FARMERS' USE OF MOBILE PHONE TECHNOLOGY FOR AGRICULTURAL INFORMATION SERVICES IN LILONGWE DISTRICT, MALAWI

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When I received a “no” on my first admission attempt into Purdue University, it seemed that all the doors were closed. Darling, you were so right that ‘many more doors were opened.’ In disbelief, I was given a second chance as a proof to your point. This thesis is dedicated to you my dear wife, Chrissy Chisama, and to my little daughters, Esther and Ellen Chisama. I am greatly indebted to you for the sacrifices you made which enabled me to study abroad for a year when you needed me most. Your recognition of the importance of the value to our family of my advanced study and your endurance throughout the entire year to make it happen was dearly appreciated. Chrissy, I am very thankful for your encouragement during my entire study period. I fall short of words for your big heart, taking care of our kids and my mum while I was busy studying. My song compositions, cannot fully explain how much I appreciate your love. To my beautiful daughters, I know you have brighter futures and I am glad you are working hard towards the right path. May God richly bless you, my sweeties.

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PERSONAL REFLECTION

The results of this study will support further efforts to develop innovative agricultural extension systems in Malawi's Lilongwe district and beyond. The evidence provided by the farmers will facilitate appropriate changes in Malawi's mobile agricultural information services. These results of this study should be disseminated to all who have a stake in mobile phone-based extension and rural development initiatives. A couple of simple questions from my experience were: 'are farmers with mobile phone accessing mobile agricultural information services; and can we say that they have already surpassed information asymmetry challenges and the digital-divide age?' Farmers with these gadgets might have a very special tool for accessing mobile agricultural information services and additional mobile services. Through the literature review process, I learned a lot on how our colleagues in East and West Africa as well as East Asia embraced mobile phone-based extension services. The research studies, whether basic in nature or complex modeling studies, provided a diversity of conceptual and theoretical frameworks. Prior to this study, I would not have predicted that farmers needed and valued an integrated approach to mobile agricultural information services with additional interactivity for their use and gratification. Nor would I have recommended enhancing extension programming to increase farmers' awareness and knowledge on mobile agricultural information services (MAIS). The discussion for future research areas would not have been possible without the hard and soft evidence obtained through this study. My new role now is to disseminate these results further and advocate for integrated MAIS.

ACRONYMS

ADMARC	Agricultural Development and Marketing Corporation
AEDC	Agricultural Extension Development Coordinator
AEDO	Agricultural Extension Development Officer
AHL	Action Holdings limited
APA	American Psychological Association
ARET	Agricultural Research and Extension Trust
ATCC	Agricultural Technology Clearing Committee
CADECOM	Catholic Development Commission of Malawi
CBO	Community Based Organization
CDs	Compact Disks
CITI	Collaborative Institutional Training Initiative
DAES	Department of Agricultural Extension Services
DAHL	Department of Animal Health and Livestock Development
DAO	District Agricultural Office
DAPS	Department of Agricultural Planning Services
DARS	Department of Agricultural Research Services
DCD	Department of Crop Development
DFAD	Department of Fisheries and Aquaculture Development
DoI	Department of Irrigation
Dr.	Doctorate of Philosophy
DVDs	Digital Versatile Discs
EPAs	Extension Planning Areas
FAO	Food and Agriculture Organization

FM	Frequency Modulation
GoM	Government of Malawi
ICRISAT	International Crops Research Institute for Semi-Arid Tropics
ICT	Information and Communication Technologies
ICT4D	Information and Communication Technology for Development
IFPRI	International Food Policy Research Institute
IRB	Institutional Review Board
ITU	International Telecommunication Union
IWMI	International Water Management Institute
IVR	Integrated Voice Response
GDP	Gross Domestic Product
GVH	Group Village Headman
LRCD	Land Resources Conservation Department
LUANAR	Lilongwe University of Agriculture and Natural Resources
M	Mean
MACE	Malawi's Agricultural Commodity Exchange
MACRA	Malawi Communications Regulatory Authority
MAIS	Mobile Agricultural Information Services
MF	Mobile Farmer
MIRC	Malawi Industrial Research Council
MIS	Mobile Information Services
MK	Malawi Kwacha
MNSP	Mobile Network Service Providers

MMS	Multimedia Messaging Service
MTL	Malawi Telecommunications Limited
MoAIWD	Ministry of Agriculture Irrigation and Water Development
M4D	Mobile Phone Technology for Development
NACDC-ICT	Nation Agricultural Content Development Committee for ICTs in Malawi
NARS	National Agricultural Research System
NASFAM	National Smallholder Farmers' Association of Malawi
NGOs	Non-Governmental Organizations
NSO	National Statistics Office
PDA	Personal Digital Assistant
PPP	Public Private Partnerships
SD	Standard Deviation
SIM	Subscriber Identity Module
SMS	Short Message Service
SMSs	Subject Matter Specialists
SSA	Sub-Saharan Africa
TA	Traditional Authority
TAMA	Tobacco Association of Malawi
TV	Television
TNM	Telecom Networks of Malawi
UILTCB	USAID Initiative for Long-term Training and Capacity Building
USAID	United States Agency for International Development
VDC	Village Development Committee
VH	Village Headman

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ABSTRACT

Chisama, Benjamin, F., Purdue University, August 2016. Farmers' use of mobile phone technology for agricultural information services in Lilongwe District, Malawi. Co-Advisors: Roger Tormoehlen and Neil Knobloch.

Mobile phone technology can be a useful tool to provide farmers with relevant and reliable agricultural information for critical farming decisions in developing countries such as Malawi. An increasing number of rural farmers have been faced with information asymmetry challenges due to some pitfalls in the extension systems. In addition, knowledge gaps on farmers' use of mobile phone technology; their awareness and use of MAIS; and their preferred topics to be delivered using mobile platforms were identified. However, little was known on how farmers were using existing MAIS. This study's aim was to explore the potential of providing mobile agricultural information services to farmers in Malawi's Lilongwe District. The mixed research modes was used to capture information from 291 participants using a structured questionnaire. Data analysis was done using descriptive statistics in SPSS (Version 16) and thematic analysis. The study's findings showed that only 14% of farmer participants were aware of MAIS, with only 12% and 6% using IVR and SMS services, respectively. The farmers expressed a strong desire for an integrated MAIS system with additional interactive approaches incorporated into existing extension programs. It was concluded that farmers were quite a bit motivated and optimistic to use MAIS with nearly half indicating willingness to pay for voice call and SMS text services. As per farmer's perceptions on values of MAIS, it was recommended for service providers to increase awareness and seek farmers' inputs on various topics.

Keywords: Mobile phone, agricultural information, advisory services, mobile agricultural information services, Information and Communication Technology.

CHAPTER 1: INTRODUCTION

1.1 Background of the Study

Mobile phone technology can be a useful tool to provide farmers with access to relevant and reliable agricultural information for making critical farming decisions. Over the past decade, mobile phone technology has emerged as the primary form of electronic communication and information dissemination channels even in the rural areas of developing countries such as Malawi (Tenhunen, 2008). According to data compilation by the International Telecommunication Union (ITU; 2014), mobile phone penetration in the developing world has reached about 97%, Africa was reported to have 69% and Sub-Saharan Africa (SSA) region was estimated at 52%. SSA was predicted to reach 79-90 % by 2020 **(**ITU, 2014; AMGOO Marketing Team, 2015). It was also noted, that the majority of the rural population used mobile phones to access agricultural information (Duncombe, 2012; Aker, 2011). The results of a study conducted by the Malawi Communications Regulatory Authority in 2014, indicated that 85 of 100 inhabitants were reported to have a mobile phone in the country and out of total rural population constitute 42%. Analysis of the statistics on mobile phone subscription for two years there is a 31% increase in the number of rural people with a mobile phone in Malawi. It was clear that use of mobile phones has changed significantly the landscape of information dissemination in many disciplines propelling rural development including agriculture, health, education, and banking (Chhachhar & Hassan, 2013). It was therefore, important to understand how farmers with mobile phones use the technology to access agricultural information services in Malawi's context.

In Malawi, agricultural information dissemination had been largely done through face-to-face or interpersonal communication using the agricultural extension and advisory systems. Like

most Sub-Saharan African (SSA) countries, Malawi's agricultural extension system has been overwhelmed with the diverse information needs of farmers (Davis, 2008; Oladele, 2011). Most rural farmers still remain largely dispersed in wider geographic locations and depend on interpersonal exchange of agricultural information disseminated by agricultural extension officers (Cole & Fernando, 2012). In addition, farmers face barriers to obtaining agricultural information due to limited access to radio, television, newspapers and landlines (Aker, 2011). According to Cole & Fernando (2012), limited resources prevent the rural extension system from delivering information beyond the targeted easy-to-reach or resource advantage farmers. In most studies, the lack of information by the farmers affects agricultural productivity and economic development negatively because they make uninformed decisions (Molony, 2006). This implied that there has been persistent challenges of information symmetry because most farmers failed to access timely, consistent and actionable agricultural information services (Aker, 2011; Duncombe, 2012; Baumüller, 2012). On the other hand, Information and Communication Technologies (ICT) such as mobile phone technology have been viewed as an innovative way to reduce the disparities in extension services provision and speed up rural development.

Of late, the proliferation of mobile agricultural information services has been noted in most developing countries (Duncombe, 2012). The services ranged from SMS text message-based, voice-based, integrated text to voice systems, help lines, market information sharing platforms and other services (Donovan, 2011). Usually, farmers with mobile phones willingly subscribe to such services and therefore access push-based information (FAO, 2013). Most previous studies focused on the economic impact of mobile phone technology and the established Marketing Information System (MIS) in rural areas of developing countries (Katengaza, 2012; Aker, 2011; Muto & Yamano, 2009). A study by Duncombe (2012)

indicated that, there was a requirement to understand the needs of the farmers and their context before implementing MAIS. These results have drawn a wider view to understanding the research aspects so far conducted on farmers' use of mobile phone technology. Among them was a need to conduct context-specific studies on how farmers were accessing mobile agricultural information services. An exploratory study was conceived to gain a greater understanding of how farmers were currently using mobile phones and how they foresee them being used in the future to access agricultural information in the Lilongwe district. The next section covers the importance of agriculture in Malawi as a background context for this study.

1.2 Information about Malawi

Malawi is one of the top-five least developed countries located in the southeast part of Africa. The country has an area of over 118,000 km^2 that includes land and several water bodies. It shares borders with Zambia to the west, Mozambique to the south and Tanzania to the north. It is geographically divided into three parts namely: southern region, which covers 3,176 km^2, central region that covers 3,559 km^2, and northern region which covers 2,690 km^2. The regions are further sub-divided into 28 districts (Appendix C, Figure 4). Lilongwe is in central part of the country.

Malawi had an estimated population of 14 million (NSO, 2008), and is regarded as one of the most densely populated countries in Sub-Saharan Africa with 46 people/ km^2 (FAO, 2006). Eighty (80) percent of the total population lives in rural areas where they are directly or indirectly involved in agriculture (GoM, 2009). Smallholder farming is the primary occupation, and provides food and income for most rural dwellers.

1.3 Importance of Agriculture in Malawi

Agriculture is very important to Malawi because it is the mainstay of the economy, contributing about 40% of its gross domestic product (GDP), 90% of its export earnings, and employing 85% of the population (GoM, 2009). The agricultural sector is sub-divided into smallholder and estate farming sub-sectors. Smallholder farming still produces 90% of the food crops, although a decrease in land holding size from 0.8 to 1.53 ha per household has occurred (Chirwa, Kumwenda, Jumbe, Chilonda, & Minde, 2008). The estate sector is oriented towards cash crops such as tobacco, maize, tea, sugarcane for export markets and commercial livestock production operations. The majority of the smallholder farmers are involved with crop production. Some smallholder farmers integrate small-scale livestock production alongside their crop operation and a few solely depend on livestock production. Crop production accounts for 74% of the rural income (Chirwa et al., 2008). Smallholder farmers grow crops such as maize, rice, sorghum, millet, groundnuts, soybeans, pigeon pea, cowpeas, sweet potato, cassava, and common beans for food with the excess sold to provide cash to the family (Masambuka-Kanchewa, 2013). Maize is the main food crop, and is grown by 90% of the smallholder farmers (Chirwa et al., 2008). The smallholder farmers grow cash crops such as tobacco, tea, cotton, sugarcane, banana, coffee and chilies, which are sold locally or exported through farmer associations (GoM, 2009). Livestock production contributes 20% to the total agricultural production (Chimera, Gondwe, & Mgomezulu, 2008). Farmers raise dairy cattle, beef cattle, poultry, pigs, goats, sheep and other small ruminants for their source of protein and to supply domestic market demands.

While the number of smallholder farmers has increased, the level of productivity has not increased and remains quite low. Smallholder farmers faces a number of challenges, including lack of agricultural information on productivity, input and output markets, and financial services (Katengeza, 2012). According to Cole & Fernando (2012), the root causes of the problem are spatial dimension, temporal dimension, and institutional rigidities within the agricultural extension system. Further complicating the issue is that most farmers are marginalized from accessing agricultural information due to failure of the extension systems to reach them using traditional in-person communication methodologies. Facing the dilemma of limited credible information, farmers resort to getting information from local available information sources including family, friends and colleagues, who provide inconsistent information and experiences (FAO, 2013). New extension innovations incorporate the use of Information and Communication Technologies (ICTs) such as mobile phone to improve agricultural information services delivery. However, the reviewed literature indicated that most research has been focused on the supply side of agricultural information (Duncombe, 2012). In that regards, there is little documentation on the demands from the farmers' side for mobile phone-based agricultural information services in Malawi. This research study was conducted to understand farmers' use of mobile technology, their mobile agricultural information needs, and their motivations to use mobile agricultural information services in Malawi's, Lilongwe District.

