MOBILE PHONE BASED MARKET INFORMATION SERVICES AND SMALLHOLDER FARMERS' MARKET PARTICIPATION IN LILONGWE, MALAWI

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A DISSERTATION SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE DEGREE OF MASTER OF SCIENCE IN AGRICULTURAL ECONOMICS OF SOKOINE UNIVERSITY OF AGRICULTURE. MOROGORO, TANZANIA.

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ABSTRACT

This study analyses the effect of mobile phone based market information services (MIS) on smallholder farmers' maize market participation in Lilongwe rural, Malawi using survey data sourced directly from 196 smallholder farmers. The study reveals insufficient evidence to suggest that existing mobile phone-based MIS in Malawi which entails users subscribing to short (text) message service (SMS) price alerts, influence smallholder farmers' market participation decisions. Knowledge of prevailing prices is different from having the ability to take advantage of this information, and the average Malawian smallholder farmer often has no say in the prices they receive from vendors and lacks transportation to distant markets where prices may be better. Consequently, farmers with no access to alternative markets fail to improve their marketing outcomes. The findings of this study suggest that channelling government's resources towards improving extension services and increasing farmers' productivity are ideal ways to promote smallholder farmer market participation. The findings further suggest the need to integrate radio and mobile in agricultural market information services, and to provide farmers with information related to agricultural production in addition to market prices. A pertinent area for further research is to assess how to adapt the existing mobile phone-based MIS initiatives to the context of Malawi so as to bring about significant effect.

DECLARATION

I, Thokozani Chikuni, do hereby declare to the Senate of Sokoine University of Agriculture that this dissertation is my own original work done within a period of registration and that it has neither been submitted nor being concurrently submitted in any other institution.

_____ _____

Thokozani Chikuni Date

(MSc. Candidate)

The above declaration is confirmed by;

_____ _____

Prof. F.T.M. Kilima Date

(Supervisor)

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DEDICATION

This work is dedicated to mom, dad, Chisomo, and Sarah.

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LIST OF ABBREVIATIONS

ACE	Agricultural Commodity Exchange
AEDO	Agricultural Extension Development Officer
AMIS	Malawi Agricultural Market Information System
BVPM	Bivariate Probit Model
DD	Difference in difference
EPA	Extension Planning Area
ICT	Information and Communication Technology
MIS	Market Information System
MWK	Malawi Kwacha
NGO	Non-Governmental Organisation
PSM	Propensity score matching
SMS	Short Message Service
VIF	Variance Inflation Factor

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background

A key focus of recent information and communication technology (ICT) and development initiatives in Africa has been to promote the use of mobile phones for improved smallholder farmers' access to information and markets (Steinfield *et al*., 2015; Nakasone *et al*., 2014). This emphasis is based on the notion that agricultural sectors in developing countries predominantly comprise resource poor, small-scale subsistence farmers (Tadesse and Bahiigwa, 2015) who face high transaction costs and information constraints that limit their market participation (Katengeza *et al*., 2014; Martey *et al*., 2012). Effective use of ICT devices such as mobile phones is considered ideal in reducing asymmetries of information between traders and producers and subsequently reducing farmers' transaction costs (Dixie and Jayaraman, 2011).

The Government of Malawi and development agencies have been implementing ICT-based projects with the aim of providing market actors with market information services (MIS) to promote their market participation (IFPRI, 2013). Currently, the largest scale initiative is the Malawi Agricultural Market Information System (AMIS), with a mandate to provide farmers and traders with market information (Ministry of Agriculture and Food Security, 2011). Prior assessment of the AMIS in 2013 indicated that targeted users do not use the data for trade-related decisions as dissemination is three months later on a website (IFPRI, 2013). The assessment revealed that there are similar projects implemented by Non-Governmental Organisations (NGOs) such as the Agricultural Commodity Exchange (ACE), which disseminate market information via mobile phones instead of websites.

Subsequently, the use of mobile phones has been intensively promoted to address the untimely dissemination of AMIS owing to increasing use of these devices (Fig. 1).

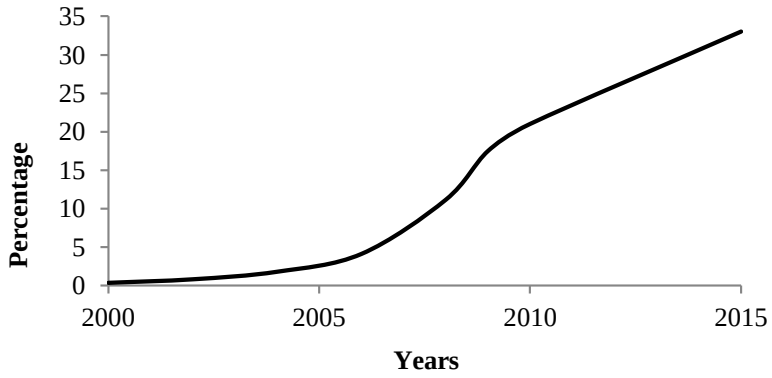

Figure 1: Trend of mobile phone subscribers in Malawi both rural and urban

Source: Malawi National Statistics Office (2014).

The increased mobile phone ownership is believed to be associated with the potential of these communication devices to reduce users' information search cost and enhance market participation (Katengeza *et al*., 2014). However, it is not yet established whether a significant number of farmers have access to MIS through the existing NGO's initiatives, and if this access has led to increased market participation of smallholder farmers in Malawi. Furthermore, studies on the impact of mobile phone-based MIS conducted in other countries reveal mixed results (Nakasone *et al*., 2014).

Some studies suggest a significant effect of mobile phone based MIS on farmers' market participation. Aker and Fafchamps (2014) found that mobile phone coverage reduced the spatial dispersion of producer prices for cowpeas in Niger while Muto and Yamano (2009) reveal that banana growers in Uganda realised better prices after getting access to market information through a mobile network. Courtois and Subervie (2014) and Nyarko *et al.* (2013) found that farmers with access to the ESOKO ICT-MIS received higher prices than

those without access to the service in Ghana. Moreover, similar interventions are reported to have integrated resource poor farmers into a higher value agricultural chain in Kenya (Okello *et al.*, 2010). Conversely, other studies suggest insignificant impact of mobile phone-based MIS on farmers' market participation. Tadesse and Bahiigwa (2015) found no effect of mobile phones on farmers' marketing decisions in Ethiopia while Fafchamps and Minten (2012) found insignificant differences in price between people with and without access to an internet-based MIS in India. Baumüller (2013) found insufficient evidence for the effect of a mobile phone-based MIS in Kenya and a comprehensive review of ICT and its effect on agricultural development in developing countries found that access to mobile phones improved agricultural market performance at the macro level but not at the micro level (Nakasone *et al.*, 2014).

1.2 Problem Statement and Justification

Existing studies reveal varied and country specific impacts of mobile phone-based MIS on smallholder farmers' marketing decisions. To the knowledge of the researcher, the only related study conducted in Malawi assessed the effect of ICT-based MIS on farmers' transaction costs, and not their marketing decisions (Katengeza *et al*., 2014). Currently, no study has examined the effect of mobile phone-based MIS implemented by NGOs to determine if these interventions have significantly enhanced smallholder farmer market participation. Hence the situation in Malawi is not known. The thrust by the Malawian Government to enhance smallholder farmers' market participation through mobile phone-based MIS should be examined thoroughly to ascertain a priori its effect on target beneficiaries. Therefore there was a need for novel research to determine the effect of the existing mobile phone-based MIS in Malawi on smallholder farmers' marketing decisions to inform decision making.

1.3 Objectives

1.3.1 Overall objective

The overall objective of the study was to evaluate mobile phone-based market information services and smallholder farmers' market participation in Lilongwe, Malawi.

1.3.2 Specific objectives

The specific objectives of the study were:

i) To analyse the determinants of smallholder farmers' market participation in Lilongwe.

ii) To examine the effect of mobile phone-based market information services on smallholder farmers' market participation in Lilongwe.

