not related to the magnitude of concentration of the markets. This magnitude increased as traders moved from the local market to participate in the district and city markets. However, in the city market, a direct relationship was observed between the magnitude of market concentration and market margin.

On the other hand, the results of the estimates of the MVP showed that despite the existence of a competitive market structure for groundnuts, the markets were characterized by different entry barriers. Institutional factors, market transaction costs, trader' characteristics, and storage infrastructure influenced entry into the city market. The local market was characterized by entry barriers related to trader' characteristics, market transaction costs, and storage infrastructure, whereas trader' characteristics influenced entry into the district market. The results in this chapter also indicated that the district market, which had fewer entry barriers than the local and the city markets, had relatively more volume of produce transacted in it.

Other results of the MVP showed that experience in business and sole ownership of business positively influenced entry into the district and local markets, respectively. Market transaction costs and storage infrastructure negatively and positively influenced entry into local and city markets, respectively, while the quantity of produce transacted positively and negatively influenced entry into both local and city markets, respectively. Access to credit and informal credit sources positively and negatively influenced entry into city markets, respectively. Membership to informal trader' associations positively influenced entry into city markets. These findings suggest that markets that have fewer entry barriers are easier to enter than the markets with more entry barriers. Moreover, markets that had relatively little quantity of produce transacted in it had its participants expropriate relatively higher average market margins.

CHAPTER 6

CONCLUSIONS, RECOMMENDATIONS AND FUTURE RESEARCH DIRECTION

6.1 Re-capping the purpose of the study

Groundnut is one of the legumes that contribute to food and nutrition security as households in Malawi consume 60% of the production themselves. The crop also contributes to the income security of smallholders by generating 25% of agricultural cash incomes. Malawi, in general, also benefits from foreign earnings through exports of the crop, which comprise 15% of its total value of production. For these reasons, groundnut is viewed by policymakers as a strategic crop to contribute to the sustenance of food and income security of smallholders and the growth of the Malawian economy in general. The economic benefits that groundnut offers could be fully exploited with increased production and enhanced orientation towards commercialisation of the subsector. Of concern is the low productivity (yield per hectare) of the crop at the smallholder level, which is about three times below its potential. Such low yield has a bearing on the quantities that producers make available for sale, which also affects the supply of produce to the non-farming consumers. Producers also express concern over the low prices that buyers of produce offered, giving doubts on the efficiency of the output market. Consequently, production and other market chain actors become reluctant to adopt strategic actions deemed to be critical in enhancing the performance of the groundnut subsector.

Increased adoption of improved varieties and enhanced access to quality seeds among producers are key to increased productivity of groundnuts. Governmental and other stakeholders are concerned that some farmers continue to utilize low-quality seeds from low yielding varieties. This is despite the availability of improved varieties in the production system and several initiatives to enhance access to quality seeds among them. However, the policy also recognizes the importance of farmers to maintain conventional seed varieties in order to sustain the development of the crop subsector. Increased agricultural cash incomes that accrue from increased marketed surplus is also critical for the derived demand for highly productive farm inputs, such as improved varieties and fertilizer.

Existence of a competitive output market environment that is capable of distributing, proportionately among market actors, income generated along the marketing chain is also critical for increased marketed surplus. The Malawian national agriculture policy agenda is to transform the smallholder crop subsector from subsistence to a commercialized one.

Understanding the factors that influence the production and marketing decisions of smallholders and buyers of the produce, respectively, is of fundamental importance. In this view, the specific objectives of the study were to: (1) investigate factors that influence the decisions by smallholders to replace conventional and modern varieties of groundnuts, (2) assess effects of marketed surplus on demand for improved varieties, and (3) determine market competitiveness and entry barriers into groundnut markets by intermediary traders in central and northern Malawi. The data used in the study were collected in the farm household and intermediary trader' survey conducted in 2017. The farm households were selected using a simple random procedure to select 416 farm households. Further, a systematic random sampling procedure was used to select 124 traders.

Different conceptual frameworks and econometric approaches were used in addressing the objectives of the study. All the necessary tests, for example, likelihood ratio test and falsification tests, were conducted for the appropriateness of the models with the nature of the response variables used in each specific objective. The Bivariate Probit Model was applied to investigate factors that determine smallholders' replacement decisions of conventional and modern varieties of groundnuts. This model was used because the decisions by smallholders to replace groundnut varieties were considered to be not mutually exclusive. In assessing the effects of marketed surplus on demand for improved varieties, an Endogenous Switching Probit model was applied. The model was used because both the selection and outcome response variables were binary and also to control for selection bias that may arise due to the self-selection of some producers not to increase marketed surplus. Finally, interval estimation of the Herfindahl-Hirschman Index (HHI) and Multivariate Probit Model was adopted to determine a market structure and entry barriers into groundnut markets by intermediary traders, respectively. The interval estimates of the HHI were adopted because it takes account of all traders that transact in the market, unlike the other point estimates indices such as CR₄, which only considers information on few largest traders.

Further, the use of the multivariate probit model instead of, for instance, a multinomial logit was appropriate for this because the decisions by the traders to participate in the markets were not mutually exclusive. The remaining parts of this chapter present the conclusions drawn from the findings of the study, policy management issues, and suggested areas for future research.

6.2 Conclusions

6.2.1 Replacement of conventional and modern varieties of groundnuts

The empirical findings from chapter three suggest that smallholders cultivate improved varieties of groundnuts alongside the conventional ones. However, the percentage of smallholders that replaced conventional varieties was higher than the ones that replaced improved varieties. Such results suggest that the smallholders preferred improved varieties because of their high yielding and marketability attributes. Results of the coefficient estimates of the variables indicate the importance of dual-purpose production of groundnuts in influencing the replacement of both the conventional and modern varieties. This finding suggests that farmers consider the two varieties as equally important in meeting their consumption as well as cash income needs. With the large family size and small landholding size, farm households require high yielding improved varieties to increase yield per unit area of land. Moreover, with volatility in the price of tobacco, which farmers rely on as their main cash earner, the cultivation of other crops such as groundnuts becomes a plausible option. The high yielding varieties provide the potential for farmers to increase marketed surplus. In this case, farmers would replace the low yielding conventional varieties with the high yielding modern ones.

Large land size for the cultivation of crops is critical for farmers to increase production. Results in this chapter showed that farmers that allocated more land to the cultivation of groundnuts were more likely to replace conventional varieties with improved ones. Such finding is in line with the assertion that large land size makes farmers less vulnerable to the risk of trying new agricultural technologies. Moreover, the expectation of increased yield per unit area of land from modern varieties makes their decision to replace conventional varieties rewarding. Land for the cultivation of crops is limited and, in some cases, is declining due to increased population pressure.

Reallocating more land to the cultivation of crops that have the potential to enhance their welfare, such as groundnuts, is a prudent decision that farmers could make.

Access to agricultural extension by farmers is not an end in itself. The quality of extension services delivered to them is critical. The increase in the farmer to extension agent ratio in most developing countries, including Malawi, implies that the frequency of farmer extension contact is low. In this circumstance, extension messages that are delivered to farmers would be focused on crops that are traditionally considered to be important for the improvement of farm households' livelihoods. In the study areas, such crops are tobacco and maize. The finding of the positive association between the perception of farmers on the quality of the extension services and replacement of conventional varieties suggests that farmers look for extension services that address their particular needs. The provision of specialized extension messages on groundnut production is therefore critical.

Poor rural road networks increase transportation costs of supplying farm inputs to farmers. If supplied, the farm inputs become expensive, or there is scarcity in the inputs as few farm input dealers would be involved in their supply. The combined effects of these scenarios make access to improved inputs difficult. In this situation, farmers would resort to the use of low yielding crop varieties, which they readily acquire locally. The negative association between poor road status and replacement of conventional varieties with the improved ones is critical for complementary efforts in promoting the improved varieties and enhancing communication infrastructure development. Thus, the promotion of enhanced access to improved varieties among farmers should also take cognizance of good road infrastructure that facilitates their distribution to the farmers.