1.4 Statement of the Research Problem

The smallholder farmers have diverse agricultural information needs that can be provided through mobile phones to assist them in decision-making. As discussed in the introduction sub-section, the number of farmers using mobile phone has increased and the issue of information

asymmetry still exists among them. However, the issues of 'digital divide' in terms of the individual's basic skills (literacy or digital skills), motivation values and use of information accessed through mobile phone were overlooked in past studies conducted in most developing countries. Globally, farmers' information needs falls in three broad categories, which are production system management, market access, and financial inclusion (Vodafone, 2011). In respect to Malawi, similar gaps were noted in studies conducted on the effectiveness of Mobile Market Information Systems (MIS) where farmers demanded more agricultural advisory information (Katengeza, 2012; Simuja, 2012). This implies that little has been done to understand the farmers' mobile information needs, the farmers' desire to be engaged with the MAIS providers in developing content, and application tools.

There was limited documentation of farmers' motivations to use mobile agricultural information services (MAIS). However, it was important to get their perspectives on appropriate information to match with their motivations and intentions of MAIS providers. Therefore, understanding these motivations and the use of mobile agricultural information services would contribute to the body of existing knowledge with farmer-centered MAIS orientation.

1.5 Significance of the Study

This study was significant for four main reasons: 1) contributes to a body of knowledge on innovative agricultural extension services, and therefore, potentially improving the quality of mobile agricultural information services; 2) provides insights to various institutions providing agricultural information to farmers for improved productivity and increased income; 3) enables mobile network service providers and other key players in the mobile industry to improve their

service packages on agriculture; and, 4) informs the research and policy institutions in making decisions on innovative extension systems.

First, the study contributes to a body of knowledge on innovative agricultural extension services from the perspectives of farmers with access to mobile phone technology. Mobile agricultural information services are a relatively new field in Malawi and therefore it was important to explore various mobile technologies, already being used by farmers. Results from the study can also assist to inform on how to address the farmers' information needs within traditional extension system. This study offers an opportunity to learn from farmers concerning their motivation, resources and capabilities to use context-specific or generalized information from the extension service providers.

Second, provide justification for the various institutions that provide mobile agricultural information services to incorporate the farmers' informational needs in their programs and therefore improve agricultural productivity and increase incomes. It was therefore, important to conduct this study to explore how to deal with the challenge of information asymmetry within agricultural extension systems that limit agricultural productivity and rural development.

Third, information from the study will enable mobile network operators and other key players in the mobile industry improve their services packages for agricultural development. The industry has the capability to improve customer care that includes reliable mobile networks, affordable mobile services and scalability of mobile agricultural information services capacities at local and national levels.

Finally, various research and policy institutions in their decision-making processes may use the findings from the study including government institutions, non-governmental organizations and private sector groups (i.e. mobile network operators, marketers, and

producers). Incorporating mobile agricultural information programs will assist farmers to achieve appropriate productivity levels. Agricultural Extension policy advocates for pluralistic and demand-driven service provision (GoM, 2002). Currently, the Malawi Communications Regulatory Authority was legislated under the Malawi's Communications Act of 2005 regulates information and communication technologies (ICTs).

1.6 Purpose of the Study

The purpose of this needs assessment study was to identify the potential for using mobile technology to provide agricultural information and advisory services to farmers in Lilongwe District of Malawi.

1.7 Research Questions

The research questions guiding this study were:

1. What types of mobile phone were the farmers using and to what extent did they use the technology?
2. Were the farmers aware of mobile agricultural information services and to what extent do they use them with additional mobile services?
3. What were the farmer participants' motivations and optimism to use mobile agricultural information services?
4. What were the farmers' preferred agricultural information (topics, channels and sources) and willingness to pay for mobile agricultural information services?

5. What were the key challenges, suggestions for improvement and opportunities for farmers to access mobile agricultural information services?

1.8 Delimitations of the Study

The results of the study may be limited due to some external validity threats. The study was conducted in two of the 19 Extension Planning Areas (EPAs). Within the two selected EPAs, there were additional farmers with mobile phone who were not included in the survey. However, the study managed to identify a large sample frame of about 80%, which necessitated the need to increase sample size for subsets that were included in the study. The subset multistage random selected reduced the potential for unbiased conclusions.

Because ubiquity of the mobile phone is a relatively new concept in most rural areas, high illiteracy levels, lack of digital skills, and lack of awareness on existing developments (Aker, 2011) may affect the topics of discussion. A deliberate question was included to check the literacy capabilities of individual respondents who claimed the ability to read and write if they received SMS text messages. The instruments were pre-tested and reviewed by extension experts to increase instrument reliability. Due to low literacy levels, some farmers struggled to articulate their issues and new needs, which made it difficult to reach any conclusions on specific individual cases with few responses. However, they provided a general picture that was triangulated by the key informants (extension officers) who were contacted later for more clarity.

This cross sectional survey did not exhaust all the farmers' agricultural information needs since they were numerous. This study focused on farmers with mobile phones, their digital skills, and their motivation to access the mobile agricultural information services. It was noted that mobile phone-based information services are dynamic so the farmer's access might change with

time and advancements in mobile technology. It was therefore important to note that a cross-section survey was use to explore the recent developments on MAIS.

Lastly, the survey methodology employed lacked the ability to gain more in-depth information on farmers' use of mobile phone technology to access agricultural information. However, a mixed method design was used to capture quantitative and qualitative responses, triangulated by information from key informants before drawing conclusions of the study. Three experts on the thesis committee assessed the internal validity of the results before and after data collection.

1.9 Assumptions of the Study

This study had five main underlying assumptions to guide the understanding on how farmers were interfacing with mobile phones technology for mobile agricultural information services:

- Mobile phones were a household asset and could be accessed by household members especially heads of the family who were supposed to access agricultural information.
- Mobile phone technology offered an opportunity for all farmers with an appropriate phone to demand and get agricultural information services ranging from productivity, input and output markets, finances, to risk or uncertainty management.
- Farmers had access to mobile phone available alternative sources of agricultural information and preferred channel (e.g. radio, TV and printed materials).

- The farmer participants possessed different capacity levels to use mobile phone-based communications media such voice calling, SMS text messaging and other applications for agricultural information services.
- The mobile agricultural information service providers had various information and communication technology (ICT) tools at their disposal to disseminate agricultural information.

1.10 Definition of Terms

The following terms were defined and contextualized for used in this study.

- *Agricultural Extension Services:* Refers to all activities that include information, technical skills, and new technologies offered by various agricultural organizations to support the efforts of the farmers and other players to solve their own problems (Babu, Glendenning, Asenso-Okyere, & Govindarajan, 2012). Its main goal is to assist in promoting the use of scientific knowledge and therefore increase productivity or income to improve rural livelihoods. In this study, agricultural extension services means all the various approaches and methodologies used to deliver agricultural information and new knowledge on farming techniques to farmers.
- *'Digital divide':* Digital divide refers to a popular concept where the advancements in communication and information technology creates a gaps or inequalities on those who have and do not have access to technology, as well as inequalities on capabilities and outcomes of using the information (Wei, Toe, Chan, & Tan, 2011). In this study, the concept was operationalized to cater for farmer who had mobile phone and do not have

the capacity to access mobile agricultural information services in existing extension systems for their benefits due to various challenges.

- *Participant farmers:* For this study, it included smallholder farmers, individuals who were small-scale rural producers with various land holding size, producing crops and livestock and possessing mobile phones for their communications. In this study, the term participant farmers was used interchangeably with respondents throughout the context since it only focused on farmers with mobile phones.

- *Information and Communication Technologies (ICTs):* Indicates a wide-range of software applications, network infrastructures and communication media that aided information acquisition, processing, storage, retrieval and dissemination among linked computer devices at both local and global levels (Zahedi & Zahedi, 2012; Russell & Steele, 2013). In the case of Malawi, radio and mobile phones are the most common type of ICT used in typical rural areas. In this study, the term ICT is used to identify other ICTs devices including mobile phones, which are already subject matter of this study.

- *Mobile agricultural information services (MAIS):* These were referred to as a series of activities to produce agricultural-related information and dissemination efforts through mobile phone platforms. MAIS characteristics were also referred to as intangibility, inseparability of production and consumption, potential variability, perishability and lack of ownership (Mathiassen & Sorensen, 2008). In this study MAIS was referred to as the key product of mobile services that have been directed towards agricultural productivity, weather information, market prices, agro-processing and other messages that enhances farmers rural livelihoods through the extension systems (FAO, 2012).

- *Mobile phone:* An electronic device that is used for voice communication and exchange of data through SMS text messages, audios and videos over a network with other mobile phone and computer devices.

- *Motivation:* In this study, the term “motivation” is used to represent farmer participants’ opinions on sources of their inner drive to access agricultural information perceived useful for future agricultural activities that could affect their rural livelihoods.

- *Sections:* A physically demarcated area designated for extension officers to operate within and generally considered to have two or more blocks of farming communities. In this study, the term “section” is used to refer to extension services delivery in a particular block of an Extension Planning Area.

CHAPTER 2: REVIEW OF THE LITERATURE

2.1 Introduction

This chapter provides an overview of previous research studies, academic books, workshop proceedings and credible online sources to understand further the topics that were investigated. The chapter provides a review of the literature on various topics as follows: (1) agricultural information; (2) agricultural information generation and dissemination in Malawi; (3) mobile agricultural information services; (4) farmers' agricultural information needs and additional mobile services; and, (5) theoretical/conceptual frameworks. In addition, the chapter discusses the analysis of the recent past research related to the study.

2.2 Study Focus

The study assessed the potential for using mobile technology to provide agricultural information and advisory services to farmers in Lilongwe District of Malawi. The five research questions covered farmers' use of mobile technology, awareness and use of MAIS, information needs, challenges and opportunities for MAIS.

2.3 Literature Review Methodology

The study was informed by literature sources across several academic disciplines, using various search methods. References were identified using the Purdue University e-Journal Database, Purdue University Catalogue, Google Scholar and Google Search. The search terms used were "mobile phone," "mobile agricultural information services," "agricultural information," "agricultural extension services," "farmers' agricultural information needs," "agricultural information generation and dissemination," "digital divide concept," "expectancy

values of motivation," and "use and gratification theory." The analysis of literature also included some important documents from the Malawi Government, institutional reports and general information from the 'Open Sources' libraries. This was done to understand the context of similar studies, identify the research gaps in the existing body of knowledge, and to compare or conclude on the findings of this study. The citations were made using the APA style as required faculty of Agriculture Education at Purdue University.

2.4 Agricultural Information

2.4.1 Agricultural Information

Agricultural information is a loaded term that is extensively used without any description by most studies reviewed (Mittal & Mehar, 2013; Egbule, Agwu, & Uzokwe, 2014; Kashem, 2010). It combines two broad terms; "information" which is defined as an aspect that one notices or differences in the pattern of reality within your environment or oneself that can be processed into data to enhance knowledge (Case, 2012; Prihandoyo, Muljono, & Susanto, 2014); and "agriculture" which can be contextualized in various disciplines. Agriculture is an increasingly information and knowledge intensive sector that involves many new emerging and complexing issues such as climate change, variations on market input prices, and loss of biodiversity that impact rural livelihoods (FAO, 2012). Agricultural information accounts for internal and external differences in farmers' knowledge and perceptions on adoption of agricultural technologies and relevant ideas to help them improved productivity as well as their rural livelihood (Case, 2012; FAO, 2012). Numerous studies indicated that (agricultural) information is associated with various behaviors such as information needs, seeking, and practices disseminated by information sources in a particular information systems (Case, 2012; Prihandoyo et al., 2014). Several

authors recommended that future information studies should focus on the information end-users because they are also finders and interpreters, and hence drivers of information systems (Case, 2012; FAO, 2012). It was, therefore, important to focus this study on the farmers with mobile phones who were highly regarded as the end users of mobile agricultural information services or additional mobile services.

2.4.2 Agricultural Information Generation and Dissemination in Malawi

Agricultural technologies and information have been developed and dissemination by various agricultural research institutions, local or international universities, and extension organizations operating in Malawi. The research institutions of agricultural generating technologies is done by the Department of Agricultural Research Services (DARS), Agricultural Research and Extension Trust (ARET), Lilongwe University of Agriculture and Natural Resources (LUANAR), international research institutions, Malawi Institute for Industrial Research, and private companies and consultants (Mviha, Mtukuso, Banda, & Chisama, 2011). The authors also noted that the Agricultural Technology Clearing Committee (ATCC) approves all agricultural technologies and information generated by institutions in the National Agricultural Research Systems (NARS) for release. This national committee oversees the scientific processes in the development of technology and its appropriateness for deployment with the end-users in Malawi's agricultural sector. Various extension service providers formally disseminate the approved technologies and information generated by National Agricultural Research System (NARS; Mviha et al., 2011).

On the other hand, Malawi's agricultural extension system has been disseminating agricultural information and knowledge using a pluralistic approach that is demand-driven as

stipulated by national agricultural extension policy (GoM, 2002). According to Masangano & Mtinda (2012), there were 37 institutions providing extension and advisory services across the country. The Department of Agricultural Extension Services (DAES) under the Ministry of Agriculture, Irrigation and Water Development has been the major extension service provider with 98 percent of the field staff in the 28 districts (Masangano & Mtinda, 2012). The authors further clarified that the other institutions disseminating agricultural information and knowledge were universities, non-governmental organizations (NGOs), agro-dealers, multilateral organizations, private-sector organizations, parastatal organizations, cooperatives, associations, and farmers' organizations (Masangano & Mtinda, 2012; Masambuka-Kanchewa, 2013). The ministerial departments such as the Department of Agricultural Research Services (DARS); Department of Crop Development (DCD); Department of Animal Health and Livestock Development (DAHLD); Land Resources Conservation Department (LRCD); Department of Fisheries and Aquaculture Development (DFAD); Department of Agricultural Planning Services (DAPS); and Department of Irrigation (DoI), provide technical support to increase the effectiveness of the existing extension systems (Masambuka-Kanchewa, 2013). Apart from public institutions, non-governmental organizations, private companies, universities, international organizations and farmers' associations offers formal agricultural information and technologies dissemination pathways. In this regards, DAES has been coordinating and collaborating with research as well as all other extension providers to reach out effectively to farming communities.

In Malawi, the public agricultural extension system is organized into eight Agricultural Development Divisions (ADDs) which are further subdivided into 800 Extension Planning Areas (EPA) which are managed by the 28 Districts Agricultural Offices (Masangano & Mtinda, 2012).