1.4 Hypotheses

i) H_0: Socio-economic factors do not significantly influence smallholder farmers' market participation in Lilongwe.

ii) H_0: Use of mobile phone-based market information services does not significantly influence smallholder farmers' market participation in Lilongwe.

1.5 Organisation of the Dissertation

The dissertation is organised into five chapters. This chapter presents the background and rationale of the research and outlines the objectives and corresponding hypotheses. The next chapter is a comprehensive review of theoretical and empirical literature relating to mobile phone-based market information services and farmers' market participation which lays the foundation of the conceptual framework guiding the study. Chapter three describes the data used to test the hypotheses presented in the introduction, sampling techniques, empirical models and analytical tools employed in the analysis. The fourth chapter presents the results

and discusses the main findings of the paper. Finally, the fifth section highlights the major findings and key research recommendations.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Theoretical Framework

Farmers' market participation is regarded as a decision of whether to sell or not along with the volume to be sold (Osmani and Hossain, 2015; Baumüller, 2013). Asset-based and transaction costs are two main approaches identified to guide farmers' market participation decisions. The asset-based approach hypothesises that farmers' market participation will be associated with asset endowments (Boughton *et al*., 2007) whereas the transactions costs approach hypothesises that such a decision is more likely be associated with the cost of arranging and carrying out transactions such as negotitating and searching for information (Alene *et al*., 2008). What defines transaction costs is a subject that has been thoroughly studied by many scholars. Many of such studies indicate that transaction costs depend on the nature of transaction and the extent of information asymmetry and search (Tadesse and Bahiigwa, 2015). Kirsten *et al.* (2009) and Martey *et al.* (2012) reiterate that lack of perfect and freely available information leads to inefficiency and subsequently high transaction costs which can potentially limit farmer market participation.

ICT-based market information services are theoretically believed to reduce the information assymetry and consequently, concepts from Transaction Cost Economics were considered in this study as it associates the cost of information with farmers' market participation (Nakasone *et al*., 2014; Kirsten *et al*., 2009). Nonetheless, concepts from the asset ownership approach were also incorporated since farmers need to own ICT devices to access ICT-based MIS (Tadesse and Bahiigwa, 2015).

2.2 Empirical Literature

2.2.1 Smallholder farmers' Market Participation in Africa

Literature reveals that smallholder farmers in many developing countries in Africa have poor access to information and limited market participation (Tadesse and Bahiigwa, 2015; Baumüller, 2013; Sekabira *et al*., 2012). Wiggins and Keats (2013) attribute farmers' limited market participation to remoteness, low production, poor agronomic practices, low prices, and lack of market information. Empirical studies in different countries concur with this notion. Magesa *et al.* (2014) found that farmers' inability to meet market standards was a key determinant of market participation in Tanzania as lucrative markets often require high quality crops. Sekabira *et al*. (2012) found that low income levels limited farmers' access to rural markets in Uganda. Katengeza *et al*. (2011) found that transport cost was a key determinant of market participation in Malawi as it constrained farmers to access distant but better-paying markets. Tadesse and Bahiigwa (2015) found similar effects in Ethiopia where substantial transportation and labour costs hindered the participation of poor farmers in agricultural markets.

2.2.2 Factors influencing smallholder farmers' market participation decisions

There is substantial literature that examines determinants of smallholder farmer's decision to take part in markets, and most of this literature suggests that the determinants are socio-economic and farm specific characteristics (Osmani and Hossain, 2015; Maponya *et al*., 2015; Musah *et al*., 2014).

Maponya *et al.* (2015) found that distance to markets negatively affected farmers' market participation in South Africa because higher transport cost erodes farmers' gains from marketing. Moreover they also found that farmers who received extension services were more likely to participate in the market due to enhanced production capacity. The latter

finding is similar to Alene *et al.* (2008) who found that access to extension services was positively associated with market participation in Kenya. Osmani and Hossain (2015) found that farmers with larger farm sizes were more likely to participate in the market in Bangladesh as they produced more output. Furthermore farmers who reported high crop incomes in previous years had more incentive to produce and participate in the market. Burrell and Oreglia (2015) found that existing business relationships and institutional policies influenced market participation of fish farmers in China and Uganda as there were few buyers and fish is highly perishable. Tadesse and Bahiigwa (2015) found that farmers who were relatively wealthier and owned assets such as mobile phones were more likely to participate in the market in Ethiopia as they tend to produce a surplus. Musah *et al.* (2014) found that male headed households in West Africa had better access to resources and hence were more likely to produce a surplus and participate in the market and that high crop yields were significantly associated with higher market participation. The study also found that output price is an incentive for households to produce more.

2.2.3 Smallholder farmers' market participation and ICT-based agricultural market information systems

Lack of market information may be a key hindrance to farmer market participation (Baumüller, 2013). It is believed that this limitation results into high transaction costs for smallholder farmers, and may ultimately limit their market participation (Tadesse and Bahiigwa, 2015; Katengeza *et al*,. 2014; Martey *et al*., 2012; Kirsten *et al*., 2009; Alene *et al*., 2008). Empirical evidence suggests that mobile phone-based MIS reduce asymmetries of information between traders and producers and subsequently reduce farmers' transaction costs (Dixie and Jayaraman, 2011). Therefore similar to initiatives in Uganda (Sekabira *et al.,* 2012), Tanzania (Magesa *et al.,* 2014) and Nigeria (Nmadu *et al.,* 2013), a number of ICT-based projects that aim at providing farmers and other market actors with MIS have

been implemented in Malawi. Katengeza *et al.* (2014) found that farmers who accessed the mobile phone-based MIS in Malawi incurred less transaction costs because they were able to reduce the information search cost.

In general, many studies have confirmed that ICT-based MIS are indeed improving farmers' production practices and may reduce transaction costs. However, recent evaluations of the effect of mobile phone-based MIS on farmers' marketing decisions reveal insignificant results (Tadesse and Bahiigwa, 2015; Nakasone *et al*., 2014). Existing literature suggests that the insignificant effect is mainly due to low mobile phone penetration rates, poor infrastructure in rural areas, low farmer literacy levels, and challenges in market dynamics such as farmers' inability to access lucrative markets that cannot be fully addressed by provision of market information alone (Steinfield *et al*., 2015).

2.2.4 Factors influencing smallholder farmers' adoption of ICT-based market information systems

Okello *et al.* (2014) found that area characteristics, income and asset ownership were significant determinants of use of ICT-based MIS. Naturally, some areas have poor telecommunication networks which can hinder the use of these services. In addition it was also found that farmers with low incomes are less likely to use ICT-based MIS. In a similar study in Malawi, Katengeza *et al.* (2011) found that drivers of ICT-MIS usage include income, membership in farmer groups, distance to the nearest electricity centre, distance to agricultural field officers offices and land size. The study found that farmers who owned more assets and had relatively higher incomes were more likely to use ICT-based MIS as they could afford the cost of airtime and phone charging. In addition, interaction with extension officers rendered farmers more able to use the SMS functions of mobile phones and hence capable to access and use ICT-based MIS. Similarly, Sekabira *et al.* (2012) found

that poverty, unreliable supply of electricity; lack of expertise, and poor network coverage limited the use of ICT-based MIS in Uganda.

In general, studies that have so far analysed the effect of ICT-based MIS on farmers' market participation reveal mixed and context specific outcomes (Tadesse and Bahiigwa, 2015; Courtois and Subervie, 2014; Sekabira *et al*., 2012). Findings from different African countries vary as mobile phone penetration rates, farmer literacy levels, and market dynamics differ across countries in Africa. In addition, it is worth to note that in Ghana where there was significant effect of the ESOKO ICT-MIS, there has been vigorous awareness campaigns and farmer training sessions prior to project implementation, and farmers who are beneficiaries received subsidised mobile phones and free annual subscription fees which was made possible through external financing (Courtois and Subervie, 2014).