Except for experience and inadequate access to quality seed, the finding of a positive relationship between membership of farmer organizations, education level of farmers, and replacement of modern varieties is, however, in conflict with findings of the available empirical literature. Farmers that are better educated are expected to continue using improved technologies, which include modern varieties. This is because of their capacity to process information that is deemed to be beneficial in increasing crop productivity. However, it is well documented in the empirical literature that smallholders' production orientation also determines the preference of varietal attributes. The positive association between the education level of farmers and replacement of

modern with conventional varieties suggests better-educated farmers have other options of generating cash income other than farming. Such farmers may engage in farming to cultivate food crops for their consumption and not to participate in the market. In such circumstances, they would prefer conventional varieties that have yield stability. On the other hand, experience affords the farmers to accumulate information on the performance of the crop on issues to do with market prospects. Experienced farmers would, therefore, have information on the existing market for the conventional varieties and, therefore, would make informed decisions to replace modern with the conventional one.

Farmer organizations would influence not only farmers' utilization of improved technologies but also reinforce their continued use. Farmers that are members of farmer organizations are privileged to access information on agronomic as well as market aspects of crops. Such information may come directly from the organization or is shared among the farmers themselves. The positive influence of farmer organization on the replacement of modern varieties with conventional ones suggests the influence of social contacts among the farmers. These social contacts become stronger in influencing farmers' decisions on the crop variety to cultivate than the information that farmers get from the farmer organization.

Adequate access to improved seed reinforces the continued utilization of the improved varieties among farmers. The scarcity of improved seed for groundnuts and an increase in its price due to the cost of distribution leaves farmers with conventional varieties as their only option of source seed. The result that inadequate access to quality seed is positively associated with the replacement of modern varieties underscores farmers' decisions to revert to conventional varieties. Efforts at enhancing access to the improved seeds are, therefore, critical for the continued usage of the improved varieties.

6.2.2 Marketed surplus and demand for improved varieties of groundnuts

The results in chapter four demonstrate that to increase marketed surplus, factors in the output market also merit consideration.

Despite groundnut production and productivity not having changed much for over a decade, the average commercialization index for groundnuts was observed to be higher than what had been previously reported. However, the marketed surplus in this study was found to have a positive impact on the demand for improved varieties among farm households. Despite the fact that farmers demanded improved varieties of groundnuts, access to these varieties remains a challenge. Most seed markets for the improved varieties are distantly located to farmers' homes. There is also a high farmer to extension ratio, which means that extension agents fail to reach out to some farmers with information on improved varieties. Further, the results of the study have revealed that the proportion of total land allocated to the production of groundnuts was positively associated with a marketed surplus. This finding suggests that expanding land for the cultivation of groundnuts is critical for marketed surplus, which implies an increase in the intensity of households' participation in the market. To increase marketed surplus, smallholders require increases in yield per unit area of land cultivated. Crop productivity would increase through the use of high yielding crop varieties and the adoption of good agronomic practices by the farmers.

Similarly, farmers that have adequate access to market information would be able to increase their extent of participating in the market. Furthermore, farmers access to market information through radios, farmer organizations, extension agents, and from their fellow farmers. It is, therefore, imperative that efforts to enhance access to market information be complemented with strengthening the different sources of information that could be disseminated to the farmers.

Piece work jobs provide the household with supplementary income, which it can use to increase crop productivity through the purchase of high yielding crop varieties and other inputs, such as fertilizer. On the other hand, piece work jobs are counterproductive to the production of crops because they compete with households' labor requirements. However, its positive effect on marketed surplus, in the current study, suggests the need for policy support in enhancing smallholders' capacity to generate extra off-farm incomes.

6.2.3 Market structure and entry barriers into groundnut markets

The findings in chapter five suggest that the existence of a competitive structure for groundnut markets does not rule out the prevalence of entry barriers that affect market participation of intermediary traders. The relatively high percentage of produce that traders sold in the district market suggest that this market had fewer entry barriers. Similarly, the relatively high percentage of average market margins expropriated by traders that participated in the city markets is commensurate to the prevalence of relatively more entry barriers in that market. These findings suggest that markets that have relatively more entry barriers are associated with high average market margins and fewer traders that participate in it. The opposite would be true for markets that have fewer entry barriers and relatively low average market margins. However, the magnitude in the estimate of the interval HHI indicates a relative increase in the concentration of markets as traders move to sell groundnuts from local to district and city markets. The relative increase in the magnitude of the interval estimate of the HHI was also consistent with the increase in market transaction costs the traders incurred in each market.

The finding of a negative association between market search costs and ownership of storage infrastructure and trader participation in the local market indicates diseconomies of scale related to transportation and storage costs. The traders that participated in the local market transacted relatively small quantities of grain (less than 10 tons per year). Transporting such quantities from purchase sources (at the farm gate) would be costly. It would also be costly for the trader to own storage facilities. Collective transportation and storage of grain would be a plausible strategy in reducing market transaction costs. The positive association of sole ownership of grain marketing and participation in the local market reflects that the scale of operation of the trader is commensurate to the transaction in small quantities.

City markets are allocated at relatively long distances from where the traders purchase and assemble grain. The trader would be expected to transact large quantities of grain to benefit from economies of scale in transportation. Adequate financial capital and storage space are, therefore, required to accumulate large stocks. In most cases, intermediary traders have little capital. Access to credit facilities is, therefore, critical. A hired storage facility may not be compatible with the needs of the traders. In this case, own storage would be ideal. The finding of the positive

association of access to credit, own storage facility, and trader participation in the city market underscores the importance of these factors in enhancing trader's participation in the city markets. The negative association of informal credit sources and low quantities of produce transacted, and trader participation in the city market suggests that the money that traders borrow from informal credit sources does not suffice their capital needs. Further, for efficient participation of traders in city markets, large quantities of produce are required. The positive association between informal trader's association and participation in city markets indicates that being of a member of the trader association is critical in enhancing participation in city markets. By being a member of the trader's association the traders would benefit in the way of readily available credit source and reduction in transportation costs through group transportation of produce.

The different market entry barriers that have been highlighted in this chapter have the potential to affect the efficient functioning of the markets. Any inefficiencies in the functioning of the markets would affect farmers' production decisions. This is so because intermediary traders are the reliable sources through which farmers dispose of their crop harvests. The barriers that the traders encounter to participate in the markets have consequences on market returns that crop producers could earn. If the markets are inefficient, increased market search costs and other market transaction costs would be passed onto farmers through lower prices.

6.3 Policy Recommendations

6.3.1 Replacement of conventional and modern varieties of groundnuts

The findings reported in chapter three have critical policy implications for both formal and informal groundnut seed systems in Malawi and the adoption of modern varieties and conservation of conventional ones. Conventional groundnut varieties still constitute an important subsector for the Malawian groundnut seed system. This is good for crop variety diversification and conservation of conventional crops. However, the current National Seed Policy (NSP) for Malawi does not recognize seed from the informal seed system as legitimate. This is counterproductive to efforts of achieving improved seed supply among smallholders. The NSP policy is also in conflict with the National Agricultural Policy. The latter recognizes that increased crop production,

sustenance of crop variety diversity, and conservation of indigenous germplasm require complementarity of the informal and formal seed systems. Such an integrated seed system would enable farmers to increase the production of marketable surplus. At the same time, cultivating conventional varieties would help farmers to continue meeting their consumption and local market needs. In the end, the integrated seed system would also offer an opportunity for increased adoption of modern varieties and conservation of the conventional ones.

However, an integrated seed system could be fostered with the complementarity of ex-situ and in situ conservation of indigenous plant germplasm. The Malawi Government, through the Ministry of Agriculture and Food Security, implements ex-situ conservation of local germplasm. Ex-situ conservation alone is not sufficient in arresting the loss of agrobiodiversity. Deliberate efforts should, therefore, put in place to motivate smallholders to conserve conventional varieties on their farms. With government support, the smallholders that participate in the in-situ conservation could be compensated forgoing high yielding crop varieties.