The authors indicated that extension services are provided to farmers through Agricultural Extension Development Officers (AEDO) working in several villages also called 'Sections' and coordinated by Agricultural Extension Development Coordinators (AEDCs) at the EPA level. Within each district, Subject Matter Specialist (SMS) such as Extension Methodology Officers, Communications Officers, Crops Officers, and Livestock experts support them. Recent developments also advocate for a lead farmers' (farmer to farmer) approach in delivering specific agricultural technologies (Masambuka-Kanchewa, 2013). This was done to close the gaps between extension officers and farmers which was at a ratio of 1:2500 instead of the recommended 1:750 due to limited staff (Tegha, 2014).

2.4.3 Challenges on Agricultural Information Dissemination in Malawi

Malawi like most SSA countries, disseminate agricultural information primarily using face-to-face communication strategies (Masambuka-Kanchewa, 2013). The other modes of communication used were Information Communication Technologies (ICT) such as television, radio, newspapers, and landlines (Katengeza, 2012; Davis, 2008). The innovative agricultural information dissemination strategies used by agricultural extension include the use of new ICTs such as Internet connected computers, mobile phones, and information sharing platforms (Davis, 2008). However, the agricultural extension system faces some challenges with the dissemination of agricultural information. These include: 1) limited funding; 2) failure to implement policy regarding timely information delivery; 3) weak linkage between research-universities-extension-farmers; 4) limited staff; and, 5) low motivated field staff (Aker, 2011; Aker & Mbiti, 2010; Oladele, Lepetu, Subair, & Obuh, 2009; Anderson, 2007). The FAO, in 2013, reported that limited agricultural extension services in most areas create a situation where farmers seek

information from multiple sources, which are inconsistent (FAO, 2013). Therefore, ICTs such as mobile phones can be used to assist rural farmers, extension providers and other key players in sharing information, solving some of the timeliness issues with the traditional face-to-face system (Davis, 2008). The question is how best to use mobile phone-based extension services to disseminate information needed by the farmers in their context.

2.5 Mobile Agricultural Information Services

2.5.1 Mobile Agricultural Information Services in Developing Countries

The widespread usage of mobile phones in developing countries, over the past decade, has created a focus on this technology as the instrument for development (FAO, 2012). Fu and Akter (2011), observed that the use of mobile phones could benefit, in many ways, the majority of rural people who are at bottom of the economic pyramid. A sub-discipline called Mobile for Development (M4D) has gained attraction as part of the Information Communication for Development (ICT4D) agenda which was formulated in the early 2000s (Duncombe, 2012; Aker & Mbiti, 2010). Dissemination of information, via mobile technology, has proliferated in all sectors including health, marketing, financing, education, agriculture, risk management, transport and governance (FAO, 2013). According to Donovan, (2011), M4D is focused on rural livelihood services and development of applications. However, with the mobile phone being the first electronic communication device for many farmers, there is a concern that the leapfrogging of some of the electronic-based technologies may have resulted in farmers failing to understand how to use mobile-based technologies effectively (FAO, 2013). In the rural setting, mobile phones are the primary tool of communication and the core technology to support social change and empower the farming communities (Hernandez, 2012). It was evident that mobile phones

provide a new opportunity for farmers to have direct access to agricultural information from extension agents, researchers, processors and consumers.

Studies conducted in Sub-Saharan African countries, such as Tanzania, Uganda, Kenya, Nigeria and Malawi, provide evidence that the use of mobile phones is benefiting rural farmers (Duncombe, 2012; Aker, 2011). The types and capabilities of mobile phones possessed by farmers determine the type of agricultural information to disseminate for effective communication (Table 1). According to Aker (2011), SMS text messages are used extensively because they are easy to create and customize, and they are cheap to distribute to a large group of people simultaneously. Each mobile communication channel has its limitations. Among them were high illiteracy level, which requires real-time interactions in terms of farmers-help lines and interactive voice systems (Duncombe, 2012). However, little has been done to identify the types and functionality of the mobile phones possessed by farmers to determine the type of information to disseminates in Malawi.

Table 1

Types of mobile phone applications used for agricultural information

Technology	**Description**	**Availability**
Voice	The most basic channel; avoids most literacy of linguistic barriers	Basic phones
Short Message Service (SMS)	Ubiquitous text-based messaging limited to 160 characters	Basic phones
Unstructured Supplementary Services Data (USSD)	A protocol used by Global Service for Mobile Community (GSM) phones to communicate with the mobile network	Basic phones
Interactive Voice Response (IVR)	Computer programs that respond to the voice input of callers	Basic phones
General Packet Radio Services (GPRS)	Low band width data services	Midrange phones
(Mobile) Software Applications (e.g. Java, iOS)	Preinstalled or downloaded software of varied sophistication	Midrange phones but increased sophistication with smartphones
Mobile Wireless Application Protocol (WAP)	A limited manner of browsing the internet	Midrange phones
Multimedia Messaging Service (MMS)	SMS-based technology to transmit multimedia (Including images and videos)	Midrange phones
Camera	For capturing still and movie images	Midrange phones
Bluetooth	Protocol for transmitting data over a short distance	Midrange phones
Mobile Web	Full-fledged web access	Smart phones
Global Positioning System (GPS)	Technology allowing for location-based information	Smart phones

Source: Donovan (2011, p. 56)

The information in the table presents a summary on how mobile phone's different capabilities can be used to disseminate various types of information. According to Duncombe, (2012), the functions can be used as stand-alone or integrated services. Most rural farmers use basic cell phones and therefore have limited mobile channel options. However, the results from studies conducted indicated that the majority of the farmers prefer voice calling over SMS text messaging in India, Tanzania, Kenya and Uganda (Cole & Fernando, 2012; Kashem, 2010; Candalla, 2012). This has been attributed to low literacy skills, complexity of retrieving the information and incomplete messages due to the 160 character limit (FAO, 2012). On the other hand, voice calls are costly and difficult to customize messages to match the individual user's informational needs (Aker, 2011). The literature validates that face-to-face communication is useful sharing confidential information, developing skills, and providing feedback (Duncombe, 2012). It is important to understand farmers' needs and develop appropriate information based on use of mobile applications.

2.5.2 Mobile Agricultural Information Services in Malawi

In 2014, the Malawi Communications Regulatory Authority (MACRA) conducted a study and found that 42% of the rural households and 31% of individuals were using mobile phone technology as a communication tool (MACRA, 2015). However, the report did not specify whether the participants were farmers or if they were using the technology for obtaining agricultural information services. Additional studies focused on the agricultural information perceptions and behaviors of smallholder farmers on ICTs (Masambuka-Kanchewa, 2013), and effectiveness of ICTs initiatives to promote market information systems along the value chain (Katengeza, 2012; Simuja, 2012). An in-depth study conducted by Masambuka-Kanchewa

(2013), found that farmers in the central part of Malawi used various ICT tools such as radio, print media and mobile phones. Radio was reported as the most used media despite the increased informal use of mobile phones. The study used a small sample (20 farmers and 12 Communication Officers) size limiting its validity and generalization. Therefore, there was a need to conduct further studies on mobile agricultural information services with a larger sample.

The literature indicates that mobile enabled SMS push-based platforms such as Esoko, are being used to send market information, transport tracking systems and good agricultural practices to smallholder farmers, traders and producers (Katengeza, 2012; Simuja, 2012; MoAIWD, 2013). These two authors also reported that the Malawi Agricultural Commodity Exchange (MACE), Department of Agricultural Extension Services (DAES) under the Ministry of Agriculture, Irrigation and Water Development (MoAIWD), National Smallholder Farmers Association (NASFAM), Agricultural Development and Marketing Cooperation (ADMARC) were just a few of the organizations and companies using the Esoko platform. It was also noted that farmers had to register their mobile phone numbers with the various host institutions, to enable access to market prices, weather information and reminders on the agronomic practices (Simuja, 2012). It was reported that SMS text messaging was the cheapest delivery system, easy to use, and messages can be bulk distributed, but messages are limited to 160 characters per message (Duncombe, 2012).

Clodina Chowa said that there were a growing number of mobile phone-based agricultural information services such as 3-2-1 by Airtel Malawi Limited and the newly established Voice Call Center (VCC) by Farm Radio Trust (Personal communication, February, 11, 2015). Malawi was advocating for implementation of the same services that are being implemented in neighboring countries. In 2014, various concerned stakeholders formed a Nation

Content Development Committee for ICTs in Malawi (NCDC-ICT). Its main aim was to approve all the multimedia content uploaded to the various platforms such as 3-2-1 and Esoko. This truly reflected a need to document developments taking place with MAIS in Malawi.

2.6 Need for the Study

Mobile agricultural information services (MAIS) is a relatively new discipline of study with limited amount of research conducted to-date. Consequently, to promote sustainable rural development there is a need to understand the farmer's use of mobile phones and the impact on reducing the digital divide (FAO, 2012). The mobile phone was regarded as a direct tool contributing to agricultural productivity and indirectly empowering farmers to make informed decisions on agriculture and allied networks (FAO, 2013; Zahedi & Zahedi, 2012). Literature shows that mobile phone usage is at the center of agriculture and rural development in most developing countries (Duncombe, 2012). However, it is evident that there is limited documentation on rural farmers' information and knowledge needs to access MAIS suitable for local context in Malawi. Studies indicate that considerable research attention has been focused on the technology itself, especially mobile information platforms and mobile money transfers, but little has been done to determine the agricultural production needs of farmers (FAO, 2013). The use of mobile phones is a critical step to increase access to knowledge, and the most obvious and cost-effective way to improve agricultural information dissemination in many rural areas (Donovan, 2011). It was believed that having MAIS without integrating the real farmers' information needs and capabilities was not sustainable. The study was conducted to understand the farmers' motivations to use MAIS, in order, to inform future research processes, content generation and development of appropriate mobile applications.

2.7 Theoretical Framework

This study focused on two theoretical frameworks, expectance-value motivational theory and 'digital-divide' concept, to guide in contextualizing the research methodologies and its findings. Previous studies used adoption of mobile technology theory and the rural technology acceptance model (Islam & Ake, 2011), however many did not employ theories due to unavailability of specific theories on mobile agricultural information services. It was important to use two different theoretical/conceptual frameworks relating them, contributing to new knowledge.

The expectancy-value theory of motivation (EVTM) by Eccles & Wigfield (2002), discussed the motivations, beliefs, values and goals related to developmental and educational psychology. The authors modeled the expectancies and values by focusing on school children to explain their performance as well as choice of different activities. However, the theory has been used beyond the scope of education such as in organizational analysis, health, communications, marketing and economics (Lunenburg, 2011; Eklof, 2006; Cooper, Burgoon, & Roter, 2001). According to the analysis pertaining to organization, several underlying assumptions were used for EVTM by: 1) people have expectations about their needs and past experiences; 2) people want different things for their personal benefits; and, 3) people will choose alternative options to optimize outcomes for them personally (Lunenburg, 2011). This study only focused on utility value or usefulness and cost-benefits in the view that farmers as individuals have plans to fulfill certain requirements in various enterprises. They were also making various decision to engage in activities which may be valued to match their efforts to accomplish some emotional and real costs (Wigfield & Eccles, 2000).

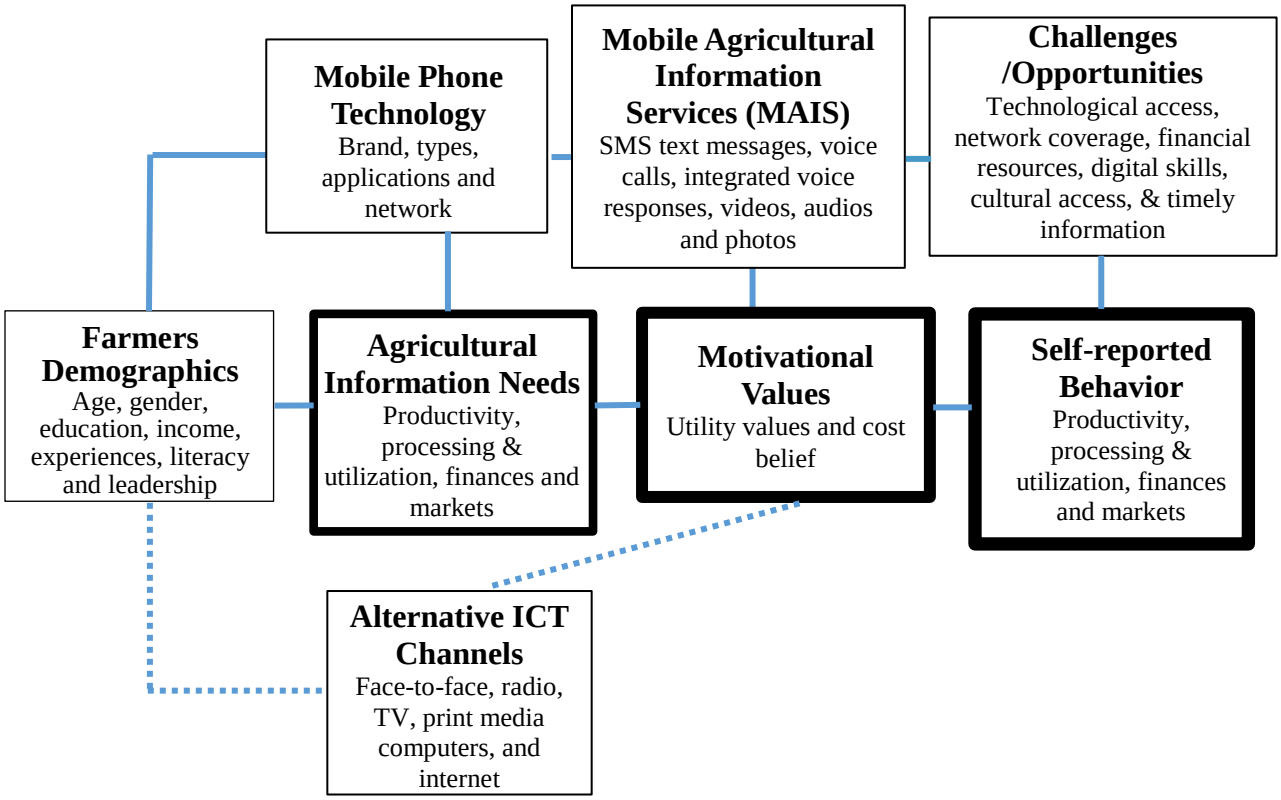
‘Digital divide’ is not a theoretical framework but rather an abstract term originally describing the differences created between the users of computer and non-users because of socio-economic differences (Pearce, 2013; Van Dijk, 2012). An analysis by Russell and Steele (2013), found that with the digital revolution, Sub-Saharan Africa region has encountered the following significant issues leading to a ‘digital divide’: 1) lack of access due to an insufficient information infrastructure; 2) lack of finances to acquire hardware and software; 3) lack of education and trainings on digital skills; and, 4) lack of sharing of information resources. The ‘digital divide’ concept was categorized into three social aspects: the first-level digital divide refers to the inequality pertaining to access of information technology (IT); the second level concerns the inequalities due to capabilities to use IT; and, the third level covers the inequalities of outcomes (Wei et al., 2011). However, the study utilized the social cognitive theory basing on home ownership of computers to create three levels of digital divide. It was worthy to note that the results do not apply to all ICTs but specifically mobile technology, but since mobile technologies are gaining more applications, and computational and storage power as stated by ‘Mores Law’ (Van Dijk, 2012); the concept may be applicable. Concerning this study, the first level digital divide did apply as all the farmer participants had access to ICT through a mobile phone. The critics indicated that there was a need to expand the conceptual framework to suite the current context for theoretical relevance of mobile media and communication in developing countries (Pearce, 2013). The digital divide concept was chosen to be part of the theoretical framework because this study explored the issues of farmers’ digital skills and perceived outcomes from accessing mobile agricultural information services. It also assisted to understand social-economic aspects that can hamper the farmers’ potential to access agricultural information in general.