Analyses of the influence of determinants of farmers' market participation were predominantly done using econometric analysis with binary choice models (Tadesse and Bahiigwa, 2015; Nmadu *et al*., 2013). Binary choice models were employed to assess whether farmers' market participation was linked to their access to ICT-based MIS. Therefore, the approach employed in this study is based on empirical evidence on factors underlying the use and effect of mobile phone-based MIS on farmers' market participation and techniques that have been adopted to model this relationship.

2.3 Conceptual Framework

The conceptual framework adopted by this study represents the hypothesised relationship among variables influencing farmer maize market participation based on the theoretical and empirical review of relevant literature (Fig. 2). It highlights the specific variables

representing farmer characteristics, production factors, institutional and market factors hypothesised to influence smallholder farmers' participation in maize markets. Maize was the particular focus for the study as it is the staple crop in Malawi and one of the main crops that can be significantly impacted by the existing mobile phone-based MIS in the country.

In reference to the theoretical framework that guided the study, the theory of transaction cost economics is relevant and reflected in the conceptual framework because the use of mobile phone-based MIS can potentially reduce farmers' information search costs. The ownership of mobile phones is also relevant as it reflects the concept of asset endowment and its effect on farmers' market participation.

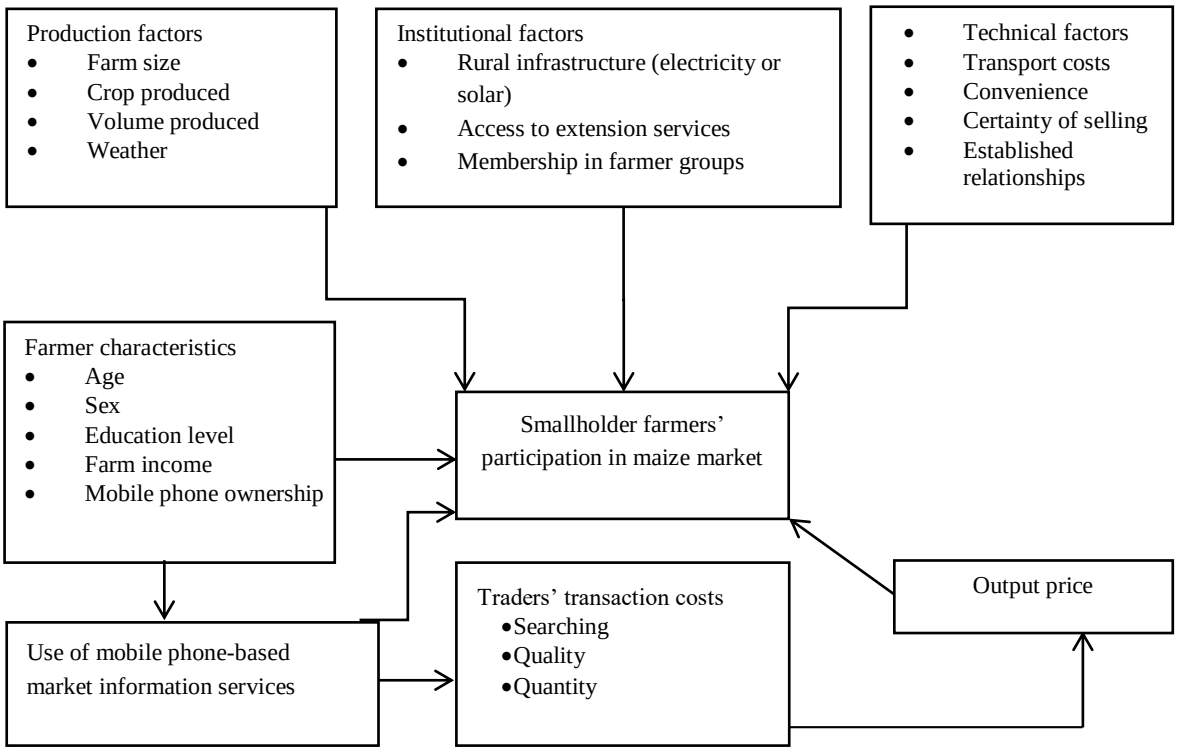

Figure 2: Conceptual framework

Source: Adapted from Katengeza *et al.* (2014) and Martey *et al.* (2012)

2.4 Discrete Choice Modelling

Farmers' market participation is a discrete choice and should be modelled using appropriate discrete choice models. In the analyses of discrete choices, the dependent variable is not a quantitative measure of some economic outcome, but rather an indicator of whether or not some outcome occurred (Greene, 2012). There are different analytical approaches that can be employed. This study used a bivariate probit model to estimate the effect of mobile phone-based MIS on smallholder farmers' participation in maize markets. Apart from a bivariate probit model, the study could have used propensity score matching (PSM) or difference in difference (DD) approaches to evaluate the same effect (Khandker *et al*., 2010). The PSM approach assumes conditional independence that unobserved factors do not affect participation and a sizable common support or overlap in propensity scores across the participant and non-participant samples (Khandker *et al*., 2010). However, the study used the simple random sampling approach to identify farmers for data collection implying that the overlap assumption was not met to validate the use of PSM. The DD could not be adopted because it measures differences in variables of interest between target beneficiaries and non-beneficiaries over years and it requires panel data that could not be observed during the study period (Khandker *et al*., 2010).

Logit and probit models are used to estimate discrete choice models, and for all practical purposes, both models give similar results. The choice of model therefore depends on the ease of computation, which is not a serious problem given readily available statistical packages (Gujarati, 2004). The dependent variable for this study was whether a farmer sold maize in the previous season or not and was regarded as a proxy for market participation. The probit model was fitted to address the first objective as it allows the use of a binary dependent variable and estimation of determinants which are associated with higher probability of market participation.

The bivariate probit model (BVPM) is employed when the outcome variable is dichotomous and the determinants of the probable outcome include qualitative information in the form of an endogenous dummy or treatment variable (Li *et al*., 2016). The BVPM entails modelling the joint determination of two binary dependent variables (Greene, 2012). The BVPM was adopted to address the second objective of the study that was to examine the effect of mobile phone-based MIS on farmers' market participation. The BVPM was considered ideal as it assumes that two binary outcomes are correlated, specifically the decision whether to access mobile phone-based MIS and participate in the market. The model was employed to estimate the joint probability of a smallholder farmer accessing mobile phone-based MIS and participating in the maize market in Lilongwe, and to determine if the resulting correlation coefficient would be significant.

CHAPTER THREE

3.0 METHODOLOGY

3.1 Description of the Area of Study

The study was conducted in Lilongwe rural, Malawi, sub-Saharan Africa (Fig. 3). Lilongwe district was purposively selected as it is where most of the ICT-based MIS initiatives are launched and promoted.