Further, policy strategies to enhance the uptake of improved varieties among the smallholders should target women farmers. Empirical evidence and the results of the current study have shown that women dominate the production of groundnuts in Malawi. Besides, the target of the policy should also be on smallholders that are more experienced in groundnut production but within the age ranges of between thirty and sixty years. These two groups of smallholders are, therefore, more likely to benefit from policy strategies that are aimed at improving access to modern varieties of groundnuts.

There is also a need for policy to change farmers' mindset, through extension efforts, to consider groundnuts as a potential source of farm income. Previously, farmers consumed a relatively higher proportion of their harvest than what they sold. This suggests that they cultivated groundnuts mainly for food. Their increased market participation, as shown by the increase in the average commercialized index, is a step towards that mindset change. Enhanced market returns would financially capacitate farmers to afford the improved varieties. Continued policy facilitation in linking farmers to profitable output markets could be a feasible strategy. With better market returns, emanating from increased market demand for some conventional varieties, farmers would

involuntarily contribute to the conservation efforts of conventional crop varieties. In Malawi, like in many other developing countries, the extension messages disseminated are on general crop production practices. In some cases, the messages are biased towards crops that are considered to be the main cash and food crops, for example, tobacco and maize, respectively. Developing and providing specific demand-driven extension messages oriented towards improved seeds of legumes and groundnuts, in particular, could increase the uptake of modern varieties.

Despite the mean education level for the farm household of about five years, many smallholders have relatively low education levels. About 78% of the farmers did not attain education level beyond grade 4 of which 46% were illiterate. Promoting adult literacy programs among the farmers that are interested could contribute to their ease of assimilating information on modern agricultural technologies. Apart from improving their literacy levels, farmers could also be encouraged to participate in field demonstrations and attend field days where improved varieties of groundnuts are showcased. Targeting experienced farmers on policies to conserve conventional varieties and promoting membership of farmer organisations would contribute to the sharing of information deemed essential to improve the performance of the groundnut subsector.

6.3.2 Marketed surplus and demand for improved varieties of groundnuts

The findings in chapter four have implications for policy efforts in enhancing the performance of the output market. Improved market returns are an incentive that could encourage smallholders to expand land for the production of groundnuts. They can do this by releasing land previously allocated to the production of other crops, which are not profitable anymore. For example, in Malawi, smallholders have, for a long time, relied on tobacco as their main cash crop. However, the performance of the crop is declining due to poor price competitiveness on the international market. In this case, smallholders could reduce land on which they cultivate tobacco to expand land available for the production of groundnuts. By expanding land for the cultivation of groundnuts, the production of groundnuts would also likely increase. The increase in production implies that the smallholders would have adequate produce for their consumption and sell the surplus in the market.

To enhance access to market information, there is a need for public-private partnerships in disseminating market information through information and communication technologies such as mobile phones. Such initiatives could help them obtain real-time information on prices and prospective buyers of groundnuts. Policy support for increased access to extension contacts is also critical. In addition to disseminating crop production messages, the extension agents should also be equipped with information regarding markets and prices of groundnuts. Market information bulletins may also be posted at Extension Planning Areas (EPA), where farmers could be informed of the available buyers and the price they offer.

Enhanced access to market information could benefit crop producers if they also have adequate access to the output markets. Crop producers are constrained to intensify their market participation because of increased market transaction costs. Most markets are located far from their homesteads. In this case, they incur high transportation costs or take a long time to reach the markets. In both cases, the marketed surplus would be negatively affected. Promoting membership to farmer organizations could be a plausible strategy in collective marketing. When farmers sell produce as a group, they will enjoy economies of scale in transportation.

Smallholders' marketed surplus suffers from the small quantities that they make available for sale. This is so because crop productivity is still low, and it becomes cost-ineffective in terms of transportation. To benefit from any intervention in enhancing market access, increasing crop productivity is a prerequisite. As already pointed out in this study, organizing producers to sell produce as a group could be the best option in circumventing the problem of small quantities that they offer for sale.

Empirical evidence indicates that piece work jobs are counterproductive as they reduce their own farm household labor productivity. However, its positive effect on the marketed surplus in the current study suggests that policy support is critical in enhancing smallholders' involvement in off-farm economic activities. One of the strategic policy actions is to involve farm households in public works programs. The beneficiaries of the programs could be involved in maintaining rural roads and constructing market infrastructure facilities in their communities.

These two are some of the rural infrastructures that constrains crop producers to access markets and store produce so that it is sold later in the market season when prices are high. Engagement of farm households in public works programs during the off-peak farming season would avoid conflict with their demand for the same labor. This arrangement is contrary to the current situation when the farm households undertake piece work jobs when they are also working in their fields.

6.3.3 Market structure and entry barriers into groundnut markets

Findings reported in chapter five have policy implications in enhancing trader participation in the markets for groundnuts. Market transaction costs in most developing countries are, among others, exacerbated by poor road connectivity between assembly points of produce and the markets. Public investment to improve road infrastructure could reduce market transaction costs in general. Own storage facilities would be costly for intermediary traders that handle relatively small quantities of produce in a marketing season. Public-private partnership investment in storage infrastructure for the traders to hire could reduce storage costs.

Furthermore, inadequate financial capital remains a challenge for most intermediary traders. Policy support for the formation of formal trader associations may be essential to facilitate access to credit from formal financial sources. The trader associations could also facilitate collective transportation of produce to distant markets. In this circumstance, the traders would be able to enjoy economies of scale in transportation. The trader associations could also play a crucial role in linking intermediary traders with large produce buyers. The associations would also negotiate better prices on behalf of the intermediary traders. These strategies would create an environment in which market entry barriers are reduced and competitive market structure created that would allow the participation of many traders in the market.

6.4 Limitation of the Study and Direction for Future Research

The study used primary cross-section data, which provides limitations to understanding the trends in, for instance, variety replacement regimes by smallholders and the impact of marketed surplus on demand for improved varieties. However, the dynamics of events are critical for proper policy interventions. Although there is substantial evidence on the institutional factors that influence the

use and discontinued use of modern crop varieties, little is known on how policy-related variables affect crop variety replacement decisions. To close this gap, the study suggests future research to investigate the impact of the farm input subsidy program that the government of Malawi has been implementing since 2005 on the extent of groundnut variety replacement. The study also used cross-section data that do not inform of trends of the association between continued adoption of improved crop varieties and commercialization. Future research should consider using panel data and rate of adoption of improved crop varieties, as treatment variables. Most empirical studies, including the current one, used cross-section data, which does not show changes in the smallholders' production and marketing decisions over time. The study, therefore, recommends future research to consider using panel data, which is capable of showing the dynamics, for example, in the marketed surplus and demand for improved varieties for a specified period.

Finally, most empirical studies in developing countries on market structure have found agricultural output markets to be concentrated among a few market players. This is probably because the techniques used in determining the structure were not as robust as the interval estimate of the HHI. Furthermore, the focus of the empirical studies has been on understanding the determinants of market participation among smallholders. Empirical evidence on trader market participation has not been adequately investigated. No consensus has been reached on the relationship between credit access, trader associations, and trader market participation. The study, therefore, recommends more research to be conducted on the structure of agricultural output markets using the robust interval estimation of the HHI. Future research should also focus on the determinants of the extent of market participation in different marketing channels of intermediary traders.

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APPENDICES

Appendix 7.1: Farm Household Survey Questionnaire



Discipline of Agricultural Economics
School of Agricultural, Earth and Environmental Sciences
College of Agriculture, Engineering and Science
University of KwaZulu-Natal

Groundnut Variety Replacement, Market Structure, Marketed Surplus and Demand for Improved
Varieties In Malawi: The Case of Smallholders and Traders

Ph.D. Research in Agricultural Economics
Farm Household Survey Questionnaire

IDENTIFICATION	
AGRICULTURAL DEVELOPMENT DIVISION (ADD)	
DISTRICT	
EXTENSION PLANNING AREA	
SECTION	
BLOCK	
VILLAGE	
TRADITIONAL AUTHORITY	
INTERVIEWER'S NAME	
DATE OF INTERVIEW	
NAME AND SIGNATURE OF SUPERVISOR	
DATE	

INTRODUCTION

Hello. My name is _____ I am working with the Ministry of Agriculture

Irrigation and Water Development. We are carrying out a survey on the Functioning of the input and output markets for groundnuts in Malawi. The purpose of the survey is to solicit information that will enable policymakers to improve the performance of the groundnuts sector in Malawi through improved access to seed, better access to profitable output markets. The information you provide will be kept strictly confidential. If you have any questions about this before we proceed, please let me know.