2.8 Conceptual Framework

The combination of two theoretical frameworks enabled the author to build a conceptual framework for this study in relation to mobile agricultural information services. Demographics such as personal information, literacy skills, farming experiences and socio-economic characteristics, constituted part of the preliminary findings in the methodologies section, to assist in interpretation of the results. The concept of mobile phone technology was contextualized to refer to hardware and software used by the farmer participants at the study's particular point in time. Mobile phone technology advancements are dynamic, as stated by 'More's Law, thus it was necessary for the technology utilized to be specified during the study's time. Mobile technology was closely related to the mobile-based information sharing platforms also known as mobile agricultural information services. These were defined as various mobile enabled media to disseminate the information to farmers and other key stakeholders in the agricultural sector. It was assumed that MAIS services would be provided to all farmers with mobile phones, regardless of their enterprises and needs.

It was noted that the farmers were not a homogeneous group and therefore, they have different agricultural information needs. Previous studies used extensively the term agricultural information without proper definition. The key components of this study were obtaining farmers' perceived agricultural information needs and their inputs on how to improve delivery and timeliness of the information. The expectancy value motivations were drawn to assess whether the farmers were able to foresee usefulness and cost-benefits of mobile agricultural information services and therefore the contribution of the body of knowledge on innovative agricultural extension systems.

Lastly, challenges and opportunities were drawn to assist in assessing the potential that farmers will use mobile agricultural information services and ascertain availability of 'digital divide'. The findings and conclusions of this study were based on the self-reported behaviors of individual farmers, aggregated into the bigger and general picture of MAIS in Lilongwe a central district of Malawi. Below is the summarized conceptual framework for this study.



Source: Chisama, 2014

CHAPTER 3: METHODOLOGY

3.1 Introduction

This chapter provides an overview on the research methods and procedures used to collect, process, analyze and interpret data for the study. The chapter discusses the research design, participant-sampling methods, of data types collected, data analysis and demographical characteristics of the participant farmers. The instrumentation, validity, reliability, data collection, data management, and data analyses processes are also discussed. The following sections are also covered to reflect the research focus of the study.

3.2 Research Focus

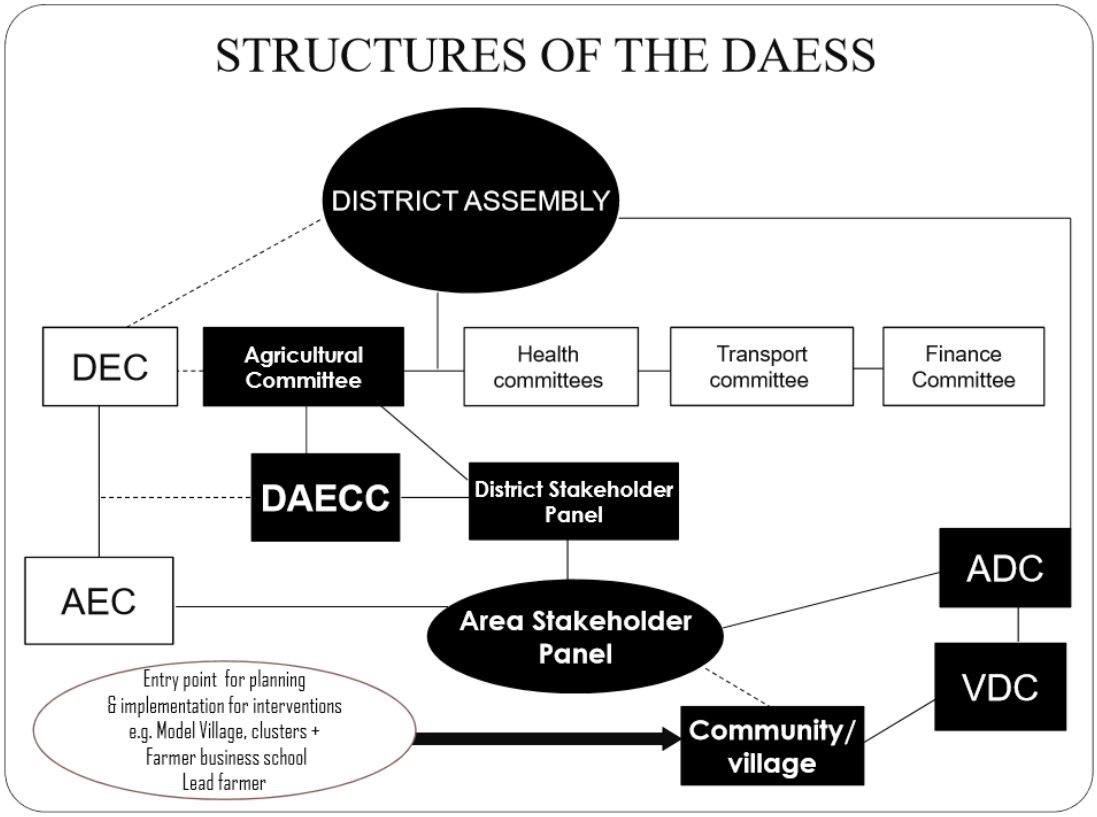
The study assessed the potential for using mobile technology to provide agricultural information services to farmers in Lilongwe District of Malawi. The five research questions covered farmers' use of mobile technology, awareness and use of MAIS, information needs, challenges and opportunities for MAIS.

3.3 Study Area

The study was conducted in the Republic of Malawi's Lilongwe District, which is located in the central part of the country. Lilongwe lies between the latitudes 13 30' South and 14 45' South, and longitudes 33 15' East and 33 30' East. The district covers 6,159 km^2 and hosts Lilongwe City, which is the capital city of Malawi (Appendices C, Figure 4). In total the district had a population of 1,897,167 with 1,230,834 (65%) living in rural areas (NSO, 2008). The Lilongwe District Assembly coordinates all developments efforts by all sectors governed by the District Assembly. Following the government's restructuring initiative, the district operates

utilizing the decentralized system at the local level with various offices for agriculture, education, health, transport, and many more sectors.

In terms of agriculture, Lilongwe District Agriculture Offices (DAO) coordinates all activities related to agriculture and rural development. Lilongwe has both urban and rural farming due to the expansion of the city and peri-urban areas. The DAO coordinates various extension programs in collaboration with other public outreach organizations and non-governmental actors. It has been using the District Agricultural System Structures (DAES) where various agricultural development committees comprised of farmers, agricultural experts and other stakeholders make decisions on district development and programs (Figure 2, below).



Source: DAES, 2015

Figure 1, District Agricultural Extension Services System in Malawi

The District Agricultural Office has 19 Extension Planning Areas (EPAs) that were demarcated based on the agro-ecologies and Traditional Authority boundaries. This study involved Mpingu and Mitundu EPAs, selected randomly to represent all other EPAs in the district (Appendix C, Figure 5). The EPAs are further sub-divided into blocks also known as 'Sections' with a minimum of nine and maximum of 19. For this study, five sections from Mpingu and five from Mitundu were also randomly selected from a total of 19 and 12 respectively.

3.4 Research Design

The research had a post-positivist perspective and mix methods research design was used to draw the inferences from the two EPAs that could be generalized to the entire Lilongwe District. This aimed at overcoming the limitation of a single design and to triangulate the results. A cross-sectional survey method targeted exploring various aspects of farmers using mobile phone technology to access agricultural information and services. According to Schutt (2012), survey research was deemed an efficient and versatile method of collecting systematic data from individuals within their social setting (Lilongwe). The participant farmers' opinions, suggestions and foreseen opportunities of using mobile agricultural information services were collected using open-ended questions. The pre-arranged in-person interviews focused on both quantitative and qualitative data from the farmers' perspectives on MAIS in the two EPAs. A research team was trained before conducting in-person interviews and key informants' validations because there are high illiteracy levels in rural communities. In-person interviews ensured quantity and quality of data collected because the interviewer asked the question and the respondents provided answers rather than filling out a questionnaire themselves (Ingrid, 2011). In this study, using 'survey'

methodology was ideal to cover several topics related to the farmers' use of mobile phone technology to access agricultural information to make decisions (Schutt, 2012). According to Ingrid (2011), the disadvantages of in-person survey interviews are: 1) high costs on travel and time; 2) difficult access into the typical rural remote areas; 3) resistance by potential respondents; and 4) interviewer biases due to personal presence during interviews. However, the challenges regarding costs were minimized through strategic planning and timing for quality data. Other challenges were minimized by collaborating with the field extension officers, community leaders and lead farmers.

3.5 Institutional Review Board Approval

Purdue University Institutional Review Board (IRB) approved the protocols of this study in February 2015 for the reason that it involved the use of human subjects. The project's key researcher completed the Collaborative Institution Training Initiative (CITI) Group 2: The Protection of Human Subjects in October 2014. The CITI report and data collection instrument were submitted to IRB in December 2015. In Malawi, permission was obtained from the Director of the Agricultural Extension Services under the Ministry of Agriculture, Irrigation and Water Development in January 2015 (Appendices A, Figure 3). A graduate research committee at Purdue University as stipulated by the Graduate School approved all procedures as stipulated by the IRB issued approval letter for the study in March 2015 (Appendices A, Figure 2).

3.6 Participants

The researcher involved two Extension Planning Areas for which a database of farmers with mobile phones did not exist. Agricultural Extension Development Officers (AEDOs) in

each EPA were able to compile a list of farmers within the selected five clusters (Sections) who possessed a mobile phone. The accessible population meeting the study's parameters for participation was 1402 farmers drawn from unexhausted theoretical population predicted for the research sites. Probability online sampling tools were used to determine a total number of participant from a sample frame, at 95% confidence level. Results indicated a sample size of 302. The actual number of farmers who agreed to participate in the study was 291. Information provided by the farmers was validated by10 key experts (nine extension officers and a Deputy Director of Agricultural Extension Services) who clarified some ambiguous issues raised by the farmers during the study. Therefore, it is important to note that the results presented in this study report were collected from the participant farmers and confirmed by these experts for validity.

3.7 Sampling Procedures

The study used multistage sampling procedures to get a representative sample from Lilongwe DAO. Nineteen EPAs under the Lilongwe District Agricultural Office were listed and assigned random numbers. A simple random number selection was conducted to identify two EPAs as opposed to a purposive selection to avoid researchers' biases. The two identified EPAs were Mpingu and Mitundu with 19 and 12 sections respectively. Five Sections were randomly identified per EPA using a random number selection applet. Within each Section, a list of individual farmers with mobile phones was compiled. A total of 1402 farmers with a mobile phone were identified as a sample frame as discussed in the participants sub-section. An online sample size calculation program for surveys provided by Creative Research Systems (CRS, 2012) was used to determine the total number of participants needed to achieve a 95% confidence level. The calculated representative proportion was 302 that could be attained by

identifying approximately 30 participants per Section. However, the actual number of participants who agreed to participate in the study was 291. Nine respondents failed to turn up for interviews.

3.8 Instruments

The survey instrument was a structured questionnaire for participant farmers. The author developed most of the questions in the instruments based on the literature and similar research studies. The questions covered various topics such as: 1) demographic characteristics and personal information; 2) types, brands, mobile phone technology categories and frequency of using mobile phone applications; 3) farmers access to mobile agricultural information services (MAIS); 4) farmers' agricultural information needs; and 5) farmers' challenges and opportunities to access MAIS. Responses were provided for each question by individual farmers to facilitate completion of the oral interviews that lasted approximately 45 minutes. Various experts such as agricultural research scientists, extension officers and graduate committee (youth development, extension educators and social research scientists) validated the information contained in the tool. A team of five language experts translated the questionnaires from English into the national language for Malawi (*Chichewa*). It was later pre-tested by the research team in areas close to the study's sites for uniformity.

3.9 Training Interviewers

Eight interviewers were recruited as a team from research and extension institutions to collect data and process it according to objectives of the study. This was done through targeted recruiting on social media to extension experts who were willing to take part in the survey. Team

members were trained for two days using principle of adult learning approaches. The topics covered: 1) breaking the ice and seeking the farmers' consent; asking research questions and capturing data; and, probing and seeking clarification from farmers. The plenary discussion also covered issues of validation of responses, capturing extra information and logistical arrangements for the study. The interviewers had a hands-on opportunity to practice administering the questionnaires to at least three farmers before conducting their first official survey. Practical sessions were supervised by the researcher to ensure teamwork and provide directions on completing various sections of the questionnaire. The exercise also assisted to time the actual interviews, and reword and sequence some questions in the instrument. The team members were also familiarized with other research protocols to be followed in village set-ups where local leaders expect to be respected and provide permission to interview only those farmers with mobile phones.