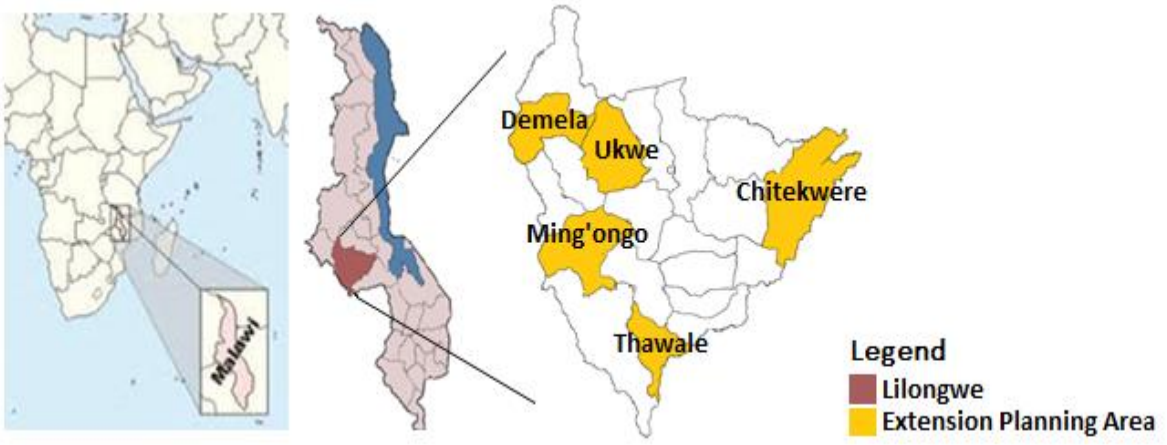

Figure 3: Map of Malawi and Lilongwe showing the sampled EPAs

Source: Adapted from Kundhlande *et al.* (2014)

3.2 Research Design, Sources of Data, and Collection Methods

The research design adopted for the study was a cross-sectional survey as it allowed collection of similar information from farmers in different extension planning areas (EPAs). Primary data from a household survey and focus group discussions and secondary data from relevant sources were used in the study. During the survey, households who were sampled were interviewed by experienced and well-trained enumerators using a structured and pretested questionnaire (Appendix 1). The survey and focus group discussions involved five enumerators and 15 days of field work to complete. The data collected were on socio-

economic characteristics of the farmers, their access to ICT-based MIS along with market participation, and production factors.

3.2.1 Sampling design

Lilongwe district has 20 extension planning areas (EPAs) sub-divided into sections. Agricultural Extension Development Officers (AEDOs) are assigned up to five sections, and have lists of the farmers they interact with (Ministry of Agriculture and Food Security, 2011). A multistage (three stage) sampling technique was used to select households for interview. In the first stage five EPAs were selected using simple random sampling, and these were Chitekwere, Ukwe, Ming'ongo, Thawale and Demela (Fig. 3). In the second stage, two sections were randomly sampled from each EPA while in the third stage, households were systematically sampled from the respective AEDO's lists. A total of 196 households were selected for interviews and focus group discussions.

3.2.2 Sample size

According to the United Nations (2005) handbook for designing household survey samples, the estimation formula for sample size is:

$$n_h = (z^2)(r)(1-r)(f)(k)/(p)(\breve{n})(e^2) \quad \ldots\ldots (1)$$

Where n_h is the number of households, *r* is an estimate of a key indicator to be measured, *f* is the sample design effect, *k* is a multiplier to account for non-response, *p* is the proportion of the target population in the entire population, $\breve{n}$ is the average household size and *e* is the margin of error that can be tolerated.

Recommended values for some of the parameters are a *z*-statistic of 1.96 for the 95-percent level of confidence, a default value of 2.0 for *f*, and a value of 1.1 for *k* (United Nations, 2005). The Malawi National Statistics Office (2014), reports that average household size $\breve{n}$

in Malawi is 6 people. According to Kundhlande *et al.* (2014) the proportion of the total population accounted for by smallholder farmers *p* is 80%. Findings from the survey on access and usage of ICT services in Malawi conducted by the National Statistics Office (2014) estimate that on average 35% of the rural population own mobile phones and consequently the estimate of a key indicator to be measured (*r*) was 0.35. A key indicator measured by the survey was access to ICT-based MIS, and the majority of the existing ones in Malawi at the time of the study used cellular technology.

Thus the sample size was computed as:

$n_h = (3.84)(0.35)(0.65)(1.2)(1.1)/(0.8)(6)(0.01) = 196$ …….…..…… (2)

In order to systematically sample farmers, a sampling interval was determined as follows:

$i = N/n$ ……..……..…… (3)

Where; i is the sampling interval, n is the sample size and N is the population size. On average each AEDO is responsible for 2500 smallholder farmers (Palmer and Darabian, 2017; Kundhlande *et al*., 2014).

Therefore $i = 2500/196 = 12$ ……..…….. (4)

The sampling interval per section was the 12^{th} household on the AEDOs lists. The interval was determined at section level as lists of farmers per EPA level were not available.

3.3 Analytical Tools and Techniques

A combination of quantitative and qualitative analysis was employed to address the research objectives and corresponding hypotheses. Descriptive statistics, Chi-square analysis, and regression models were suitable to analyse the quantitative data collected from the survey. However, a qualitative approach was necessary to evaluate the information obtained from the farmer focus group discussions. Chi-square test of independence analysis was used to evaluate association between the decision to participate in the maize market and categorical socio-economic characteristics of smallholder farmers. The Chi-Square test of

independence is used to determine if there is a significant relationship between two categorical variables and is based on the following ratio:

$$\chi_k^2 = \Sigma \left(\frac{(O-E)^2}{E}\right) \quad \text{..... (5)}$$

Where; χ_k^2 is the Chi-square statistic with degrees of freedom k, O is the observed frequency, and E is the expected frequency.

The Chi-square test of independence tests the hypothesis that there is no association between two categorical variables, and can be rejected based on the significance of the corresponding p-value (Gujarati, 2004).

3.3.1 Determinants of smallholder farmers' market participation in Lilongwe

The first objective was to analyse determinants of smallholder farmers' market participation in Lilongwe and was based on a random utility model with expected utility of two choices (Greene, 2009).

$$U_{i1} = X'_{i1}\beta + e_{i1} \quad \text{..... (6)}$$

$$U_{i0} = X'_{i0}\beta + e_{i0} \quad \text{..... (7)}$$

Where; $U(.)$ is the non-observable utility function with 1 for market participation and 0 otherwise, X' is a vector of observable attributes and household specific characteristics, β is a vector of parameters, and the random terms e represent unobservable influences on utility.

The decision to participate in the market involves comparison of expected utilities, and a farmer makes a choice between participating in the market or not based on which outcome provides greater utility. Market participation is 1 if $\Delta U_i > 0$ and is zero otherwise. The latent random variable $Y^* = U_{i1} - U_{i0}$ is non-observable, however the choice made by a farmer

is the actual decision made and is observable (Greene, 2012). In this study farmers who sold crop in the previous season were regarded as market participants.

The decision to participate in the market or not was specified as:

$$Y_i \begin{cases} 1, & Y_i^* > 0 \\ 0, & Y_i^* < 0 \end{cases} \quad \text{……………………………………………………………………...…. (8)}$$

$$Y^* = \beta_0 + \beta_1 X_{i1} + \beta_k X_{ik} + \varepsilon_i, \qquad \varepsilon_i = iidN(0, \sigma^2) \quad \text{…………..…..... (9)}$$

Where; Y_i* is the latent variable, X_{ik} is a vector of explanatory variables, β_k is a vector of parameters, and ε_i is the error term.

The probability that a farmer participates in the market is a function of the independent variables and was estimated with a probit model (Greene, 2012):

$$Prob(Market\ Participation = 1) = Prob(CropSold > 0) \quad \text{…………...………….. (10)}$$

$$P_r\,(Y_i = 1) = P_r\,(Y^* > 0|X)$$

$$P_r\,(Y_i = 1) = P_r\,(X_i'\beta + \varepsilon_i > 0|X)$$

$$P_r\,(Y_i = 1) = 1 - P_r\,(\varepsilon_i \leq -X_i'\beta)$$

$$P_r\,(Y_i = 1) = 1 - \mathbf{\Phi}\,(-X_i'\beta)$$

$$P_r\,(Y_i = 1) = \mathbf{\Phi}\,(-X_i'\beta) \quad \text{………………………………………………………….. (11)}$$

Where; $\mathbf{\Phi}$ is the cumulative distribution function, X' is a vector of explanatory variables, and β is a vector of parameters that are estimated using maximum likelihood method.