Participation in this interview is voluntary. Now, are you willing participate

Date: /..... /2017 Start time: |__||__|. |__||__|

SECTION A: SOCIO-DEMOGRAPHIC INFORMATION

QN	Question	Response																																																																																																						
01A	Name of the respondent																																																																																																							
02A	Gender of Respondent	(1) Male (2) Female																																																																																																						
03A	In which year was the respondent born	Year born..... Age.....																																																																																																						
04A	What is the marital status of the respondent?																																																																																																							
05A	Are you the head of the household?	(1) Yes (2) No																																																																																																						
06A	What is the literacy level of the respondent?																																																																																																							
07A	A roster of other members of the household																																																																																																							
	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 15%;">Name</th> <th style="width: 10%;">Age</th> <th style="width: 5%;">Sex</th> <th style="width: 25%;">Relationship with household head</th> <th style="width: 20%;">Responsibility</th> <th style="width: 25%;">Level of Education</th> </tr> </thead> <tbody> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> </tbody> </table>	Name	Age	Sex	Relationship with household head	Responsibility	Level of Education																																																																																																	
Name	Age	Sex	Relationship with household head	Responsibility	Level of Education																																																																																																			
	¹ Put the household members in their age order starting with the household head ² Use the following codes in the table for each member of the household:																																																																																																							

	Head (1), Wife or Husband (2), Son or Daughter (3), Father or Mother (4), Brother or Sister (5), Other relatives (s) (6), Servant or Servant's relative (7), Tenant or Tenant's relative (8), and other persons related to the household head (9). ³ Put '0' if he/she does not have any labour contribution because of age or permanent illness such as handicap, '1' if she/he is a student, and '2' if he/she is economic active. ⁴ Put '0' if he/she is illiterate and '1' he/she can read or write because of church education or Quran, any informal means of getting literacy and/or schooling up to grade '1'.				
SECTION B: INCOME AND ECONOMIC ACTIVITIES					
QN	Question	Response			
01B	State the income realized from each of the following income sources?	INCOME SOURCE/ANNUAL INCOME			
		Income source	Year (2015/16)	Year(20115/14)	Year(2014/13)
		1.crop production			
		2. formal employment			
		3. piecework			
		4. remittances			
		5.transfer payments			
		6. non-farm activities			
		7. other(s) specify			

SECTION B CONTINUED: INCOME AND ECONOMIC ACTIVITIES				
02B	Please give estimates for your household asset endowment	Asset	Number	Estimated value (MWK)
		LIVESTOCK		
		Cows		
		Pigs		
		Chickens		
		Goats		
		Rabbits		
		Sheep		
		Guinea fowl		
		Pigeons		
		Ducks		
		TRANSPORT		
		Oxcart		
		Bicycle		
		Motor vehicle		
		Wheelbarrow		
		ELECTRONICS		
		TV		
		Mobile phone		
		Radio		
		FARM IMPLEMENTS		
		Hoes		
		Plough		
		Panga		
		Hand folk		
		Sickle		

		HOUSES			
		Brick house thatched with grass			
		Brick house thatched with iron sheet			
		Mudhouse thatched with grass			
		Mudhouse thatched with iron sheets			
		The total value of assets			
SECTION C: LAND TENURE AND GROUNDNUT PRODUCTION					
QN	Question	Response			
01C	What type of land tenure system do you use?	Land Tenure ownership	Acres		
		1. Own land			
		2. Rented			
		3. Other(s) specify			
02C	What crop do you grow? Indicate the land size and purpose of the growing the crops	Crop	Size of land (acres)	Purpose of production	
				1. Farm income	
				2. Food	
				3. Food and income (both)	
		Tobacco			
		Cotton			
		Maize			
		Rice			
		Groundnuts			
		Pigeon peas			
		Soybeans			
		Common beans			
		Cassava			
		Sweet potato			
		Vegetables			
		Other(s) specify			
03C	If you grow groundnuts, for how long have you been growing the crop?	Period (in years) [.....]			
04C	How important is groundnuts to your household?	1. Most important, 2. Very important, 3. Important 4. Less important 4. Not important			
05C	What are the sources of seed you and cost of the seed	Seed Source	Cost (MWK)		
		1. Purchase from a local market			
		2. Purchase from formal seed suppliers			
		3. Farm input subsidy			
		4. Village seed bank loan scheme			
		5. Free from seed support programs			
		6. Own farm-saved seed			
		7. Gift from friends and family			
		8. Barter exchanged with fellow farmers			
		9. Other(s) specify			
		Total seed cost			
06C	What time do you purchase/acquire seed and reasons	Seed source	Time of the year	Reason	
			1. Soon after harvest		
			2. Mid period after harvest		

			3. Just before planting 4. Other(s) specify	
		1. Purchase from local market		
		2. Purchase from formal seed suppliers		
		3. Farm input subsidy		
		4. Village seed bank loan		
		5. Free from seed support programs		
		6. Own farm saved seed		
		7. Gift from friends and family		
		8. Barter exchanged with fellow friends		
		9. Other(s) specify		
07C	How far is the nearest input market where you purchase seed?	Seed Source	Distance (walking time)	
		1. Local Market		
		2. Formal seed supplier		
		3. Farm input subsidy		
		4. Village seed bank loan scheme		
		5. Gift from friends and family		
		6.		
		7. Barter exchanged with fellow farmers		
08C	Do you know any local/improved variety that you plant?	1. Yes, 2. No		
		If NO skip 9C -17C		
09C	Have you ever replaced the local variety you have been planting with improved variety for the past three years?	1. Yes 2. No		
10C	Have you ever reverted to the cultivation of local	1. Yes 2. No		

	variety after abandoning it?																								
11C	If Yes to the above did you fully or partially replace the variety	1. Partial 2. Full																							
12C	If Yes to replacement, what are the replacement choices you preferred, and why?	<table border="1"> <thead> <tr> <th>Replacement Choice</th> <th>Reason</th> </tr> </thead> <tbody> <tr> <td>Local to an improved variety</td> <td>1. Low yield</td> </tr> <tr> <td></td> <td>2. Low market demand</td> </tr> <tr> <td></td> <td>3. Seed scarcity</td> </tr> <tr> <td></td> <td>4. Low resistance to pests and diseases</td> </tr> <tr> <td></td> <td>5. Other(s) specify</td> </tr> <tr> <td>Improved to a local variety</td> <td>1. Seed unavailability</td> </tr> <tr> <td></td> <td>2. Seed is expensive</td> </tr> <tr> <td></td> <td>3. Poor taste</td> </tr> <tr> <td></td> <td>4. Market unavailability</td> </tr> <tr> <td></td> <td>5. Other(s) specify</td> </tr> </tbody> </table>	Replacement Choice	Reason	Local to an improved variety	1. Low yield		2. Low market demand		3. Seed scarcity		4. Low resistance to pests and diseases		5. Other(s) specify	Improved to a local variety	1. Seed unavailability		2. Seed is expensive		3. Poor taste		4. Market unavailability		5. Other(s) specify	
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	4. Market unavailability																								
	5. Other(s) specify																								
13C	Do you face any challenges in accessing quality seed?	1. Yes 2. No																							
14C	If Yes, what are some of the challenges?	1. Inaccessibility of seed markets 2. Unavailability of seed in the market 3. Price of new seed is high 4. Low yield to save as seed 5. Other(s) specify																							
SECTION D: GROUNDNUT PRODUCTION AND MARKETING																									
01D	What yield did you realize in 2015/16 season?	Quantity [] 50 Kgs bags																							
02D	What is the estimated yield a normal season?	Quantity [] 50 Kgs bags																							
03D	Of the total production realized in 2015/16 how much quantity did you consume?	Quantity [] 50 Kgs bags																							
04D	Of the total production realized in 2015/16, how much quantity did you use as seed?	Quantity [] 50 Kgs bags																							
05D	Of the total production realized in 2015/16, how much quantity did you sell?	Quantity [] 50 Kgs bags																							
06D	Who are your regular buyers of groundnuts?	1. Mobile small-scale grain buyers 2. Large scale grain buyers 3. Consumers 4. Other(s) specify																							
07D	Who decides the price at which you sell your groundnuts?	1. Buyer dictates the price 2. I set the price 3. I negotiate the price with the buyer 4. The price is negotiated on my behalf by the farmer organization I belong																							