3.10 Data Collection

The research team collected data from selected participant farmers for a period of four weeks in their respective Sections during August and September 2015. The study followed Dillman's tailored modes for conducting in-person surveys (Dillman, 2011). The selected farmers were notified about the interview schedules (day, time and locations) through extension officers. On the day of interviews the farmers in each 'Section' were notified to meet at one of two sites depending on distance from their home/farm. This was done to cut travel costs of visiting individual farmers in their homesteads. Farmer participants were briefed about the study objectives and had to provide a verbal consent before commencement of the interviews. Individual interviews were done separately and privately, giving respondents the opportunity to

answer as, they felt appropriate per IRB standards (Appendix B, Figure 6). The interviews ranged from 30 to 50 minutes to complete filling out a questionnaire as anticipated. The researcher supervised the data collection exercise to ensure that interviewers stayed focused and remain impartial in capturing farmers' given responses. The Agricultural Extension Development Officers for the area were present during the interviews to clarity some pertinent issues raised by farmer participants. Each completed questionnaire was checked for completeness and accuracy by the researcher before final submission of data entry.

3.11 Data Analysis

In this study, quantitative data sets were analyzed using the Statistical Package for Social Scientists (SPPS, Version 16). The analysis was done by descriptive statistics, cross tabulation, multiple responses, reliability test and non-parametric tools. The results were presented by frequencies and percentages comparing two EPAs and the totals. On the other hand, qualitative data was organized and evaluated by a simple open axial coding system, developing categories and then summarizing categories into six assertions. Codes, categories, and assertions were vetted through a peer debriefing, and checked by two social science researchers. The qualitative findings were presented using six assertions, followed by categories with some supporting quotations from participants. The key informants validated the farmers' claims.

3.12 Demographic Information Results

The research tool gathered some demographic and personal information about the study's farmer participants. The categories covered were age, gender, education, income, occupation, leadership roles, land size, farming experience, and economic information. The results are

presented in this section of Chapter 3 to permit Chapter 4 to focus on the study's five research questions. Sections below are the demographic information results of farmer participants from Mpingu and Mitundu EPAs.

3.12.1 Section Information

Table 2 indicated that approximately half (51%) of the respondents were Mpingu residents with slightly less from Mitundu (49%). It should be noted that a largest percentage was from Katate (11%) with Umodzi (9%) providing the smallest percentage. The mean number of farmer participants per section was 29.10 farmers (*SD* = 1.20) with no differences between the two Extension Planning Areas (EPAs).

Table 2

Number participant farmers per Sections

Sections	Extension Planning Area (EPA)				Total (N = 291)	
	Mpingu (n = 149)		Mitundu (n = 142)			
	Frequency	*Percent (%)*	*Frequency*	*Percent (%)*	*Frequency*	*Percent (%)*
Katope	0	0.00	30	21.13	30	10.31
Namphande	0	0.00	29	20.42	29	9.96
Khubwi	0	0.00	28	19.72	28	9.62
Katayansengwa	0	0.00	28	19.72	28	9.62
Umodzi	0	0.00	27	19.01	27	9.28
Katate	31	20.81	0	0.00	31	10.65
Kandere	30	20.13	0	0.00	30	10.31
Mpenga	30	20.13	0	0.00	30	9.97
Kalima	29	19.46	0	0.00	29	9.97
Kagwatipenya	29	19.46	0	0.00	29	9.97
Percent for total		51.20		48.80		100.00

In terms of Traditional Authorities (TAs), the largest percentage of respondents was from Malili (41%) and Chiseka (36%) in Mpingu and Mitundu respectively. Overall the number of villages represented for each EPA were 55 in Mpingu and 73 in Mitundu with the mean number of villages being 31.25 (*SD* = 17.50) per Traditional Authority (Table 3).

Table 3

Number of participant farmers per Traditional Authority location

Traditional Authorities	Extension Planning Area (EPA)				Total (N = 291)	
	Mpingu (n = 149)		Mitundu (n = 142)			
	Frequency	*Percent (%)*	*Frequency*	*Percent (%)*	*Frequency*	*Percent (%)*
Chadza	0	0.00	38	26.76	38	13.06
Chiseka	0	0.00	104	73.24	104	35.74
Njewa	31	20.81	0	0.00	31	10.65
Malili	118	79.19	0	0.00	118	40.55

Note: Traditional Authority Areas are local political systems where the subjects consist of several Group Village Headmen/women.

3.12.2 Personal Information

The results on gender indicate that there were more males (62%) as compared to females (38%). In terms of the differences within EPAs the Mitundu sample had more males (77%) whereas the Mpingu sample was just over fifty (51) percent female (Table 4).

Table 4

Gender categories of participant farmers

Gender Categories	Extension Planning Area (EPA)				Total (N = 290)	
	Mpingu (n = 148)		Mitundu (n = 142)			
	Frequency	*Percent (%)*	*Frequency*	*Percent (%)*	*Frequency*	*Percent (%)*
Males	72	48.65	109	76.76	181	62.41
Females	76	51.35	33	23.24	109	37.59

In terms of age, the largest proportion of participant farmers were middle-aged (49%), with remaining half divided between the older adults (21%) and young adult (19%) categories. The overall mean age of the participants was 36 years of age (*SD* = 12.60). The respondents' ages did not differ significantly between the two EPAs (Table 5).

Table 5

Age categories of participant farmers

Age Categories (years)	Extension Planning Area (EPA)				Total (N = 289)	
	Mpingu (n = 147)		Mitundu (n = 142)			
	Frequency	*Percent (%)*	*Frequency*	*Percent (%)*	*Frequency*	*Percent (%)*
18-25 (Young adults)	26	17.69	29	20.42	55	19.03
26-39 (Middle-age adults)	72	48.98	70	49.30	142	49.14
40-54 (Older adults)	28	19.05	32	22.54	60	20.76
55-69 (Senior adults)	17	11.56	10	7.04	27	9.34
Over 69 (Elderly)	4	2.72	1	0.70	5	1.73

The respondents were asked to indicate number of people living in their households. The results in table 6 indicates that nearly half (46%) of the households were medium size, 37 percent were small sized, and 16 percent were classified as large-sized households (Table 6). The overall mean household size was 5.45 (*SD* = 2.18). There was no difference between the two Extension Planning Areas.

Table 6

Household sizes of participant farmers

Number of household members	Extension Planning Area (EPA)				Total (N = 289)	
	Mpingu (n = 148)		Mitundu (n = 141)			
	Frequency	*Percent (%)*	*Frequency*	*Percent (%)*	*Frequency*	*Percent (%)*
Small (1-4)	57	38.51	51	36.17	108	37.37
Medium (5-7)	66	44.59	68	48.23	134	46.37
Large (More than 7)	25	16.89	22	15.60	47	16.26

The results in table 7 on marital status categories of respondents indicated that the majority of participant farmers were married (83%) with 13 percent reporting they were single. There were slight differences on marital status between farmer participants from Mitundu and Mpingu EPAs.

Table 7

Marital Status categories of respondents

Marital status Categories	Extension Planning Area (EPA)				Total (N = 291)	
	Mpingu (n = 149)		Mitundu (n = 142)			
	Frequency	*Percent (%)*	*Frequency*	*Percent (%)*	*Frequency*	*Percent (%)*
Single	18	12.08	18	12.68	36	12.37
Married	119	79.87	123	86.62	242	83.16
Divorced	5	3.36	1	0.70	6	2.06
Widowed	4	2.68	0	0.00	4	1.37
Separated	3	2.01	0	0.00	3	1.03

Respondents' education levels included those who only attended and completed a particular educational level. More than half of the participant farmers attended primary school (65%) with just over a quarter (28%) working on a secondary school education. Mpingu had the largest percentage of participants who attended primary schools (68%). In comparison of the two EPAs, Mitundu had largest percent of farmers with a secondary education (30%; Table 8).

Table 8

Participant farmers education level categories

Educational Levels	Extension Planning Area (EPA)				Total (N = 291)	
	Mpingu (n = 148)		Mitundu (n = 142)			
	Frequency	*Percent (%)*	*Frequency*	*Percent (%)*	*Frequency*	*Percent (%)*
None	10	6.71	11	7.75	21	7.22
Primary	100	67.11	88	61.97	188	64.60
Secondary	38	25.50	42	29.57	80	27.49
Tertiary	0	0.00	1	0.70	1	0.34

Note: Primary school ages = 6 to 13 years, secondary school age = 14 to 18 years and tertiary education = 18 above. Educational levels refer all to those who attended or completed.

In terms of occupation, the participants gave multiple responses to the question. Most of the respondents were engaged in full-time farming (98%) with a few holding full-time off-the-farm jobs (3%). All Mitundu participants (100%) indicated they were full-time farmers unlike Mpingu where 93 percent cited full-time farming as their major occupation. Mpingu had the largest percent of casual laborers (7%) and full-time off-farm employment (6%; Table 9).

Table 9

Multiple responses on participant farmers' occupation

Occupation Categories	Extension Planning Area (EPA)				Total	
	Mpingu (n = 149)		Mitundu (n = 142)		(N = 291)	
	Frequency	*Percent (%)*	*Frequency*	*Percent (%)*	*Frequency*	*Percent (%)*
Full-time Farming	139	93.29	142	100.00	281	96.56
Small business	13	8.72	12	8.45	25	8.59
Casual labor	10	6.71	2	1.40	12	4.12
Full-time job	8	5.36	0	0.00	8	2.75
Student	4	2.68	2	1.40	6	2.06
Skilled labor	2	1.34	1	0.67	3	1.03

Regarding community leadership involvement, the minority (45%) of participant farmers revealed that they had various community leadership roles (Table 10).

Table 10

Participant farmers' community leadership involvement

Leadership Roles	Extension Planning Area (EPA)				Total (N = 291)	
	Mpingu (n = 149)		Mitundu (n = 142)			
	Frequency	*Percent (%)*	*Frequency*	*Percent (%)*	*Frequency*	*Percent (%)*
No	78	52.35	81	57.04	159	54.64
Yes	71	47.65	61	42.96	132	45.36

The most common specific major leadership roles cited were village headmen (25%) and village headman's advisor (17%). Mitundu EPA had a greater percentage of its participants who were village headmen (36%) and religious leaders (13%). Mpingu had a greater percentage who were Village Development Committee (VDC) members (20%) and lead farmers (8%). It was also indicated that 3% of respondents in Mpingu did not disclose leadership roles (Table 11).

Table 11

Multiple responses on participant farmers' community leadership roles

Leadership roles	Extension Planning Area (EPA)				Total (N = 132)	
	Mpingu (n = 71)		Mitundu (n = 61)			
	Frequency	*Percent (%)*	*Frequency*	*Percent (%)*	*Frequency*	*Percent (%)*
Village Headmen	11	15.49	22	36.07	33	25.00
VH Advisor	11	15.49	11	18.03	22	16.67
VDC[1] members	14	19.72	7	11.48	21	15.91
CBO[2] members	7	9.86	5	8.20	12	9.09
Religious leaders	4	5.63	8	13.11	12	9.09
Lead farmers	6	8.45	3	4.92	9	6.89
Volunteer Teachers	4	5.63	3	4.92	7	5.30
Farmer's clubs	2	0.00	2	2.90	4	0.00
School committee	2	2.82	2	3.27	4	3.03
Association leaders	3	2.82	1	1.63	4	3.03
Women's advisors	2	4.23	1	1.63	3	3.03
Group VH	2	2.82	1	1.63	3	2.27
Undisclosed roles	3	2.82	0	0.00	3	2.27

Note: [1]VDC = Village Development Committee, [2]COB=Community Based Organization.

3.12.3 Literacy Test Information

Participants were asked if they had reading and/or writing abilities. As noted in Table 12, a majority (88%) of the respondents reported that they could read and write. A small percent (11%) indicated that they could neither read nor write. The literacy rates were similar among the farmers in both EPAs.

Table 12

Participant farmers' responses on literacy abilities

Literacy ability	Extension Planning Area (EPA)				Total (N = 291)	
	Mpingu (n = 149)		Mitundu (n = 142)			
	Frequency	*Percent (%)*	*Frequency*	*Percent (%)*	*Frequency*	*Percent (%)*
Both (read and write)	130	87.25	125	88.037	255	87.63
Read only	2	1.34	0	0.00	2	0.69
Write only	2	1.34	1	0.70	3	1.03
None	15	10.07	16	11. 27	31	10.65

Note: These were the self-reported results on literacy levels. Both=those who indicated they could read and write and, none=those who acknowledged not having reading or writing abilities.

A literacy test was conducted to determine if the participant farmers could read an SMS text message. Eighty-seven (87) percent of the participants passed the test. Identical results were noted and validated for both EPAs (Table 13). These findings were similar with the self-reported results reported in Table 12.

Table 13

SMS text message-based reading test for participant farmers

Literacy test result	Extension Planning Area (EPA)				Total (N = 291)	
	Mpingu (n = 149)		Mitundu (n = 142)			
	Frequency	*Percent (%)*	*Frequency*	*Percent (%)*	*Frequency*	*Percent (%)*
Pass	129	86.58	123	86.62	252	86.60
Fail	20	13.42	19	13.38	39	13.40

The participant farmers who failed the literacy test reported they relied on their family (41%) and friends (30%) to get content received through SMS text messages. Some respondents consulted their neighbors (10%) and schoolteachers (5%) for literacy assistance. Overall, Mitundu participants were more likely to seek assistance from friends (38%) and spouses (30%) while those in Mpingu were more likely to use family (35%) and children (27%) to get SMS text messages (Table 14).

Table 14

Participant farmers' coping mechanisms for SMS text messages

Aids for who could not read	Extension Planning Area (EPA)				Total (N = 39)	
	Mpingu (n = 20)		Mitundu (n = 19)			
	Frequency	*Percent (%)*	*Frequency*	*Percent (%)*	*Frequency*	*Percent (%)*
Family	9	45.00	7	36.84	16	41.02
Friends	5	25.00	7	36.84	12	30.77
Spouse	2	10.00	6	31.58	8	20.51
Children	7	35.00	0	0.00	7	17.94
Neighbors	2	10.00	2	10.53	4	10.26
Teachers	1	5.00	1	5.26	2	5.13

Note: The data in Table 12 reflects a multi-response question

3.12.4 Farming Experience

Regarding farming experiences, a majority (58%) of the respondents had 15 years or less farming experience (Table 15). The overall mean years of farming experience was 15.78 (*SD* = 11.30). Mpingu had a slightly larger percentage (37%) of respondents with less than 10 years of experience. These results correspond with the ones on age in Table 5.