The empirical model was specified as:

Maize Market Participation = β_0 + β_1*Farm size* + β_2*Yield* + β_3*Age* + β_4*Sex* + β_5*Low primary* + β_6*Mobile phone* + β_7*EXTMrktng* + β_8*Price* + β_9*SMS alerts* + β_{10}*Purpose* + β_{11}*Variety* + β_{12}*Distance* + β_{13}*ICT-MISCost* + *e* ………….................................... (12)

3.3.2 Theoretical model to measure the effect of mobile phone-based market information services on smallholder farmers' market participation in Lilongwe

The second objective was to examine the effect of mobile phone-based MIS on smallholder farmers' market participation and was analysed using BVPM. The BVPM was employed as the outcome of interest was whether farmers' participation in the maize market was significantly influenced by their use of mobile phone-based MIS. This association entails two binary dependent variables that can be modelled using the BVPM (Li *et al*., 2016).

Adapting the general specification suggested by Greene (2012), the model was specified to estimate the joint probability of farmers' market participation and use of mobile phone-based MIS:

$$I^* = X_1'\beta_1 + \varepsilon_1, \qquad I = 1 \; if \; I^* > 0, 0 \; otherwise, \quad \text{.................................} (13)$$

$$M^* = X_2'\beta_2 + \gamma I + \varepsilon_2, \qquad M = 1 \; if \; M^* > 0, 0 \; otherwise, \quad \text{.........................} (14)$$

$$\begin{pmatrix} \varepsilon_1 \\ \varepsilon_2 \end{pmatrix} |X_1, X_2) \sim N \; \left[\begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} 1 & \rho \\ \rho & 1 \end{pmatrix} \right] \quad \text{..} (15)$$

Where; I^* and M^* are latent variables for use of mobile phone-based MIS and maize market participation, respectively; X_i denotes common covariates, ρ is the correlation coefficient, and ε_i is the error term with unit variance and mean of zero.

The relationship can be compactly expressed as a joint probability:

$$P(M = 1, I = 1) = P(I = \text{M} \,|I = 1)P(I = 1) \quad \text{..} (16)$$

$$P(M = 1, I = 1) = \boldsymbol{\Phi}(X_2'\beta_2 + \gamma, X_1'\beta_1, \rho) \quad \text{..} (17)$$

Where; M is market participation, I is use of mobile phone-based MIS, $\boldsymbol{\Phi}$ is the the cumulative distribution function of the bivariate standard normal distribution, β denotes the

parameters that are estimated by maximum likelihood method and X' is a vector of explanatory variables for market participation and use of mobile-phone based-MIS.

The variables fitted in the models specified above and their a priori expectations along with the hypothesised relationships between the dependent variable and the explanatory variables are summarised in Table 1 and clarified thereafter.

Table 1: Description of dependent and independent variables fitted in the probit and bivariate probit models

Variable category	Variable	Variable Description	Nature	Expected Sign
Dependent	Market participation	Whether a farmer participated in the maize market	Binary 1=Yes 0=No	
Independent	Farm size	Farm size in acres	Continous	+
	Yield	Volume of maize produced in Kg	Continous	+
	Age	Age of farmer in years	Continuos	+
	Sex	Whether farmer is male or female	Binary 1= Male 0 = Female	+
	Education level	Education attained whether Lower Primary, Upper Primary, Secondary, or Tertiary	Dummy	+
	Mobile phone	Whether farmer owned mobile phone	Binary 1= Yes 0 =No	+
	Access to extension	Whether farmer had access to marketing extension	Binary 1= Yes 0 =No	+
	Crop variety	Whether a farmer planted improved maize varieties or local varieties	Binary 1= Improved 0 =Local	+
	Subscribe SMS alerts	Whether a farmer used mobile phone-based MIS	Binary 1= Yes 0= No	+
	Purpose of cultivation	Whether a farmer cultivated maize as a food and cash crop	Binary 1= Yes 0 =No	+
	Cost of using ICT-based MIS	Amount of money used to access ICT-based MIS and charge mobile phone	Continuous	-
	Output price	Market price of maize in MKW	Continuous	+
	Distance to market	Distance to market in Km	Continuous	_

Source: Authors' conception based on theoretical and empirical review

Dependent variable: Market participation was regarded as a decision whether to sell maize or not. The variable took the value of 1 for households that sold maize in the previous season of 2015/16 season and 0 for those who did not sell maize during the season.

Age: Age was measured as a continuous variable of the age of the household's head in years. It was hypothesised that younger farmers would be more likely to participate in the market and use mobile phone-based MIS (Tadesse and Bahiigwa, 2015).

Sex: Sex was measured as a dummy variable that took a value of 1 if the household head was male and 0 if female. It was expected that male headed households would have better access to resources and would be more likely to produce a surplus and participate in the market (Musah *et al*., 2014).

Education level: Education level was measured as a dummy variable with four categories based on relative levels of literacy. It was hypothesised that farmers who had acquired more than lower primary school education would be more productive and therefore more likely to participate in the market (Sekabira *et al*., 2012).

Mobile phone: Mobile phone ownership was measured as a dummy variable that took a value of 1 if the farmer owned a mobile phone and 0 if they did not. It was hypothesised that farmers who owned mobile phones would be more likely to participate in the market as better off farmers tend to produce more (Tadesse and Bahiigwa, 2015).

Farm size: Farm size was measured in acres as a continuous variable of how much agricultural land the household owned. It was hypothesised that farmers with larger farm

sizes would be more likely to participate in the market as effective use of their farms would allow them to produce more (Osmani and Hossain, 2015).

Yield: Volume produced was measured as a continuous variable of maize yield in kilograms per acre that the household produced in 2015/16. Maize yield was hypothesised to be significantly associated with higher probability of participating in the market as households with higher yield would be more likely to have a surplus for marketing (Musah *et al*., 2014).

Distance to market: Distance to the market was measured as a continuous variable of how far (kilometres) the farmer travelled to sell crop. It was hypothesised that long distance would negatively affect market participation due to cost implications (Maponya *et al*., 2015).

Output price: Output price was measured as average price in Malawi Kwacha (MKW) of maize in the previous season of 2015/16. It was hypothesised that high output price would be an incentive for households to produce and participate in the market (Musah *et al*., 2014).

Subscription to SMS price alerts: Subscription to SMS price alerts was used to measure access to mobile phone-based MIS as the majority of such initiatives in Malawi currently use cellular technology. It was measured as a dummy variable which took 1 if the farmer subscribed to SMS price alerts and 0 if they did not subscribe to the service. It was hypothesised to have a positive influence on farmers' market participation (Tadesse and Bahiigwa, 2015).

Access to marketing extension: Access to extension services was measured as a dummy variable which took 1 if the farmer received extension services related to marketing in the

previous season 2015/16 and 0 if they did not access extension services. It was hypothesised that farmers who receive extension services especially those related to marketing would be more likely to participate in the market (Maponya *et al*., 2015).

Maize variety grown: Crop variety grown was measured as a dummy variable which took 1 if the farmer planted improved varieties of maize in the previous season 2015/16 and 0 if they planted local varieties. It was hypothesised that farmers who planted improved varieties would be more likely to participate in the market and access ICT-based MIS as they would realise higher yield (Osmani and Hossain, 2015).

Purpose of cultivation: Purpose of cultivation was measured as a dummy variable which took 1 if the main purpose of maize production was to ensure food availability and generate a surplus for sale and 0 if the main purpose was solely to ensure food availability. It was hypothesised that farmers who cultivated maize as a food and cash crop would be more likely to participate in the market and use ICT-based MIS (Musah *et al*., 2014).

Cost of using ICT-based MIS: The cost of using ICT-based MIS was measured as a continuous variable of average weekly amount in MKW. It was expected that households which incurred higher costs would be less likely to use ICT-based MIS (Katengeza *et al.*, 2014).

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 Farmers' Socio-economic Characteristics

The socio-economic characteristics of the farmers are presented in Table 2.