		5. Other(s) specify	
SECTION E: ACCESS TO INFORMATION ON SEED AND OUTPUT MARKET			
QN	Question	Response	
01E	How do you get information on the availability of seed for different sources?	Seed source (codes)	Information source 1. Fellow farmers 2. Public extension agent 3. NGO 4. Radio/TV 5. Mobile phones 6. Cooperatives
			7. Associations 8. Local leaders
		1. Local market	
		2. Formal seed suppliers	
		3. Farm input subsidy	
		4. Village seed bank loan scheme	
		5. Other seed support program	
		6. Gift from friends and family	
		7. Exchange with fellow farmers	
		8. Other(s) specify	
02E	Which of the following seed sources of information are reliable?	Information source 1. Fellow farmers 2. Public extension agent 3. NGO 4. Radio/TV 5. Mobile phones 6. Cooperatives 7. Associations 8. Local leaders	
03E	How do you get information on output availability for your produce?	1. Fellow farmers 2. Government extension agents 3. NGOs 4. Mobile phones 5. Radio/TV 6. Farmer Organizations 7. Local output markets 8. Other(s) specify	
04E	Which of the following sources of information on the output market are reliable?	1. Fellow farmers 2. Government extension agents 3. NGOs 4. Mobile phones 5. Radio/TV 6. Farmer Organizations 7. Local output markets 8. Other(s) specify	
SECTION F: ENVIRONMENTAL BIO-PHYSICAL FACTORS			
QN	Question	Response	

01F	Have you ever been affected by drought in the past years	1. Yes 2. No		
02F	If yes, how did you affect your production in 2015/16	1. Yield was low 2. Most pods were infested with pests 3. High disease incidences 4. Other(s) specify		
03F	What are the challenges that you face in groundnut production	1. Lack of quality seed 2. High prices for seed 3. Weather problems 4. High production costs 5. Poor output market prices 6. Lack of access to profitable markets 7. Other(s) specify		
SECTION G. INSTITUTIONS FACTORS				
QN	Question	Response		
01G	Do you belong to any farmer organization or association?	1. Yes 2. No		
02G	If No, why?	1. Requires membership fee 2. Not aware pf any association in the area 3. Available association are dominated by one type of gender 4. Other(s) specify		
03G	If Yes, what are the organization you belong to and period of membership?	Farmer organization 1. NASFAM 2. ASSMAG 3. Farmer club 4. Cooperative 5. Other(s) specify	Period of membership	
04G	What services do you get for belonging to the farmer organizations above?	1. NASFAM	1. Seed loan 2. Free seed 3. Extension services 4. Market of produce 5. Other(s) specify	
		2. ASSMAG	1. Seed loan 2. Free seed 3. Extension services 4. Market of produce 5. Other(s) specify	
		3. Farmer club	1. Seed loan 2. Free seed 3. Extension services 4. Market of produce 5. Other(s) specify	
		3. Cooperative	1. Seed loan	

			2.Free seed 3.Extension services 4.Market of produce 5.Other(s) specify
		4. Other(s) specify	1. Seed loan 2.Free seed 3.Extension services 4.Market of produce 5.Other(s) specify
05G	Are you happy about being a member of an association?	1. Yes 2. No	
06G	If No, what are the reasons?		
07G	Do you have access to government extension services?	1. Yes 2. No	
08G	If Yes, how frequently do you get access to the extension services?	Frequency of extension services contact 1. Once a week 2. Once a month 3. Quarterly 4. Other(s)	
09G	If No to (07G) what other organizations offer extension services?	Other Organizations 1..... 2..... 3..... 3.....	
10G	Are you happy with the quality of extension services?	1. Yes 2. No	
11G	If Yes, what are the areas that you are happy with?	1..... 2..... 3..... 4.....	
12G	If No, what are the areas that need to be improved?	1..... 2..... 3..... 4.....	
END OF INTERVIEW Thank the respondent for his/her participation in the survey [END TIME.....]			
INTERVIEWER'S COMMENTS TO BE FILLED IN AFTER COMPLETING EACH INTERVIEW COMMENTS ABOUT THE RESPONDENT 			

Appendix 7.2: Key Informant Interviews with Stakeholders in the Groundnut Subsector



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Groundnut Variety Replacement, Market Structure, Marketed Surplus and Demand for Improved Varieties In Malawi : The Case of Smallholders and Traders

Key Informant Interviews with Stakeholders in the Legume/Groundnuts Subsector

1. Seed Development, Production, and Distribution

- a. What are the organizations that;
 - i. develop
 - ii. produce
 - iii. distribute improved seed for groundnuts?
- b. Which organizations produce the following categories of groundnuts seed
 - i. breeder/foundation seed
 - ii. basic seed
 - iii. certified seed?
- c. How do the organizations producing the named seed categories dispose of the seed they produce?
- d. What criteria do the organizations mentioned above used to predict/know what seed varieties to develop, how much seed to produce, and where to distribute?
- e. What mechanisms do the organizations have in place to ensure quality control of the seed produced and distributed?
- f. How do organizations and stakeholders in the seed industry coordinate in the development, production, and distribution of groundnuts seed?
- g. What strategies are in place to support farmers that have no access to seed due to economic constraints?
- h. How are the strategies funded, and what mechanisms are there to ensure their sustainability?
- i. What are the strengths and weaknesses of the strategies that are used to improve access to seed among farmers?

2. Policy Intervention in the Seed Industry

- a. What are the policy intervention measures that are in place to improve access to seed among farmers?
- b. For how long have the intervention measures been implemented?
- c. How are the beneficiaries of the said intervention measures identified?
- d. What is the geographical coverage of beneficiaries of policy intervention measures designed to improve seed access to farmers?
- e. What improvement in terms of crop production has been recorded because of the intervention measures to improve seed access among farmers?
- f. How does policy envision sustaining seed access among farmers after phasing out of any seed support programs?
- g. How has policy ensured that the intervention measures to improve access to improved seed among farmers do not threaten the loss of crop diversity through farmers abandoning their local seed varieties of groundnuts?
- h. Are there efforts by policymakers to mitigate the loss of crop genetic biodiversity through ex-situ conservation of local groundnuts varieties?
- i. What is the optimal period that research recommends for farmers to recycle groundnuts seed?
- j. Are there any efforts to integrate the formal and informal seed subsectors of groundnuts to ensure that farmers have timely access to groundnuts seed for their preferred attributes?

3. Marketing of Groundnuts

- a. What are the farmers' organizations that facilitate or link farmers to profitable output markets for groundnuts?
- b. Which category of farmers do the farmer organizations facilitate to sell their produce?
- c. Where do the organizations store farmers' produce before it is sold?
- d. Under what conditions do the organizations facilitate the sale of groundnuts for farmers?
- e. Which category of grain buyers do the farmer organizations target to sell farmers' produce?
- f. In terms of export markets, how are small scale farmers linked to these markets, and what market share do they have?

4. Pre-and Post-Harvest Management of Groundnuts

- a. What measures do farmer organizations take to facilitate the production and marketing of good quality groundnuts?
- b. What other organizations coordinate with the government in sensitizing farmers to reduce pre- and post-harvest losses in groundnuts?
- c. What is the extent of post-harvest losses in groundnuts?
- d. What is the main cause of post-harvest losses in groundnuts?
- e. Under what conditions are the major causes of post-harvest losses in groundnuts likely to occur?
- f. What initiatives are in place to reduce post-harvest losses in groundnuts?
- g. What are the main factors that lead to aflatoxin contamination in groundnuts?