Table 15

Respondents farming years

Farming years	Extension Planning Area (EPA)				Total (N = 285)	
	Mpingu (n = 146)		Mitundu (n = 139)			
	Frequency	*Percent (%)*	*Frequency*	*Percent (%)*	*Frequency*	*Percent (%)*
Less than 10 years	55	37.67	43	30.93	98	34.39
10-15 years	32	21.92	38	23.34	70	24.56
16-20 years	19	13.01	26	18.71	45	15.78
21-25 years	13	8.90	8	5.76	21	7.37
26-30 years	11	7.53	11	7.91	22	7.73
More than 30 years	16	10.96	13	9.35	29	10.18

The study's participant farmers indicated that their primary farming enterprise goals were to both produce food and raise cash (83%). Only 16 percent of the subjects were farming for food only and considerably fewer (1%) were farming to get cash only. As shown in Table 15, Mitundu farmers were primarily dependents on both enterprise for food and cash (90%) whereas in Mpingu farmers were less concerned with earning cash only and more focused on raising food (26%).

Table 16:

Participant farmers' farming goals

Farming Goals	Extension Planning Area (EPA)				Total (N = 291)	
	Mpingu (n = 149)		Mitundu (n = 142)			
	Frequency	*Percent (%)*	*Frequency*	*Percent (%)*	*Frequency*	*Percent (%)*
Both (Food + Cash)	107	71.81	134	89.93	241	82.82
Food only	40	26.85	6	4.02	46	15.80
Cash only	2	1.34	2	1.34	4	1.37

Farm sizes for most participating farmers (63%) were in the category of 1 to 3.99 acres and followed by 4 to 6.99 acres (27%). Overall, mean land holding size was 3.60 (*SD* = 2.50). The average farmers in Mitundu operated a 4 acre farm (*SD* = 2.50) while Mpingu farmers operated farms that averaged 2.80 acres (*SD* = 2.00; Table 17).

Table 17

Farmer participant's farm sizes

Farm sizes	Extension Planning Area (EPA)				Total (N = 290)	
	Mpingu (n = 148)		Mitundu (n = 142)			
	Frequency	*Percent (%)*	*Frequency*	*Percent (%)*	*Frequency*	*Percent (%)*
Less than an acre	2	1.35	2	1.40	4	1.38
1-3.99 acres	118	79.73	64	45.10	182	62.76
4-6.99 acres	23	15.54	54	38.03	77	26.55
7-9.99 acres	2	1.35	17	11.97	19	6.55
10 or more acres	3	2.02	5	3.52	8	2.76

Note: The land size includes farmers' owned and rented land for agricultural production.

Table 18, shows that the most common farm enterprises reported by the respondents were: crop production only (76%); crop and livestock production (22%); and, livestock production only (2%). Mitundu had more respondents who only raised crops (82%) while Mpingu had a greater percentage of farmers who operated both crop and livestock enterprises (28%; Table 18).

Table 18

Farmer participant's main farming enterprise

Main farm enterprises	Extension Planning Area (EPA)				Total (N = 290	
	Mpingu (n = 148)		Mitundu (n = 142)			
	Frequency	*Percent (%)*	*Frequency*	*Percent (%)*	*Frequency*	*Percent (%)*
Crops only	104	70.27	117	82.39	221	76.20
Both (crops and livestock)	41	27.70	23	16.19	64	22.06
Livestock only	3	2.03	2	1.40	5	1.72

Overall, the main crops grown by participants were maize (86%), tobacco (12%) and groundnuts (2%). Nearly all the farmers in Mpingu grew maize (95%) as compared with Mitundu (76%). Tobacco was a more commonly grown crop in Mitundu (27%) as compared to Mpingu (3%; Table 19). For more information on all crops grown by participating farmers, see Appendix D, Tables 58 and 59.

Table 19

Respondents' main crops grown

Crops	Extension Planning Area (EPA)				Total (N = 286)	
	Mpingu (n = 147)		Mitundu (n = 139)			
	Frequency	*Percent (%)*	*Frequency*	*Percent (%)*	*Frequency*	*Percent (%)*
Maize	139	94.55	106	76.30	245	85.7
Tobacco	4	2.72	30	21.58	34	11.89
Ground nuts	4	2.72	3	2.16	7	2.45

Goats (36%), chickens (26%), and pigs (25%) were the main livestock enterprises cited by the respondents of this study. The two EPAs had similar results except for beef cattle where Mitundu had a higher percentage of farms with beef cattle (12%; Table 20). The overall means showed that goats with an overall mean of 3.54 (*SD* = 2.30) raised by 36% of participant farmers. The second most common livestock was chickens with an overall mean of 12.46 (*SD* = 11.30) raised by 26% of the participants. The third major livestock was pigs with an overall mean of 4.67 (*SD* =3.50) raised by 25% of the respondents. The other common animals found on the participants' farms are noted in Appendices D, Table 60.

Table 20

Farmer participants' main livestock enterprise

Main livestock	Extension Planning Area (EPA)				Total (N = 262)	
	Mpingu (n = 131)		Mitundu (n = 131)			
	Frequency	*Percent (%)*	*Frequency*	*Percent (%)*	*Frequency*	*Percent (%)*
Goats	49	37.40	44	33.59	93	35.50
Chickens	36	27.48	32	24.43	68	25.95
Pigs	36	27.48	30	22.90	66	25.19
Beef Cattle	3	2.29	16	12.21	19	7.25
Dairy Cattle	3	2.29	5	3.82	8	3.05
Sheep	3	2.29	0	0.00	3	1.15
Pigeons	1	0.76	1	0.76	2	0.76
Donkey	0	0.00	1	0.76	1	0.38
Ducks	0	0.00	1	0.76	1	0.38
Fish	0	0.00	1	0.76	1	0.38

3.12.5 Economic Information

Regarding sources of income, farmers indicated that they depend primarily on selling crop produce (91%). Mitundu respondents were financially dependent on selling crop produce (90%) whereas other income sources play a more significant role in Mpingu (livestock sales, small business, and casual labor with proportions of 13%, 12%, and 10% respectively). A smaller number of farmers utilize livestock (10%) and small business enterprises (9%) as their income sources (Table 21).

Table 21:

Respondents multiple responses on income sources

Sources of Income	Extension Planning Area (EPA)				Total (N = 291)	
	Mpingu (n = 149)		Mitundu (n = 142)			
	Frequency	*Percent (%)*	*Frequency*	*Percent (%)*	*Frequency*	*Percent (%)*
Selling crop produce	130	87.25	136	95.77	266	91.41
Selling livestock	27	18.12	9	6.34	36	12.37
Small Business	25	16.78	7	4.93	32	11.00
Casual Labor	21	16.78	0	0.00	21	7.41
Fulltime Employment	7	4.70	0	0.00	7	2.40
Skilled work	4	2.68	0	0.00	4	1.37

Note: This was a multiple response question.

Results on income levels, provided in Table 22, indicated that four out of every five farmers (84%) are operating on a medium-low to low income (MK 399, 999 or less). The average income level for respondents was MK 252, 410 (*SD* = MK 345, 311). To gain a deeper appreciation for economic status farmer participants were asked to identify household assets (Appendices D, Table 61).

Table 22

Distribution of responses income level classes

Income levels	Extension Planning Area (EPA)				Total (N = 289)	
	Mpingu (n = 148)		Mitundu (n = 141)			
	Frequency	*Percent (%)*	*Frequency*	*Percent (%)*	*Frequency*	*Percent (%)*
Low (Less than MK 100,000)	49	33.10	32	22.69	81	28.03
Medium low (MK 100,000-K399,999)	83	56.08	80	56.74	163	56.40
Medium (MK 400,000-K699,999)	13	8.78	19	13.47	32	11.07
Medium high (MK 700,000-K999,999)	0	0.00	3	2.10	3	1.04
High (More than MK 1,000,000)	3	2.02	7	4.96	10	3.46

Note: Income levels included estimates of annual revenue or gross earnings. All the means were in Malawi Kwacha (MK). Conversion rate was MK 580 = $1.

3.12.6 Summary of Demographic Information

The summary of demographic information assisted to interpret the main conclusions of this study because there were no available databases to provide this information. It was concluded that the two hundred and ninety-one (291) farmer participants came from 128 villages in four Traditional Authorities (TAs) namely Malili, Njewa, Chiseka, and Chadza of Lilongwe District. The results also confirmed that all 10 Sections from two EPAs were involved in the research study.

It was indeed concluded that the farmers with mobile phones were heterogeneous in all ranges of ages, gender, marital status, family sizes, education levels, occupations, literacy levels, farming experiences, farming goals, farming enterprises (crops grown and livestock), and leadership roles. The notable variations were on main occupations, reading coping mechanisms for SMS text messages, farming sizes and main crops grown in the two EPAs. On the other hand, the results implied that the participant farmers from the two EPAs were similar and had the same generalizable attributes based on agro-ecological zones.

On the other hand, at the individual level the results concluded that farmers' reported literacy skills corresponded with a test that was conducted based on SMS text message only. The findings indicated that about nine tenth (87%) of the participant farmers were literate. This concluded that the farmers with mobile phones, in general, were literate and those who cannot read or write SMS text messages have some coping mechanisms to access the information.

CHAPTER 4: RESULTS

4.1 Introduction

This chapter presents the findings based on five research questions of the study. The chapter covers the results on the following sub-topics: (1) farmers' use of mobile phone technology and mobile applications; (2) farmers' awareness and use of existing mobile agricultural information services (MAIS), and use of additional mobile services; (3) farmers' motivations to use MAIS; (3) farmers' agricultural information needs and willingness to pay for mobile information services; and, (4) farmers' challenges and opportunities to use MAIS. The demographic information was covered in Chapter 3 for a summary see section 3.12.6. Below are results of the study's five research questions.

4.2 Results of the Study

Research Question 1: What types of mobile phone were farmers using and to what extent do they use the technology?

4.2.1 Participant Farmers' Mobile Phone Technology

4.2.1.1 Respondents' mobile phone technology brands and categories

The participating farmers were asked to indicate the brand of mobile phone being used. Most farmer participants used Nokia (48%), iTel (33%) and Techno (18%) brands. Approximately three-fifths (59%) of the farmers in Mitundu had a Nokia phones and in Mpingu, about a half (47%) had iTel. Table 23 contains a top 10 list of commonly used mobile brands by the participant farmers. The complete list of mobile phones possessed by participant farmers is listed in Appendix D, Table 63.

Table 23

Brands of mobile phone used by participant farmers

Brands of mobile phones	Extension Planning Area (EPA)				Total (N = 277)	
	Mpingu (n = 139)		Mitundu (n = 138)			
	Frequency	*Percent (%)*	*Frequency*	*Percent (%)*	*Frequency*	*Percent (%)*
Nokia	55	36.91	83	58.87	138	47.75
iTel	70	46.98	25	17.73	95	32.87
Techno	27	18.12	26	18.44	53	18.34
ZTE	20	13.42	17	12.06	37	12.80
Samsung	15	10.07	21	14.89	36	12.47
Donado	0	0.00	8	5.67	8	2.79
Corn	5	3.36	2	1.42	7	2.42
Huwel	4	2.68	2	1.42	6	2.08
KGTEL	2	1.34	3	2.13	5	1.73
Vodaphone	2	1.34	1	0.71	3	1.04

Note: The list of mobile phone brands was based on responses by the participant farmers. The results included basic, mid-range and smart phones categories.

Overall, approximately three-quarters (76%) of the participant farmers used mid-range phones, some still had basic cell phone (23%) and a very few had smartphones (1%). The two EPAs had similar results per the types of mobile technology utilized (Table 24). For a list of mobile applications for all phone types, refer to Appendix D, Table 64.

Table 24

Types of mobile phones used by respondents

Mobile phone Types	Extension Planning Area (EPA)				Total (N = 289)	
	Mpingu (n = 149)		Mitundu (n = 140)			
	Frequency	*Percent (%)*	*Frequency*	*Percent (%)*	*Frequency*	*Percent (%)*
Mid-range Phone	112	75.16	108	77.14	220	76.12
Basic Phone	36	24.16	30	21.42	66	22.83
Smart phone	1	0.67	2	1.42	3	1.03

4.2.1.2 Participant farmers acquisition of mobile phones technology

The results in Table 25 indicate the majority of participant farmers (92%) purchased their mobile phones, five percent received them as gifts from relatives and three percent got them as part of a project.

Table 25

Respondents' responses on acquisition mobile phones

Acquisition of Mobile phone	Extension Planning Area (EPA)				Total (N = 291)	
	Mpingu (n = 149)		Mitundu (n = 142)			
	Frequency	*Percent (%)*	*Frequency*	*Percent (%)*	*Frequency*	*Percent (%)*
Purchased	137	91.95	131	92.25	268	92.10
Gift from relatives	5	3.36	9	6.34	14	4.81
Under a project	7	4.70	2	1.41	9	3.09

4.2.1.3 Subscriptions to mobile network services

Farmers were asked to reveal their subscriptions to Mobile Network Service Providers (MNSPs). Over three-quarters of the participant farmers subscribed only to Airtel Malawi Limited only (78%), a few only used TNM only (5%) and some had SIM cards for both Airtel and TNM (17%). Mitundu had the most users with only Airtel SIM cards (85%). One–fifth (22%) of farmers in Mpingu had SIM cards for both Airtel and TNM (Table 26).