Table 2: Socio-economic characteristics of the farmers

Variable name		Frequency	Percent	Chi-square	p-value
Sex	Male	177	89	2.4452	0.118
	Female	22	11		
Age	18-35	64	32	0.081	0.776
	36-59	89	45		
	60+	46	23		
Household head literacy	Yes	178	89	3.9991**	0.046
	No	21	11		
Marital status	Single	4	2	3.3645	0.499
	Married	174	87		
	Widowed	10	5		
	Divorced	11	5.5		
Household owns radio	Yes	90	45	8.0476**	0.005
	No	109	55		
Household owns mobile	Yes	100	50.3	3.9046**	0.048
	No	99	49.7		
Maize yield above 1000kg	Yes	42	21	14.061***	0.000
	No	157	79		
Farm size above 2.50acre	Yes	77	39	14.606***	0.000
	No	122	61		
Where maize sold	Local market	9	5	27.023***	0.000
	Vendor	106	53		
	Main trading centre	17	9		
	Company	36	18		
	Other	31	15		
Condition of road	All season tarmac	36	18	6.149	0.292
	All season dirt	114	57		
	Seasonal dirt	9	5		
	Partially seasonal dirt	6	3		
	Other	34	17		
Subscribe SMS alerts	Yes	21	11	0.132	0.899
	No	178	89		
Marketing extension	Yes	50	25	4.594**	0.032
	No	149	75		
Farmers' group member	Yes	106	53	13.134***	0.000
	No	93	47		

Source: Authors' estimation based on survey data

***, ** p significant at 1% and 5% levels of significance respectively

Cross tabulations of Chi-square analysis were used to determine whether the decision to participate in the maize market or not was significantly associated with socio-economic characteristics of smallholder farmers. As expected, the results indicate that farmers who decide to participate in the market tend to be literate and own ICT devices such as a radio or mobile phone. The positive effect that education and asset endowment has on farmers' market participation has been observed in numerous studies (Osmani and Hossain, 2015; Magesa *et al*., 2014) as relatively better-off smallholder farmers tend to be more productive and hence more likely to produce a surplus to sell in the market. Above average maize yield and farm size are significantly associated with the probability to participate in the market. This was anticipated and it concurs with theory and available evidence that higher yields ensure a marketable surplus (Musah *et al*., 2014). This is particularly true for maize in Malawi, where smallholder farmers only participate in the market if they produced a surplus or are in immediate need for money.

Surprisingly, the use of mobile phone-based MIS is not significantly associated with the probability to participate in the market. This is contrary to findings in Ghana (Courtois and Subervie, 2014) where farmers who subscribed to the ESOKO MIS were more likely to participate in the market. However, similar findings were found in Ethiopia (Tadesse and Bahiigwa, 2015). This is likely due to huge differences in national mobile phone subscription rate between Malawi (37%) and Ghana (113%), and more similar rates with Ethiopia (31%) (Steinfield *et al.*, 2015). Generally, mobile phone-based MIS have weak impact in contexts where mobile penetration is low (Wyche and Steinfield, 2015). In addition, the majority of the farmers sold their crop to vendors which may further explain why access to mobile phone based-MIS is not associated with market participation in Malawi. Vendors move around villages buying crop from individual farmers who cannot afford transportation charges to market their produce in distant markets. These spot

exchanges normally do not allow price negotiations. Consequently, if farmers do not have alternative options for markets, information will not influence their marketing outcomes (Fafchamps and Minten, 2012).

4.2 Comparison of Smallholder Farmers with and Without Subscription to Mobile-phone Based MIS

Mobile phone-based MIS are believed to provide farmers with price information they need to facilitate sale decisions and negotiations with traders (Wyche and Steinfield, 2015). Therefore farmers with access to the existing mobile phone-based MIS were expected to have enhanced bargaining power, receive higher prices, and sell more maize than those without such access (Katengeza *et al*., 2014). To faciliate comparisons the farm size, volume of maize sold, and average price received in the previous season were analysed for farmers who had subcribed to mobile phone-based MIS and those who had not (Table 3).

Table 3: Comparison of farmers with and without subscription to SMS market information alerts

Variable	**Subscription to SMS alerts N = 21**	**Non-Subscription to SMS alerts N = 178**	**T test of differences in mean**		
	Mean	Mean	t-stat	p-value	Mean diff
Maize sold (kg)	336.19	212.58	0.934	0.352	123.606
Farm size (acre)	2.9	2.3	1.741*	0.083	0.671
Maize price (MKW)	76.67	75.51	0.056	0.956	1.161

Source: Authors' estimation based on survey data
***** significant at 10% level of significance
1 USD = MKW726

As expected, farmers who subscribed to SMS market information alerts owned more land for agricultural production. Similar findings were found in Ethiopia (Tadesse and Bahiigwa, 2015). The results indicate that use of mobile phone-based MIS had no significant effect on the price farmers received. While counter intuitive, this is consistent with the current context

in Malawi where the average smallholder farmer sells individually to a vendor and is a price taker, and therefore subscription to market information alone has insignificant effect.

4.3 Determinants of Smallholder Farmers' Maize Market Participation Decisions

The analysis to determine significant determinants of a smallholder farmer's decision to participate in the maize market was estimated using a probit model and the results are presented in Table 4.

Table 4: Estimation of factors influencing smallholder farmer maize market participation

Variables	**Maximum likelihood estimates**			**Marginal effects**		
	Coef.	Rob. Std. Err.	p-value	dy/dx	Rob. Std. Err.	p-value
Distance	0. 015*	0.008	0.054	0.0008*	0.0004	0.066
HHSex	-1.178**	0.428	0.006	-0.065**	0.023	0.007
HHAge	-0.012	0.014	0.412	-0.0006	0.0007	0. 403
Mobilephone	0.698*	0.411	0.089	0.038*	0.023	0.095
Farmsize	-0.033	0.145	0.821	-0.002	0.008	0.822
SMSalerts	0.027	0.383	0.944	0.001	0.020	0.944
Yield	0.0008***	0.0003	0.004	0.0004***	0.0001	0.005
Price	0.027***	0.003	0.000	0.001***	0.0001	0.000
EXTMrktng	0.829**	0.368	0.024	0.045**	0.020	0.026
LogICTMISCost	-0.197*	0.121	0.104	-0.010*	0.006	0.079
LowPrimary	0.123	0.381	0.746	0.006	0.021	0.744
_cons	-2.385	0.865	0.006			

Number of obs = 196
Wald χ^2 (12) = 86.08
Prob > χ^2 = 0.0000
Log pseudolikelihood = - 20.386367
Pseudo R^2 =
0.8453
Hosmer-Lemeshow χ^2 (183) = 53.90 Prob > χ^2 = 1.000

Source: Authors' estimation based on survey data
*******, ******, ***** p significant at 1%, 5%, and 10% levels of significance respectively

Prior to reporting a diagnostic test for multicollinearity was conducted based on VIF. The mean VIF of the model was 2.81 which is below the maximum value of 10 that is used as a

rule of thumb to indicate the presence of extreme multicollinearity (Gujarati, 2004). In addition, the correlation matrix confirmed the absence of severe multicollinearity. The model was estimated with robust standard errors to correct for heteroscedasticity and other misspecification problems as the data used were from a cross-sectional survey (Musah *et al*., 2014).

The chi-squared value of 86.08 which is significant at 1% level of significance implies that overall the model is jointly significant and therefore there is sufficient evidence to suggest that socio-economic and farmer characteristics significantly influence farmers' maize market participation. In addition, the pseudo R^2 of 0.845 suggests that variations in smallholder farmers' market participation decisions can be attributed to the variation in the explanatory variables included in the model. The Hosmer and Lemeshow's goodness-of-fit test was also applied to test if the model fitted well. A good fit as measured by Hosmer and Lemeshow's test should yield a large p-value. As shown above the p-value of the test is 1.00 and therefore implied that the model fitted the data well.