- h. How are various stakeholders coordinating to reduce aflatoxin contamination in groundnuts?

5. Access to Agricultural Information among Farmers

- a. Which organizations facilitate the dissemination of agricultural information to farmers?
- b. What types of agricultural information do the organizations provide to disseminate information to farmers?
- c. Who develops the agricultural information that is disseminated to farmers?
- d. How does the agricultural information the organizations disseminate reach the farmers (e.g. use of ICT tools)?
- e. What are the cost implications for farmers for them to access agricultural information?
- f. What are the challenges that organizations face when developing and disseminating agricultural information to farmers?

Appendix 7.3: Focus Group Discussion with Farm Households



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Groundnut Variety Replacement, Market Structure, Marketed Surplus and Demand for Improved Varieties In Malawi : The Case of Smallholders and Traders

Focus Group Discussion with Small Scale Groundnuts Farmers

1. Groundnuts seed varieties, seed sources, and access

- a. What groundnuts seed varieties do farmers grow in the area?
- b. Why do farmers prefer the seed varieties they grow?
- c. What is the source of groundnuts seed varieties they grow?
- d. How do farmers access the seed of groundnuts they grow (purchase, seed loans, free distributions from NGOs, free seed exchange among farmers, or seed subsidies)?
- e. What time of the year do farmers purchase seed and reasons for purchasing seed at that particular time?
- f. What are the farmers' groups/associations that link farmers to seed markets in the area?
- g. From what other organizations and/or seed support programs do farmers benefit from accessing groundnuts seed?
- h. Apart from economic challenges, what other constraints hinder farmers from accessing improved groundnuts seed?

2. Seed Replacement Decisions

- a. Do farmers replace seed they grow with any new seed or any new seed variety?
- b. If they do not, what are the reasons for not replacing seed?
- c. If they do, what influences them to replace seed?
- d. If they do, for how long do they recycle seed before replacing it?
- e. Is the seed recycling period that most of the farmers follow the same as the optimal period that research recommends?
- f. If they do, what seed replacement choices do they make (new seed/new seed variety)?
- g. What influences farmers' seed replacement choices?

3. Marketing of Groundnuts

- a. In what form do farmers sell groundnuts produce?
- b. How do farmers process their groundnuts before selling to the market?
- c. Who are the buyers of groundnuts in this area?
- d. Who are the reliable buyers of groundnuts in this area?
- e. Do the farmers sell groundnuts as individuals or collectively?
- f. What are the benefits of selling produce under any one of the above arrangements?
- g. How far is the nearest output market where farmers sell their produce?
- h. Who decides on the price at which farmers sell their produce?
- i. What are the units of measurement that farmers use when selling their produce?
- j. Do the farmers export their produce?
- k. If YES, how are they linked to the export markets?

4. Knowledge of Pre-and Post-Harvest Losses in Groundnuts

- a. When do farmers plant groundnuts?
- b. What pest and disease problems do farmers experience in groundnuts production?
- c. What methods do farmers use to control pests and diseases in groundnuts fields?
- d. How do the farmers harvest and handle their groundnuts before storage?
- e. In storage, how do the farmers store their groundnuts?
- f. Do farmers know about mould contamination in groundnuts?
- g. If YES, what causes mould contamination in groundnuts?
- h. What are the likely effects of mould contamination in groundnuts?
- i. What can mould contamination lead to?
- j. What can farmers do to prevent post-harvest losses caused by mould contamination?

5. Smallholder Farmers Access to Agricultural Information

- a. How do farmers access information on seed markets (e.g., use of ICT tools and materials)?
- b. How do farmers access information on seed varieties (e.g., use of ICT tools and materials)?
- c. How do farmers access information on agricultural production practices?
- d. How do farmers get information on post-harvest management of groundnuts?
- e. Among the available information sources, what is the source that farmers commonly use to access market information?
- f. How does each of the information sources that farmers indicated above help to improve the production and marketing of groundnuts?
- g. Do farmers pay to access the type of information indicated above?
- h. What are the challenges that farmers face to access agricultural information in general?

6. Membership to Farmers' Association/ Cooperatives

- a. What are the farmers' associations/ Cooperatives that farmers belong to?
- b. For each of the farmers' association/ Cooperatives, what are farmers' membership in terms of gender?
- c. What are the conditions for farmers to belong to these farmers' associations/ Cooperatives?
- d. What benefits or services do farmers get for belonging to these farmers' associations/ Cooperatives?

Appendix 7.4: Trader Market Survey



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Groundnut Variety Replacement, Market Structure, Marketed Surplus and Demand for Improved Varieties In Malawi: The Case of Smallholders and Traders

Ph.D. Research in Agricultural Economics

Market Survey Questionnaire

IDENTIFICATION	
NAME OF RESPONDENT	
AGRICULTURAL DEVELOPMENT DIVISION NAME	
DISTRICT NAME	
TRADING CENTER/MARKET NAME	
INTERVIEWER'S NAME	
INTERVIEWER'S VISITS	
SUPERVISOR NAME: _____ DATE: / /2017	FIELD SUPERVISOR/EDITOR NAME: _____ DATE: / /2017

INTRODUCTION

Hello. My name is _____ I am working with the Ministry of Agriculture Irrigation and Water Development. We are carrying out a market survey on the **Functioning of the output market for groundnuts in Malawi**. The purpose of the survey is to solicit information that will enable policymakers to devise strategies that will help to improve the performance of the groundnuts sector in Malawi through improved, efficient output markets. The information you provide will be kept strictly confidential. The interview will take not more than 30 minutes.

Participation in this interview is voluntary. Now, do you have any question about the exercise?

Signature of interviewer: _____ Date: / / 2017 Start time: |__||__|. |__||__|

SECTION A: SOCIO-DEMOGRAPHIC INFORMATION		
QN	Question	Responses
01A	What is your name (Respondent):	
02A	Gender of the respondent	Male.....1 Female.....2
03A	In which year were you born (respondent)?	Year born ____ Age in years __
04A	What is your marital status (respondent)?	Never married.....1 Married.....2 Divorced/separated.....3 Widowed.....4
05A	What is the highest level of school you attended?	None.....1 Lower Primary.....2 Upper Primary.....3 Secondary.....4 Tertiary.....5 Vocational.....6 Adult literacy.....7
SECTION B: INCOME AND ECONOMIC ACTIVITIES		
QN	Question	Responses
01B	What grain produce do you trade-in?	Groundnuts.....1 Soybean.....2 Pigeon pea.....3 Maize.....4 Common beans.....5 Ground beans.....6 Others (specify).....7
02B	For whom do you operate this business of groundnuts' trade?	Own business1 Agent.....2 Joint venture3 Others (specify).....4
03B	When did you start the business of produce trading?	Years started.....

04B	What type of business assets do you own?	Financial Resources	
		Working capital	Amount (MWK)
		Start-up capital.....1	
		Current capital.....2	
		Last year's capital.....3	
		Own capital4	
		Other(s).specify.....5	
05B	Do you have access to credit facilities?	Yes.....1 No.....2	
06B	If NO, what are the reasons for the lack of access?	Reasons for lack of access	
		Do not know the creditors.....1	
		Creditors charge high-interest rates.....2	
		Credit demand collaterals.....3	
		Other (s) specify.....4	
07B	If YES, mention the sources of the credit?	Credit sources Interest rate charged(%)	
		Financial institutions...1	
		Private money lender..2	
		Friends and relatives...3	
		Others (specify).....4	
08B	What type of physical assets do you possess?	Physical Assets	
		Asset	Number: Value (MWK)
		Weighing scale.....1	
		Bicycle.....2	
		Motorcycle.....3	
		Motor vehicle.....4	
		Oxcart.....5	
		Storage facility.....6	
		Mobile phone.....7	
		Radio.....8	
		TV.....9	
		Own home.....10	
		Others (specify).....11	
SECTION C: MARKETING ACTIVITIES			
QN	Question	Response	
01C	What quantity of groundnuts do you handle in a marketing season?	Marketing Season Quantity in (Kgs)	
		1. Current season (2016/17)	
		2. Last season (2015/16)	
		3. Previous two seasons (since 2014/15)	
		4. Last five seasons (since 2010/11)	
02C	Where do you purchase the grain produce that you trade in?	Direct from farmers' homes.....1	
		From farmers in the local markets.....2	
		From other intermediate traders in the local markets.....3	
		From commodity market exchange.....4	