Table 26

Participant farmers' subscriptions to mobile network service providers

Subscriptions to Mobile Network	Extension Planning Area (EPA)				Total (N = 291)	
	Mpingu (n = 149)		Mitundu (n = 142)			
	Frequency	*Percent (%)*	*Frequency*	*Percent (%)*	*Frequency*	*Percent (%)*
Airtel only	107	71.81	121	85.21	228	78.35
TNM only	8	5.37	6	4.23	14	4.81
MTL	1	0.67	0	0	1	0.34
Both (Airtel + TNM)	33	22.15	15	10.56	48	16.49

Participants were asked to indicate their preferred Mobile Network Service Providers (MNSP). The results in Table 27 show that 90% of the farmers preferred Airtel because more of their friends or relatives used the service creating a larger social network. Airtel was also cited for having fairer airtime costs (Appendix D, Table, 65). The results on preferred MNSP were similar in both EPAs.

Table 27

Respondents' preferences on mobile network service providers

Preferred Mobile Service Provider	Extension Planning Area (EPA)				Total (N = 288)	
	Mpingu (n = 146)		Mitundu (n = 142)			
	Frequency	*Percent (%)*	*Frequency*	*Percent (%)*	*Frequency*	*Percent (%)*
Airtel	131	89.73	129	90.85	260	90.28
TNM	14	9.58	13	9.15	27	9.38
MTL	1	0.68	0	0.00	1	0.35

4.2.1.4 Participant farmers' use of mobile phone applications

Farmers were asked to indicate on a scale of 1 to 8, how often they use various mobile applications. Voice calling application was the most commonly used with an overall mean of 7.87 (*SD* = 0.61) followed in second place by SMS text messages at 5.40 (*SD* = 2.55). Results were similar for Mpingu and Mitundu EPAs (Table 28).

Table 28

Mean distribution of responses on frequency of using mobile applications

Statistics									
Application	Extension Planning Area (EPA)						Total		
	Mpingu			Mitundu					
	N	*Mean*	*SD*	*N*	*Mean*	*SD*	*N*	*Mean*	*SD*
Voice	149	7.79	0.67	141	7.87	0.54	290	7.82	0.61
SMS text messages	149	5.13	2.53	141	5.67	2.54	290	5.40	2.55
FM Radio	149	3.67	3.26	137	3.39	3.17	286	3.54	3.21
Multimedia player	149	3.60	3.39	136	3.3	3.22	285	3.46	3.30
PDA	149	3.33	2.93	141	3.49	2.92	290	3.41	2.92
Storage/memory card	149	2.13	2.75	137	3.07	3.16	286	2.58	2.99
Camera	149	1.93	2.41	137	2.35	2.54	286	2.13	2.48
Bluetooth	149	1.99	2.53	137	1.88	2.21	286	1.94	2.38
Multimedia recorder	148	1.90	2.54	136	1.74	2.28	284	1.82	2.42
Internet	149	1.4	1.83	137	1.53	2.00	286	1.47	1.91
MMS	149	1.03	1.26	137	1.37	1.82	286	1.19	1.56

Note: A scale of 1 to 8 was used where 1= none; 2 = once a month; 3= 2 to 3 times a month; 4= once a week; 5= 2 to 3 times a week; 6= Once a day; 7= 2 to 3 times a day; and 8= more than 3 times a day.

Research Question 2: *Were the farmers aware of mobile agricultural information services and to what extent do they use them with additional mobile services?*

4.2.2 Participant Farmers' Awareness and Use of Mobile Agricultural Information Services

4.2.2.1 Participant farmers' awareness of MAIS

The participants were asked if they were aware of available Mobile Agricultural Information Services (MAIS). Only one in five farmers (20%) was aware of MAIS to some extent (Table 29). Results were similar in the two Extension Planning Areas.

Table 29

Participant farmers' responses on awareness of mobile agricultural information services

Awareness about MAIS	Extension Planning Area (EPA)				Total (N = 291)	
	Mpingu (n = 149)		Mitundu (n = 142)			
	Frequency	*Percent (%)*	*Frequency*	*Percent (%)*	*Frequency*	*Percent (%)*
Yes	29	19.46	30	21.13	59	20.27
No	120	80.54	112	78.87	232	79.73

The results in Table 30 indicate that, approximately half of the participant farmers aware of MAIS had knowledge on Integrated Voice Response System (58%) with fewer having knowledge on SMS text bases systems (33%). The results on Mitundu showed that almost three-fifth (60%) of respondents who were aware of MAIS knew about IVR. It was observed that Mpingu had a larger percentage of its participants who knew about SMS format (41%) versus Mitundu (27%).

Table 30

Respondents' awareness on formats on existing MAIS platforms

Available Formats on Existing MAIS	Extension Planning Area (EPA)				Total (N = 57)	
	Mpingu (n = 27)		Mitundu (n = 30)			
	Frequency	*Percent (%)*	*Frequency*	*Percent (%)*	*Frequency*	*Percent (%)*
Interactive Voice Response (IVR)	15	55.56	18	60.00	33	57.89
SMS text messaging	11	40.74	8	26.67	19	33.33
Mobile Internet Services	0	0.00	1	3.33	1	1.75
Voice calling	1	3.70	0	0.00	1	1.75

Note: Multiple response results. The frequencies and percentages presented were based on total number of farmer participants (N=57) who responded that they were aware about MAIS.

Farmers who were aware of the mobile agricultural information services knew that Airtel (67%), Agricultural Commodity Exchange (19%) and the Ministry of Agriculture, Irrigation and Water Development (19%) were the MAIS providers (Table 31). Some differences in knowledge of MAIS providers existed between the two EPAs.

Table 31

Respondents' multiple response on awareness of MAIS providers

MAIS providers	Names of Extension Planning Area (EPA)				Total (N = 57)	
	Mpingu (n = 29)		Mitundu (n = 30)			
	Frequency	*Percent (%)*	*Frequency*	*Percent (%)*	*Frequency*	*Percent (%)*
Airtel	18	66.67	20	66.67	38	66.67
Malawi's Agricultural Commodity Exchange (MACE)	6	22.22	5	16.67	11	19.30
Ministry of Agriculture	8	29.63	3	10.00	11	19.30
Auction Holdings Limited	0	0.00	3	9.70	3	6.00
NASFAM	0	0.00	3	10.00	3	5.26
TAMA	2	7.4	0	0.00	2	3.31

Note: Multiple response results. The frequencies and percentages presented were based on total number of farmer participants (N=57) who responded that they were aware about MAIS.

More than half of the participants (61%) who were aware of MAIS cited the 3-2-1 IVR system. Esoko's SMS text messaging was a distant second at 20 percent. Mitundu had the largest percentage of farmer participants with knowledge on the 3-2-1 platform (65%) and Mpingu had a greater percentage of respondents using SMS text messages (31%; Table 32).

Table 32

Participant farmers' multiple responses on awareness of MAIS platforms

MAIS Platforms	Extension Planning Area (EPA)				Total (N = 60)	
	Mpingu (n = 29)		Mitundu (n = 31)			
	Frequency	*Percent (%)*	*Frequency*	*Percent (%)*	*Frequency*	*Percent (%)*
3-2-1 (IVR)[1]	16	55.17	20	64.51	36	61.00
Esoko (SMS text)[2]	9	31.3	3	9.68	12	20.00
ACE Mobile Market System	1	3.45	4	12.90	5	8.33
AHL SMS Membership	1	3.45	1	3.23	2	3.33
Voice calling	0	0.00	2	6.45	2	3.33
CADECOM Website[3]	2	6.90	0	0.00	2	3.33

Note: Multiple response results. The frequencies and percentages presented were based on total number of farmer participants (N=60) who responded that they were aware about MAIS.

Table 33 shows that the most common ways farmers learned about mobile agricultural information services were from Extension agents (27%), lead farmers (10%), and mobile phone promotions messages (10%). There were some differences between the two EPAs. One-third (33%) of the participant farmers in Mitundu learned from public extension officers, lead farmers accounted for 17 percent and family an additional 13 percent. The Mpingu farmers were more likely to have learned about MAIS through their phones (17%; Table 3).

[1]3-2-1 uses an Integrated Voice Response (IVR) and USSD systems.
[2]Esoko platform uses push based SMS text messaging systems.
[3]The mentioned website was accessed using a mobile phone.

Table 33

Respondents' multiple responses on sources of knowledge on MAIS

Source of awareness on MAIS	Extension Planning Area (EPA)				Total (n = 59)	
	Mpingu (n = 29)		Mitundu (n = 30)			
	Frequency	*Percent (%)*	*Frequency*	*Percent (%)*	*Frequency*	*Percent (%)*
Extension Agents	6	20.69	10	33.33	16	27.12
Lead Farmer	1	3.45	5	16.67	6	10.17
Mobile phone	5	17.24	1	3.33	6	10.17
Family	1	3.45	4	13.33	5	8.47
MAIS Agents	1	3.45	2	6.67	3	5.08
Radio	1	3.45	1	3.33	2	3.39

Note: Multiple response results. The frequencies and percentages presented were based on total number of farmer participants (N=59) who responded that they were aware about MAIS.

4.2.2.2 Farmer participants' use of mobile agricultural information services

The results in Table 34 indicate that one-third (34%) of the farmers who had knowledge of MAIS had access to SMS text messages. Over two- thirds (71.5%) of farmer participants with knowledge had access to IVR services (72%).

Table 34

Farmer participants' multiple responses on access to MAIS

Format		Name of Extension Planning Area (EPA)				Total (N = 59)	
		Mpingu (n = 29)		Mitundu (n = 30)			
		Frequency	*Percent (%)*	*Frequency*	*Percent (%)*	*Frequency*	*Percent (%)*
SMS Text	Yes	12	41.40	8	26.70	20	33.90
	No	17	58.60	22	73.30	39	66.10
IVR	Yes	19	65.50	23	76.70	42	71.50
	No	10	34.35	7	23.30	17	28.80

Note: Multiple response results. The frequencies and percentages presented were based on total number of farmer participants (N=59) who responded that they were aware about MAIS.

Respondents reported limited use of MAIS services (Table 35). Farmers who were aware about MAIS indicated using SMS text messaging on average 2.68 times (*SD*=2.4) and IVR 1.94 (*SD*=1.90) times in their previous season. Results were similar for both EPAs.

Table 35

Respondents' multiple responses on the frequency of use for MAIS

Statistics									
Frequency of use of MAIS	Extension Planning Areas (EPAs)						Total (N=59)		
	Mpingu (n=29)			Mitundu (n=30)					
	N	*Mean*	*SD*	*N*	*Mean*	*SD*	*N*	*Mean*	*SD*
SMS text messages	12	3.25	2.78	8	2.11	2.02	16	2.68	2.40
IVR	16	2.31	2.24	19	1.63	1.57	35	1.94	1.90

Note: Multiple response results. The frequencies and percentages presented were based on total number of farmer participants (N=59) who responded that they were aware about MAIS.

4.2.2.3 Type of information accessed through mobile agricultural information services

The farmer participants who were aware about MAIS were asked about the types of agricultural information accessed through SMS text messages. The most common topics were reminders related to farm management activities (21%), crop varieties (18%) and market prices for crops (12%; Table 36)

Table 36

Farmer participants' multiple responses on information accessed SMS messages

SMS Text Messages	Extension Planning Area (EPA)				Total (N = 57)	
	Mpingu (n = 27)		Mitundu (n = 30)			
	Frequency	*Percent (%)*	*Frequency*	*Percent (%)*	*Frequency*	*Percent (%)*
Reminders on farm management activities	8	29.63	4	13.33	12	21.05
Crop varieties	5	18.52	5	16.67	10	17.54
Market prices	4	14.81	3	10.00	7	12.28
Fertilizer application rates	3	11.11	3	10.00	6	10.52
Soil fertility management	4	14.81	2	6.67	6	10.52
Pest management	4	14.81	1	3.33	5	8.77
Weather updates	3	11.11	2	6.67	5	8.77
Crop field management	3	11.11	1	3.33	4	7.02
Irrigation practices	0	0.00	1	3.33	1	1.75
Pasture management	1	3.70	0	0.00	1	1.75
Alerts on livestock distribution	0	0.00	1	3.33	1	1.75

Note: Multiple response results. The frequencies and percentages presented were based on total number of farmer participants (N=57) who responded that they were aware about MAIS.

In terms of accessed information on IVR (3-2-1 platform), the majority got messages on crop varieties (40%) and crop field management (33%). A higher percentage of participant farmers from Mpingu EPA accessed both crop variety (44%) and crop field management (44%) information as shown in Table 37.

Table 37:

Respondents' multiple responses on topics accessed through Integrated Voice Response (IVR)

IVR Messages	Extension Planning Area (EPA)				Total (N = 57)	
	Mpingu (n = 27)		Mitundu (n = 30)			
	Frequency	*Percent (%)*	*Frequency*	*Percent (%)*	*Frequency*	*Percent (%)*
Crop varieties	12	44.44	11	36.67	23	40.35
Crop field management	12	44.44	7	23.33	19	33.33
Soil fertility management	3	11.11	3	10.00	6	10.52
Reminders on farm management activities	4	14.81	1	3.33	5	8.78
Fertilizer application rates	3	11.11	2	6.67	5	8.78
Field pest management	1	3.70	0	0.00	1	1.75
Market prices	0	0.00	1	3.33	1	1.75
Irrigation practices	0	0.00	1	3.33	1	1.75

Note: Multiple response results. The frequencies and percentages presented were based on total number of farmer participants (N=57) who responded that they were aware about MAIS.

4.2.2.4 Cost of information accessed through mobile agricultural information services

Table 38 shows that farmers in Malawi were not willing to pay a fee to access agricultural information using SMS and IVR messaging. When asked if they paid for the information only a few of the respondents admitted to paying for both SMS text messages (4%) and IVR messages (5%). In Mpingu, three farmer participants (11%) indicated they had paid for IVR services. This indicates that most SMS text messages were accessed for free (Table 38).

Table 38

Participant farmers' responses on payments made on MAIS

MAIS	Payments made	Extension Planning Area (EPA)				Total (N = 57)	
		Mpingu (n = 27)		Mitundu (n = 30)			
		Frequency	*Percent (%)*	*Frequency*	*Percent (%)*	*Frequency*	*Percent (%)*
SMS text messages	Yes	1	3.70	1	3.33	2	3.51
	No	26	96.30	29	96.67	55	96.49
IVR messages	Yes	3	11.11	0	0.00	3	5.26
	No	24	88.89	30	100.00	54	94.74

Note: The frequencies and percentages presented were based on total number of farmer participants (N=57) who responded that they were aware about MAIS.