The results indicate that distance to market, yield, price, mobile phone ownership, and access to crop marketing extension services positively and significantly influence the probability of a smallholder farmer participating in the market. The positive influence of all of these variables except for distance was expected based on findings from previous studies (Maponya *et al*., 2015). In most of reviewed studies, distance to the market influenced market participation negatively (Osmani and Hossain, 2015; Musah *et al*., 2014). This may be a result of many farmers incurring little to no transport costs as they sold to vendors close to their homes. The findings suggest that access to crop marketing extension services increases the probability of smallholder farmer market participation by 4.5% other things constant. This implies that in the current context of Malawi, provision of extension services

is ideal in promoting market participation. This is probably due to enhanced agricultural productivity associated with farmers' access to extension services. Mobile phone ownership increases the probability of smallholder farmer market participation by 3.8% other things constant. The finding concurs with previous studies where farmer market participation was associated with asset endowment as relatively wealthy farmers have the capacity to produce more (Tadesse and Bahiigwa, 2015; Musah *et al*., 2014).

Farmers' sex and the cost of using ICT-based MIS negatively and significantly influence the probability of a smallholder farmer participating in the market. Contrary to expectation, the findings suggest that male smallholder farmers have a lower probability of maize market participation (about 6.5% than females) other things constant. This may be a result of men in Malawi focusing on selling tobacco and soybean while women focus mainly on selling other crops such as maize and groundnuts, especially when the household is in need of immediate money.

4.4 Effect of Mobile Phone-based MIS on Smallholder Farmers' Maize Market Participation

A bivariate probit model was employed to analyse the effect of the existing mobile phone-based MIS on smallholder farmers' market participation in Lilongwe. The model was estimated with robust standard errors to correct for heteroscedasticity and other potential misspecification problems since the data used in estimation were from a cross-sectional survey (Musah *et al*., 2014). The variance inflation factor (VIF) was used to test for the presence of extreme multicollinearity. As a rule of thumb, values with VIF greater than 10 are regarded as a signal for the existence of a severe multicollinearity problem in regression models (Gujarati, 2004). The model had a mean VIF of 3.28 and hence indicated that there was no extreme multicollinearity. The estimation results are presented in Table 5.

Table 5: Effect of mobile phone-based MIS on smallholder farmers' maize market participation

Variables	Maximum likelihood estimates for bivariate probit model			Marginal effects for joint probability (p11)		
	Coef.	Std. Err.	p-value	dy/dx	Std. Err.	p-value
MrktPartMz						
HHSex	-1.160**	0.514	0.043	-0.049	0.040	0.228
HHAge	0.003	0.013	0.819	0.0002	0.0006	0.750
Farmsize	0.077	0.128	0.548	0.011	0.008	0.212
Purpose	6.869***	0.583	0.000	0.259***	0.694	0.000
Yield	0.0004*	0.0002	0.054	0.00003**	0.00001	0.046
Distance	0.015**	0.006	0.020	0.0004	0.0004	0.305
Variety	0.402	0.568	0.479	0.025	0.031	0.418
Price	0.020***	0.002	0.000	0.0003	0.00002	0.201
EXTMrktng	0.835*	0.452	0.065	0.069**	0.028	0.013
LowPrimary	-0.579	0.438	0.187	-0.076**	0.037	0.041
_cons	-2.713	1.093	0.013			
SubscribeSMS						
HHSex	-0.175	0.447	0.695			
HHAge	0.002	0.007	0.826			
Farmsize	0.105	0.073	0.153			
Purpose	0.628	0.376	0.095			
Mzyield	0.0002	0.0001	0.097			
Distance	0.0001	0.005	0.990			
Variety	0.169	0.325	0.601			
Mzavgprice	-0.003	0.001	0.067			
EXTMrktng	0.555**	0.268	0.039			
LowPrimary	-0.740**	0.314	0.019			
_cons	-1.736	0.615	0.005			
rho	-0.131	0.386				
Number of obs = 197						
Wald χ^2 (20) = 754.75						
Prob > χ^2 = 0.0000						
Log pseudolikelihood = -83.73658						
Wald test of rho=0: χ^2 (1) = 0.114 Prob > χ^2 = 0.736						

Source: Authors' estimation based on survey data
*******, ******, ***** p significant at 1%, 5%, and 10% levels of significance respectively

As expected, the results indicate that yield and price significantly influence market participation, echoing numerous studies which have established that farmers require surplus to participate in markets (Osmani and Hossain, 2015; Nmadu *et al*., 2013). The results show that farmers who cultivate maize as a food and cash crop are more likely to participate in the market as they tend to produce more. The results also indicate that farmers who are

relatively more educated and who receive marketing extension services are more likely to subscribe to SMS price alerts. This concurs with findings from a recent evaluation of a mobile phone-based information service called M'chikumbe in Malawi. Palmer and Darabian (2017) found that farmers accessed and trusted the service more when AEDOs raised awareness of the MIS.

The marginal effects for the joint probability suggest that relatively more educated farmers who receive marketing related extension services, cultivate maize as a food and cash crop and realise higher yield are more likely to subscribe to SMS price alerts and participate in the market. However, results reveal that there is insufficient evidence to suggest a significant effect of the existing mobile phone-based MIS on smallholder farmers' maize market participation in Lilongwe. The Wald test of rho (ρ) is insignificant implying that the average treatment effect is negligible. Tadesse and Bahiigwa (2015) found similar findings in Ethiopia where mobile phones had weak effect on farmers marketing decisions, and Palmer and Darabian (2017) found that farmers' use of M'chikumbe in Malawi is limited and provision of market price information has not had the predicted effect.

4.5 Findings from Focus Group Discussions

Focus group discussions were conducted in order to qualitatively analyse factors smallholder farmers' in Lilongwe consider in their maize market participation decision. The approach was based on a study by Burrell and Oreglia (2015) who suggested that the notion that information critical to decision making in terms of market participation is scarce and actively sought after by smallholder farmers is a potential misconception that is country and context specific.

While current mobile phone-based MIS in Malawi entail users subscribing to SMS alerts, only 21 (10%) of the sampled farmers used this service whereas 116 (58%) had access to

and used market information through the radio. Furthermore, the majority of farmers preferred the radio as the programs would supplement the price updates with production information and advice on collective marketing. In regards to key factors that farmers considered in their marketing decisions, 50.8% mentioned convenience, 32.7% mentioned price offered, 25.6% mentioned immediate need for money and 12.6% mentioned transport costs. Therefore, indeed, smallholder farmers require price information, but it is not the only or necessarily the most significant determinant of their market participation.

In regards to factors that limit their market participation, farmers reiterated low prices, unreliable markets, and vendors tampered weighing scales as major marketing challenges. However, lack of market information was not highlighted as a challenge in any of the focus group discussions which may be a result of vendors displaying their buying prices in villages. In addition, low prices were equally a challenge for farmers who had access to and used mobile phone-based MIS and those who had no access. Moreover, farmers specified erratic rainfall, pests and diseases, high input prices and erosion that reduced soil fertility as challenges they faced in relation to market participation. This augments the evidence that smallholder farmers' take into consideration their productivity levels when making marketing decisions.

CHAPTER FIVE

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

This study analysed the effect of mobile phone-based MIS on smallholder farmers' maize market participation in Lilongwe rural, Malawi using survey data sourced directly from 196 smallholder farmers. The existing mobile phone-based MIS which entail users subscribing to SMS price alerts have not had a significant effect in promoting smallholder farmer maize market participation. Disseminating AMIS information through a mobile phone-based MIS will indeed address the current lack of timeliness with the AMIS; however it may not immediately promote smallholder farmer market participation. There is insufficient evidence to suggest that the existing mobile phone-based MIS implemented by NGOs influence smallholder farmers' market participation decisions. Knowing prices is different from having the ability to take advantage of this information, and the average Malawian smallholder farmer is often a price taker and lacks transportation to distant markets where prices may be better.