		Other (s).specify.....5															
03C	What is the unit of measurement which you use when purchasing produce?	Use weighing scales.....1 Use of 5 litre containers.....2 Use of 50 Kgs bags.....3 Others (specify).....4															
04C	In what form do you purchase produce? (include the source of purchase unit of purchase and price)	Form of produce Unshelled.....1 Shelled.....2	Source of purchase (refer to codes in Unit of purchase MWK/Unit														
05C	Who decides on the price at which you buy produce?	Price setting mechanism <table border="1"> <thead> <tr> <th>Source of purchase</th><th>Decision on price</th></tr> </thead> <tbody> <tr> <td>Direct from farmers' homes.....1</td><td> Buyer offers price..... Use existing price on the market... Price agreed with the farmer..... Other(s) ...specify..... </td></tr> <tr> <td>From farmers in the local markets.....2</td><td> Buyer offers price..... Use existing price on the market... Price agreed with the farmer..... Other(s) ...specify..... </td></tr> <tr> <td>From other intermediate traders in the local markets.....3</td><td> Buyer offers price..... Use existing price on the market... Price agreed with the farmer..... Other(s) ...specify..... </td></tr> <tr> <td>From other intermediate traders in the districts central markets4</td><td> Buyer offers price..... Use existing price on the market... Price agreed with the farmer..... Other(s) ...specify..... </td></tr> <tr> <td>From commodity market exchange.....5</td><td> Buyer offers price..... Use existing price on the market... Price agreed with the seller..... Other(s) ...specify..... </td></tr> <tr> <td>Other(s).....6</td><td> Buyer offers price..... Use existing price on the market... Price agreed with the seller..... Other(s) ...specify..... </td></tr> </tbody> </table>		Source of purchase	Decision on price	Direct from farmers' homes.....1	Buyer offers price..... Use existing price on the market... Price agreed with the farmer..... Other(s) ...specify.....	From farmers in the local markets.....2	Buyer offers price..... Use existing price on the market... Price agreed with the farmer..... Other(s) ...specify.....	From other intermediate traders in the local markets.....3	Buyer offers price..... Use existing price on the market... Price agreed with the farmer..... Other(s) ...specify.....	From other intermediate traders in the districts central markets4	Buyer offers price..... Use existing price on the market... Price agreed with the farmer..... Other(s) ...specify.....	From commodity market exchange.....5	Buyer offers price..... Use existing price on the market... Price agreed with the seller..... Other(s) ...specify.....	Other(s).....6	Buyer offers price..... Use existing price on the market... Price agreed with the seller..... Other(s) ...specify.....
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06C	How far is the source of purchase to the assembly point of your produce?	Purchase source Direct from farmers' homes.....1 From farmers in the local markets.....2 From other intermediate traders in the local markets.....3 From the district/town/city central market.....4	Distance (in Kms)/ travel time (in m														

		From commodity market exchange5																					
		Other(s).....6																					
07C	Where do you re-sell the produce? (Source and unit price)	<table border="1"> <thead> <tr> <th>Source</th><th>Unit price</th></tr> </thead> <tbody> <tr> <td>To intermediate traders in the local markets1</td><td></td></tr> <tr> <td>To intermediate traders in district/town/city central market.....2</td><td></td></tr> <tr> <td>To large grain buyers in the city markets3</td><td></td></tr> <tr> <td>To the commodity market exchange.....4</td><td></td></tr> <tr> <td>To grain produce market board (ADMARC).....5</td><td></td></tr> <tr> <td>To agro-processing companies.....6</td><td></td></tr> <tr> <td>Grain exported to other countries.....7</td><td></td></tr> <tr> <td>To consumers in the local market.....8</td><td></td></tr> <tr> <td>Other(s).specify.....9</td><td></td></tr> </tbody> </table>	Source	Unit price	To intermediate traders in the local markets1		To intermediate traders in district/town/city central market.....2		To large grain buyers in the city markets3		To the commodity market exchange.....4		To grain produce market board (ADMARC).....5		To agro-processing companies.....6		Grain exported to other countries.....7		To consumers in the local market.....8		Other(s).specify.....9		
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08C	What mode of transport do you use to move grain produce from purchase source? (Include costs of the mode of transport)	<table border="1"> <thead> <tr> <th>Mode of Transport</th><th>Cost per unit load (MK)</th></tr> </thead> <tbody> <tr> <td>Physically carry the load.....1</td><td></td></tr> <tr> <td>Own bicycle.....2</td><td></td></tr> <tr> <td>Hired bicycle.....3</td><td></td></tr> <tr> <td>Own motorcycle.....4</td><td></td></tr> <tr> <td>Hired motor vehicle....5</td><td></td></tr> <tr> <td>Own motor vehicle.....6</td><td></td></tr> <tr> <td>Pooled transport with other traders.....7</td><td></td></tr> <tr> <td>Other (s).specify.....8</td><td></td></tr> </tbody> </table>	Mode of Transport	Cost per unit load (MK)	Physically carry the load.....1		Own bicycle.....2		Hired bicycle.....3		Own motorcycle.....4		Hired motor vehicle....5		Own motor vehicle.....6		Pooled transport with other traders.....7		Other (s).specify.....8				
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09C	Apart from transport, what other costs do you incur when buying and selling grain?	<table border="1"> <thead> <tr> <th>Transaction cost</th><th>Amount (MWK)</th></tr> </thead> <tbody> <tr> <td>Market search cost.....1</td><td></td></tr> <tr> <td>Packaging cost.....2</td><td></td></tr> <tr> <td>Packaging materials.....3</td><td></td></tr> <tr> <td>Grading/drying cost.....4</td><td></td></tr> <tr> <td>Loading and off-loading cost5</td><td></td></tr> </tbody> </table>	Transaction cost	Amount (MWK)	Market search cost.....1		Packaging cost.....2		Packaging materials.....3		Grading/drying cost.....4		Loading and off-loading cost5										
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10C	What problems do you encounter when purchasing produce from sellers?	<table border="1"> <tbody> <tr> <td>Produce mixed with foreign materials.....1</td></tr> <tr> <td>Produce not well dried.....2</td></tr> <tr> <td>Produce contaminated with moulds.....3</td></tr> <tr> <td>Other(s) specify.....4</td></tr> </tbody> </table>	Produce mixed with foreign materials.....1	Produce not well dried.....2	Produce contaminated with moulds.....3	Other(s) specify.....4																	
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QN	SECTION D: PRODUCE HANDLING AND STORAGE FACILITIES													
01D	Do you store grain produce after purchase before you resell, or do you resell soon after purchase?	Store produce after purchase.....1 Do not store, resell produce soon after purchase.....2												
02D	If you store produce after purchase, do you own the storage facility you use?	<table border="1"> <thead> <tr> <th>Storage facility</th> <th>Value/cost (MWK)</th> </tr> </thead> <tbody> <tr> <td>Own storage facility....1</td> <td></td> </tr> <tr> <td>Hired storage facility...2</td> <td></td> </tr> </tbody> </table>	Storage facility	Value/cost (MWK)	Own storage facility....1		Hired storage facility...2							
Storage facility	Value/cost (MWK)													
Own storage facility....1														
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03D	If you own your storage facility, what materials is it made of?	Grass thatched roofing.....1 Iron sheet thatched roofing.....2 Floor made of mud.....3 Floor made of cement.....4 Other (s).specify.....5												
04D	How do you stack packed produce in the storeroom?	Direct on the floor.....1 On the rack of wooden poles/planks.....2 Other(s).specify.....3												
05D	How long do you keep your produce in-store before reselling? Include reasons.	<table border="1"> <thead> <tr> <th>Length of time when produce is in storage</th> <th>Reason</th> </tr> </thead> <tbody> <tr><td>1.</td><td></td></tr> <tr><td>2.</td><td></td></tr> <tr><td>3.</td><td></td></tr> <tr><td>3.</td><td></td></tr> <tr><td>5.</td><td></td></tr> </tbody> </table>	Length of time when produce is in storage	Reason	1.		2.		3.		3.		5.	
Length of time when produce is in storage	Reason													
1.														
2.														
3.														
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5.														
06D	What are the pre-storage activities that you undertake?	<table border="1"> <thead> <tr> <th>Pre-storage activity</th> <th>Cost (MWK)</th> </tr> </thead> <tbody> <tr> <td>Drying produce before storage.....1</td> <td></td> </tr> <tr> <td>Cleaning produce before storage.....2</td> <td></td> </tr> <tr> <td>Fumigating produce before storage.....3</td> <td></td> </tr> <tr> <td>Other (s) specify.....4</td> <td></td> </tr> </tbody> </table>	Pre-storage activity	Cost (MWK)	Drying produce before storage.....1		Cleaning produce before storage.....2		Fumigating produce before storage.....3		Other (s) specify.....4			
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07D	What type of storage materials do you use to store produce?	<table border="1"> <thead> <tr> <th>Storage materials</th> <th>Value/cost (MWK)</th> </tr> </thead> <tbody> <tr> <td>Hessian sacks1</td> <td></td> </tr> <tr> <td>Plastic containers.....2</td> <td></td> </tr> <tr> <td>Sack bags.....3</td> <td></td> </tr> <tr> <td>Other (s) specify.....4</td> <td></td> </tr> </tbody> </table>	Storage materials	Value/cost (MWK)	Hessian sacks1		Plastic containers.....2		Sack bags.....3		Other (s) specify.....4			
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08D	What problems do you encounter when storing produce?	<table border="1"> <thead> <tr> <th>Problems faced when storing produce</th> </tr> </thead> <tbody> <tr><td>1.</td></tr> <tr><td>2.</td></tr> <tr><td>3.</td></tr> <tr><td>4.</td></tr> <tr><td>5.</td></tr> </tbody> </table>	Problems faced when storing produce	1.	2.	3.	4.	5.						
Problems faced when storing produce														
1.														
2.														
3.														
4.														
5.														
QN	SECTION E: INSTITUTIONAL FACTORS													
01E	Do you belong to any trader association?	1. Yes 2. No												
02E	If NO, state the reason for not belonging to any traders' association	<table border="1"> <thead> <tr> <th>Reasons for not belonging to traders association</th> </tr> </thead> <tbody> <tr> <td>1. I am not aware of any traders' association</td> </tr> <tr> <td>2. Demands payment of membership fee which I cannot manage</td> </tr> </tbody> </table>	Reasons for not belonging to traders association	1. I am not aware of any traders' association	2. Demands payment of membership fee which I cannot manage									
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		3. Other(s)..specify	
03E	If YES to the above for how long you have been a member to the traders' association	Number of years as a member [_____]	
04E	If YES to the above, what are some of the benefits/services that you get from the association	Benefits/services from traders association 1. I access market information 2. I access information on post-harvest handling of ground produce 3. I get a business loan through the association 4. The association facilitates the marketing of produce 5. Other(s) specify	
SECTION F: ACCESS TO INFORMATION ON PRODUCE AND AVAILABILITY OF MARKETS			
QN	Question	Response	
01F	How do you know that produce is available in a particular area?	Source of purchase Direct from farmers' homes.....1 From farmers in the local markets.....2 From other intermediate traders in the local markets.....3 From other intermediate traders in the district's central markets4 From commodity market exchange.....5 Other(s).....6	Knowledge of produce availability Through informants/contacts..... Through personal visits in the area... Other (s)..... Through informants/contacts..... Through personal visits in the area... Other (s)..... Through informants/contacts..... Through personal visits in the area... Other (s)..... Through informants/contacts..... Through personal visits in the area... Other (s)..... Through informants/contacts..... Through personal visits in the area... Other (s) Specify.....
02F	What Information Communication Technology (ICT) tools do you have access to?	Radio.....1 TV.....2 Newspaper.....3 Mobile phone.....4 Other(s).Specify.....5	
03F	Which of these ICT tools do you use to access information on produce availability?	Radio.....1 TV.....2 Newspaper.....3 Mobile phone.....4 Other(s) Specify.....5	
04F	How do you access information on the market where you sell your produce?	Radio.....1 TV.....2 Newspaper.....3 Mobile phone.....4 Through informants/contacts.....5 Other(s) Specify.....6	

05F	What problems do you encounter when accessing market information using the above ICT tools?		
		ICT tools	Problems encountered
		1. Radio	
		2. Newspaper	
		3. Mobile phone	
		5. Informants/contacts	
		6. Other(s)...specify	
SECTION G: AWARENESS OF AFLATOXIN CONTAMINATION IN GROUDNUTS			
01G	Are you aware of aflatoxin contamination in groundnuts?	YES.....1 NO.....2	
02G	If Yes to the above, how did you know about it?	Source of information on aflatoxin contamination in groundnut	
		1. From fellow traders	
		2. From produce sellers	
		3. From the radio	
		4. From agricultural office	
		5. From trade association, I belong	
		6. Other (s)...specify	
03G	If Yes to the above, what do you think are the causes of aflatoxin contamination in groundnuts?	Causes of aflatoxin contamination in groundnuts	
		1	
		2	
		3	
		4	
		5	
		6	
		7	
		8	
04G	What do you think are the effects aflatoxin contamination on groundnuts trade?	Effects of aflatoxin contamination on groundnuts trade	
		1	
		2	
		3	
		4	
		5	
		6	
		7	
		8	
05G	How do you think the above causes can be minimised?	Minimisation of aflatoxin contamination in groundnuts	
		1	
		2	
		3	
		4	
		5	
		6	
		7	
		8	

END OF INTERVIEW Thank the respondent for his/her participation in the survey

END TIME [_____]

INTERVIEWER'S COMMENTS

TO BE FILLED IN AFTER COMPLETING EACH INTERVIEW

COMMENTS ABOUT THE RESPONDENT

.....

.....

.....

SECTION H: RETAIL MARKET PRICE

Make visits in the local market and capture the price that consumers pay for groundnuts
(randomly interview at least 3 retailers).

ID	RETAILER	UNIT PRICE
1		
2		
3		
4		
5		

Appendix 7.5: Turnitin Similarity Index

Groundnut Variety Replacement, Market Structure, Marketed Surplus and Demand for Improved Varieties in Malawi: The Case of Smallholders and Traders

Admire Katunga PhD Thesis_Final

ORIGINALITY REPORT

12%	10%	7%	0%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

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Appendix 7.6: Ethical Clearance



21 September 2017

Mr. Admire Katunga (216076497)
School of Agricultural, Earth & Environmental Sciences
Pietermaritzburg Campus

Dear Mr. Katunga,

Protocol reference number HSS/0754/017D

Project title Economic analysis of the Performance of the Input and Output Market Systems of Groundnuts in Malawi:
Application of the O-ring Theorem and General Systems approach to organizations

Approval Notification - Expedited Approval

In response to your application received on 12 June 2017, the Humanities & Social Sciences Research Ethics Committee has considered the abovementioned application and the protocol has been granted FULL APPROVAL.

Any alteration/s to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form, Title of the Project, Location of the Study, Research Approach and Methods must be reviewed and approved through the amendment/modification prior to its implementation. In case you have further queries, please quote the above reference number.

PLEASE NOTE: Research data should be securely stored in the discipline/department for a period of 5 years.

The ethical clearance certificate is only valid for a period of 3 years from the date of issue. Thereafter Recertification must be applied for on an annual basis.

I take this opportunity of wishing you everything of the best with your study.

Yours faithfully


Dr Shenuka Singh (Chair)

/ms

Cc Supervisor: Professor Edilegnaw Wale Zegeye and Professor Gerald Ortmann

Cc: Academic leader Research: Professor O Mutanga

Cc School Administrator: Ms. Marsha Manjoo

Humanities & Social Sciences Research Ethics Committee

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