5.2 Recommendations

The findings of this study suggest that channelling government resources towards improving extension services and increasing farmers' productivity are ideal ways to promote smallholder farmers' participation in maize markets. Therefore the study recommends that the government should enhance support to the Department of Agricultural Extension Services in order to strengthen extension services in rural areas by increasing numbers of extension workers and equipping them with adequate resources. The findings further suggest the need to integrate radio and mobile in future designs of agricultural market information services. Consequently the study recommends that mobile phone-based MIS

should provide farmers with information related to agricultural production in addition to market prices.

A pertinent area for further research is to assess how to adapt the existing mobile phone-based MIS initiatives to the context of Malawi so as to bring about significant effect.

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APPENDICES

Appendix 1: Household questionnaire

District Name: _____
EPA: _____ Section: _____
Name of Respondent: _____
Village of Respondent: _____

Name of Enumerator: _____
Date of Survey: _____

SECTION A: HOUSEHOLD SOCIO-DEMOGRAPHIC CHARACTERISTICS

No.	**Name of household member**	**Age**	**Sex** 1= Female 0= Male	**Level of education** 1= None 2= Std 1-5 3= Std 6-8 4= JCE 5=MSCE 6= Tertiary 7= Adult literacy	**Marital status** 1= Single 2= Married 3= Cohabiting 4= Divorced 5= Widowed 6= Separated	**Main occupation** 1= Farming 2= Formal employment 3= School going 4= Unemployed 5= Petty trading 6= Ganyu 7= Small business 8 = None	**Relation to household head** 1= Head 2= Spouse 3= Child 4= Other	**Own working mobile phone** 1= Yes 0= No
1								
2								
3								
4								
5								
6								

SECTION B: HOUSEHOLD AND FARM ASSETS

B1: Asset name	**B2: Number owned**
1. Chair	
2. Table	
3. Hoe	
4. Axe	
5. Panga knife	
6. Shovel	
7. Wheel barrow	
8. Ox-cart	
9. Tractor	
10. Chemical sprayer	
11. Plough	
12. Water can for irrigation	
13. Irrigation treadle pump	
14. Bicycle	
15. Radio	
16. Sofa set	
17. Solar panels	
18. Motor bike	
19. Car	
20. Other ……	

B3: What is the total land owned by the household for agricultural production?
_____Acres

B4: How much land was leased or borrowed for agricultural production, if any?
_____Acres

B5: Income	**Does the household get income from this source?** 1= Yes 2= No	**If yes, how much income was obtained from this source in 2015/2016 (MK)**
Crop production sales		
Livestock production sales		
Formal permanent employment		
Casual agricultural labour (ganyu)		
Semi-skilled contract work		
Pension		
Gifts/Remittances		
Small scale Business/IGAs		
Land rentals		
Others (specify).....		
		Total income:

SECTION C: CROP PRODUCTION DETAILS FOR PREVIOUS SEASON

C1: Crop grown (Use *CROP CODE*)	**C2: Land size cultivated for crop (Acres)**	**C3: Crop variety grown** 1= Improved 0= Local	**C6: Crop output quantity (Kg)**	**C7: Main reason for crop production** 1= Food 2= Cash 3= Food and cash 4= Other	**C8: Crop Quantity sold (Kg)**	**C7: Average crop unit price (MK/Kg)**

C9: Was the production of the main cash crop adversely affected by environmental factors? _____ (1 = Yes; 0= N0)

C10: Which of these environmental factors adversely affected production of the main cash crop? (Tick all that are applicable)

1= Too much/little rain ☐
2= Erratic rainfall ☐
3= Pests ☐
4= Diseases ☐
5= Other ……☐

SECTION D: MARKET PARTICIPATION

D1: Did you sell any of the crop that you produced last season? _____ (1= Yes; 0= No)

D2: If you did not sell any crop, what was the reason? (Tick all that are applicable then move to **section E**)

1= Did not produce a surplus ☐
2= There was no reliable market ☐
3= The prices were too low ☐
4= Other …… ☐

D3: Main crop sold (Use *CROP CODE*)	**D4: Where crop was sold** 1= Local market 2= Vendor 3= Main trading centre 4= Private trader 5= Company	**D5: Distance of market from household (km)**	**D6: Condition of road to market** 1= All season car accessible tarmac 2= All season car accessible dirt road 3= Seasonal car accessible dirt road 4= Partially seasonal car accessible dirt road 5= Non-accessible by car 6= Other	**D7: Transport cost to market (MKW)**

(12minutes walk = Approximately 1km in distance)

D9: What are the three main factors you consider in your decision to participate in the market?

1= Transport costs ☐
2= Convenience ☐
3= Established relationships ☐
4= Price offered ☐

5= Immediate need for money ☐
6= Other …….. ☐

D10: What are the main challenges faced with participating in the market, if any?

1= Low prices offered ☐
2= Unreliable markets ☐
3= Market too far ☐
4= Vendors tampered scale ☐
5= Strict product quality control ☐
6= Other ……. ☐

SECTION E: ACCESS TO ICT-BASED MARKET INFORMATION SERVICES

E1: Do you have access to market information? _____ (1= Yes; 0= No)

E2: What are the sources of market information? (Tick all that are applicable)

1= Neighbours/friends ☐
2= Traders ☐
3= Extension officers/bulletins ☐
4= Other ……. ☐

E3: Do you have access to market information using ICT devices such as radio or mobile phones? _____ (1= Yes; 0= No) (If "No" move to **section F**)

E4: How do you access the market information using the ICT devices?

1= Call fellow farmers ☐
2= Call traders ☐
3= Call extension officers ☐
4= Subscribe to SMS alerts ☐
5= Listen to the radio ☐
6= Other …….. ☐

E4: For which crops do you normally use ICT devices to source market information? List three main crops in order of importance (Use *CROP CODE*)

1_____
2 _____
3 _____

E5: ICT-Based MIS	**E6: Weekly usage for market information (days)**	**E7: Average cost per usage (MKW)**	**E8: Main information obtained** 1= Commodity prices 2= Average nominal prices reported 3= Input prices (seeds, chemicals, fertiliser) 4= Exchange rates 5= Other
Radio program			
Mobile phone			
Television			

E9: Which is the most reliable ICT tool to access market information?

1= Radio ☐
2= Mobile phone ☐
3= Television ☐
4= Other …….. ☐

E10: Why is this the most reliable ICT tool?

1= It is convenient to access anytime and anywhere ☐
2= It is cheap to access ☐
3= The information is timely and reliable ☐
4= Illiterate farmers can also access the information ☐
5= Does not require a telecommunication network to operate ☐
6= Other …… ☐

E11: What are the three main challenges you face in accessing and using ICT-based market information services, if any?

1= Ownership of functioning ICT tool required to access the services ☐
2= Cost of charging mobile phones ☐
3= Unable to send/open text messages ☐
4= Difficult to verify validity of market information ☐
5= Too little crop volume available for sale ☐
6= Other …… ☐

SECTION F: ACCESS TO EXTENSION SERVICES AND MEMBERSHIP IN FARMER GROUPS

F1: Do you have access to extension services? _____ (1= Yes; 0= No)

F2: If yes, who is the source or provider of the extension services? (Tick all that are applicable)

1= Government AEDO ☐
2= NGO Extension Officer ☐
3= Tobacco Company Officer ☐
4= Other ☐

F3: On average how many times did you interact with the extension officers in the previous production season?

1= Once a week ☐
2= Twice a week ☐
3= Once a month ☐
4= Twice a month ☐
5= Once in three months ☐
6= Other ☐

F4: What was the main area that you received extension services on?

1= Agricultural production ☐
2= Agricultural marketing ☐
3= Community and Health ☐

4= Forestry and conservation ☐
5= Other ☐

F5: Are you a member of any farmer's group or association? _____ (1= Yes; 0= No)
F6: What is the name of the farmer's group or association?
_____
F7: How many years have you been a member of the group or association? _____ years
F8: Is crop marketing a major purpose of the farmer's group or association? ____(1= Yes; 0= No)
F9: Do you receive market information from the farmer's group? _____(1= Yes; 0= No)

THANK YOU FOR YOUR TIME