The overall results in Table 39 indicate that only about a quarter of the farmer participants expressed satisfaction with both IVR messages (24%) and SMS text (21%). The satisfaction level of IVR messaging was similar in the two EPAs. Approximately one-third (29%) of the respondents from Mpingu were satisfied with SMS text messages.

Table 39

Respondents' satisfaction level with accessed MAIS

Variable		Extension Planning Area (EPA)				Total (N = 57)	
		Mpingu (n = 27)		Mitundu (n = 30)			
		Frequency	*Percent (%)*	*Frequency*	*Percent (%)*	*Frequency*	*Percent (%)*
SMS text messages	Yes	8	29.60	4	13.30	12	21.10
	No	19	70.40	26	86.70	45	79.00
IVR messages	Yes	7	25.90	8	26.70	14	24.60
	No	20	74.10	22	73.30	21	75.40

Note: The frequencies and percentages presented were based on total number of farmer participants (N=57) who responded that they were aware about MAIS.

4.2.2.5 Farmer participants awareness of additional mobile services

All farmer participants were asked about their awareness of additional mobile information services related to rural development. Approximately nine-tenths (86%) of the respondents indicated that they were aware (Table 40). Interestingly, when asked about their awareness of mobile agricultural information services in Table 29 only 13 percent of the farmers indicated awareness, compared to the 85% who indicate an awareness of additional mobile services. The difference may be due to farmers' perceptions and use of constituted services.

Table 40

Awareness of additional mobile services

Additional mobile services	Extension Planning Area (EPA)				Total (N=291)	
	Mpingu (n = 149)		Mitundu (n = 142)			
	Frequency	*Percent (%)*	*Frequency*	*Percent (%)*	*Frequency*	*Percent (%)*
Yes	124	83.22	126	88.73	250	85.91
No	25	16.78	16	11.27	41	14.09

Note: Multiple response results.

Overall, almost all the participant farmers were aware of mobile banking services (99%). Few farmers were aware of mobile health services (2%). The results were similar for both Mpingu and Mitundu EPAs (Table 41).

Table 41

Participant farmers' multiple responses on types of additional mobile services

Additional mobile services	Extension Planning Area (EPA)				Total (N = 250)	
	Mpingu (n = 124)		Mitundu (n = 126)			
	Frequency	*Percent (%)*	*Frequency*	*Percent (%)*	*Frequency*	*Percent (%)*
Mobile Banking	122	98.39	125	99.21	247	98.8
Mobile Health	4	3.23	1	0.79	5	2.00
Mobile Insurance	1	0.81	0	0.00	1	0.40
Mobile Networks	0	0.00	1	0.79	1	0.40
Mobile Internet	0	0.00	1	0.79	1	0.40
Mobile Sports	2	1.61	0	0.00	2	0.80

Note: Multiple response results.

Seventy (70) percent of the participant farmers became aware of additional mobile information services through the radio. Just over a quarter (26%) learned about additional services through mobile services agents (Table 42). Based on the household assets reported in Appendix D, Table 62, i three-quarters of the respondents who were aware were radio owners.

Table 42:

Farmer participants' multiple responses on sources of knowledge on additional mobile services

Sources of knowledge	Extension Planning Area (EPA)				Total (N = 247)	
	Mpingu (n = 124)		Mitundu (n = 123)			
	Frequency	*Percent (%)*	*Frequency*	*Percent (%)*	*Frequency*	*Percent (%)*
Radio	91	73.39	83	67.48	174	70.44
MS Agent	27	21.77	37	30.08	64	25.91
Friends	17	13.71	6	4.88	23	9.31
Mobile phone	9	7.26	5	4.07	14	5.67
Family	7	5.65	3	2.44	10	4.05
Newspapers	9	7.26	1	0.81	10	4.05
Extension Agents	3	2.42	4	3.25	7	2.83
TV	1	0.81	1	0.81	2	0.81

Note: Multiple response results

Farmer participants were asked to indicate which additional mobile services they used. The results in Table 43 indicate that, while most respondents were aware of additional mobile information services, few were using them. Mobile banking was being used by 16 percent and mobile health by just 2 percent.

Table 43

Respondents' multiple responses on use of additional mobile services

Use of additional mobile services	Extension Planning Area (EPA)				Total (N = 247)	
	Mpingu (n = 124)		Mitundu (n = 123)			
	Frequency	*Percent (%)*	*Frequency*	*Percent (%)*	*Frequency*	*Percent (%)*
Mobile banking	25	20.16	17	13.82	39	15.79
Mobile health	3	2.42	1	0.81	4	1.62
Mobile network membership	0	0.00	2	1.63	2	0.81

Note: Multiple response results.

4.2.2.6 Access to Additional Sources of Agricultural Information

Apart from mobile agricultural information services, the participant farmers indicated that they had additional sources by which agricultural information could be obtained. The other trusted sources of information included: public extension agents (53%); radio (34%); and, lead farmers (13%). Mitundu farmers were more likely to get their information from public extension agents (67%) and radio (41%). In comparison, Mpingu had almost double the percentage of respondents who obtained information from lead farmers (14%) as indicated in Table 44.

Table 44:

Farmer participants' multiple responses on additional sources of agricultural information

Additional sources of agricultural information	Extension Planning Area (EPA)				Total (N = 291)	
	Mpingu (n = 149)		Mitundu (n = 142)			
	Frequency	*Percent (%)*	*Frequency*	*Percent (%)*	*Frequency*	*Percent (%)*
Public Extension Agents	59	39.60	95	66.90	154	52.92
Radio	42	28.19	58	40.85	100	34.36
Lead farmers	22	14.77	16	11.27	38	13.09
Non-Governmental Organizations	10	6.71	9	6.34	19	6.53
Family	8	5.37	4	2.87	12	4.12
Agro-dealers	2	1.34	4	2.82	6	2.06
Friends	4	2.68	1	0.70	5	1.72
Agro-Processing Companies	1	0.67	1	0.70	2	0.69
Researchers	2	1.34	0	0.00	2	0.69
Farmer clubs	2	1.34	0	0.00	2	0.69

Note: Multiple response results.

Concerning communication channels used to obtain additional agricultural information, nearly all the respondents cited face-to-face (67%), followed by radio (54%) and mobile phones (9%). Even in today's technically advanced world, farmers still value face-to-face and radio as a means to obtain agricultural information (Table 45).

Table 45:

Respondents' multiple responses on communication channels used for accessing additional sources of agricultural information services

Communication channels use for additional sources	Extension Planning Area (EPA)				Total (N = 291)	
	Mpingu (n = 149)		Mitundu (n = 142)			
	Frequency	*Percent (%)*	*Frequency*	*Percent (%)*	*Frequency*	*Percent (%)*
Face-to-face	87	58.39	108	76.06	195	67.01
Radio	67	44.97	91	64.08	158	54.30
Mobile Phone	4	2.68	22	15.49	26	8.93
Newspapers	3	2.01	3	2.11	6	2.06
TV	1	0.67	0	0.00	1	0.34
Internet	1	0.67	0	0.00	1	0.34

Note: Multiple response results.

4.2.3 Farmers Opinions on Mobile Agricultural Information Services

Upon completion of qualitative analysis on research question two it was asserted *'Most farmer participants need appropriate knowledge, and skills to use a mobile phone for agricultural information services.'* The assertion was supported by two axial categories derived from the farmers' responses. The supporting categories include: 1) Enhance farmers' capacities on digital and literacy skills; and 2) create awareness about existing mobile agricultural information services and providers. The supporting codes and quotations contained herein represent the big data set.

Enhance farmers' capacities on basic skills (literacy and digital). Several farmer participants attributing to low use of MAIS due to lack of that basic (literacy and digital) skills

[92 word counts], suggesting the needed to increase their literacy skills for effectively use MAIS. The respondents recognized that use certain media formats such as SMS text messages and USSDs needs minimum reading and writing literacy level was needed (both numbers and word). This challenge applied to only those farmers who lacked basic capacities. A male farmer from Mpingu [MF1-1] said, “I fail to read SMS text messages and PDAs (notes, reminders and calendars), because I did not attend formal school, and that is my biggest problem.” This indicated that some participant farmers are unable to use important mobile applications thus hampering their access to mobile agricultural information services.

Some respondents [4 word counts] wanted to know how farmers with mobile phones who have limited basic skills could be assisted in accessing mobile agricultural information services. A male farmer from Mitundu [MF1-2] asked, “What are you [researchers] going to do with the farmers who have low literacy levels, willing to access mobile agricultural information services?” The key informants [8 word counts] validated that there was a need to provide basic skills to farmers with mobile technology so they may successfully utilize mobile agricultural information services.

Create awareness about existing available mobile agricultural information services and providers. The participant farmers [308 word counts] reported there was lack of awareness of available mobile agricultural information services. This unawareness by farmers was preventing them from utilizing the available mobile agricultural information services.

> [MF2-1] said, “I have never heard of farmers getting agricultural information services through mobile phones. This is my first time and I am getting it from you. I remember one lead farmer came once telling us that she received a call from our

extension officer to mobilize famers who can manage a demonstration plot mounted in our village. Is this a service you are talking about?"

The participant farmers who were aware of MAIS expressed that they lacked knowledge on how to effectively use the available mobile agricultural information service platforms [47 word counts]. This was mainly referred to as 3-2-1 and Esoko platforms. [MF2-2] said, "When I dialed 3-2-1 it was taking so long so I dropped-off the call fearing they will charge me dearly for listening to one message for a long time." However, many farmers do not known that the service are free the first eight times each month accessed but charged from the ninth call onwards. This potentially explains the low frequency of using MAIS (Table 34) as farmers who were aware of the service lacked knowledge on use of it.

Participant farmers indicated they were not aware of the MAIS providers and who provides the information for uploading to the services' sources [27 word counts]. Not being aware of the source(s) of the uploaded information makes it difficult for the farmers to forward their questions related to the topic. It was suggested that the missing information must be made available for validity check and dependability of the information uploaded on the platforms. A lead farmer from Mpingu [LF1-1] said, "I am not sure whether the information uploaded on Esoko platform is appropriate and it is hard to guess who sends the messages since we (farmers) submitted our mobile phone numbers to extension officers."

Research Question 3: What were the farmer participants' motivation and optimism to use mobile agricultural information services?

4.2.3 Farmer Participants' Motivation to Use Mobile Agricultural Information Services

4.2.3.1 Farmers' motivation on use of Mobile Agricultural Information Services

Results show that the participant farmers were highly motivated to use mobile agricultural information services with an overall mean of 4.3 (*SD*=1.09) based on a scale of 1 to 5. Across the two EPAs, Mpingu had a mean of 4.36 (*SD* = 0.98) while Mitundu had a mean of 4.23 (*SD* = 1.91). More information is provided in Appendix D, Table 67. The reliability test results indicated a maximum likelihood of 0.82 using Cronbach Alpha factor analysis. This was supported by both utility values and cost-to-benefit ratio. There was a small effect size with a delta value of 0.32 for the researcher to explain to other practitioners the difference between the two Extension Planning Areas. This implied that they were the same.

Farmer participants were asked to agree or disagree with 15 statements related to utility values and cost-benefit factors (Table 46). Overall results indicated that approximately 81% of the respondents agreed with 14 of the reasons for using agricultural information services with the exception being “Information sharing” (36%). Mitundu EPA had the least proportion citing “information sharing” (21%). Since the mobile phone is an individualized communication tool, ‘conflict of interests’ issues may explained the low support to share such information to other farmers in their community.

Table 46

Participant farmers' multiple responses on reasons to use MAIS

Motivation items	Extension Planning Area (EPA)				Total (N = 291)	
	Mpingu (n = 149)		Mitundu (n = 142)			
	Frequency	*Percent (%)*	*Frequency*	*Percent (%)*	*Frequency*	*Percent (%)*
Relevance	140	93.96	123	86.62	263	90.38
Less costly	138	92.62	119	83.80	257	88.32
Livelihood	131	87.92	114	80.28	245	84.19
Fastness of communication	128	85.91	117	82.39	245	84.19
Profitability	123	82.55	118	83.10	241	82.82
Marketing	124	83.22	115	80.99	239	82.13
Decision making	121	81.21	111	78.17	235	80.76
Frequency of messaging	124	83.22	107	75.35	231	79.38
Appropriateness	124	83.22	105	73.94	229	78.69
Timeliness	120	80.54	106	74.65	226	77.66
Validity of information	117	78.52	108	76.06	225	77.32
Two-way interactivity	122	81.88	99	69.72	221	75.95
Information complexity	104	69.80	105	73.94	209	71.82
Reliability	107	71.81	96	67.61	203	69.76
Information sharing	74	49.66	29	20.42	103	35.40

Note: Multiple response results.

4.2.3.2 Farmers' interest on use of Mobile Agricultural Information Service

The farmer participants were asked if they were interested in accessing mobile agricultural information services. Nearly all the respondents expressed an interest in accessing

MAIS (98%). Similar results were noticed between the two EPAs (Table 47). Various reasons for using MAIS are included in qualitative results on Assertion 5 on page 100.

Table 47

Participant farmers' expression of interest in MAIS

Expression of interest in MAIS	Extension Planning Area (EPA)				Total (N = 269)	
	Mpingu (n = 137)		Mitundu (n = 132)			
	Frequency	*Percent (%)*	*Frequency*	*Percent (%)*	*Frequency*	*Percent (%)*
Yes	135	98.54	129	97.73	264	98.14
No	2	1.46	3	2.27	5	1.86

4.2.3.3 Farmers opinions on motivations to use MAIS

Qualitatively it was asserted that *Most farmers with a mobile phone were optimistic about the use of mobile agricultural information services for rural and extension development*. This was supported by two main categories: 1) Respondents' interest in mobile agricultural information services; and 2) participant farmers' value of the importance of mobile agricultural information services for rural development. These two categories were supported by two codes for each as follows:

Farmers were interested in available mobile agricultural information services. Participant farmers expressed their interest [35 word counts] in having access to available MAIS throughout the interviews. They suggested that MAIS programs were ideal for not only farmers with a mobile phone but to the farming communities at large. A village headman from Mitundu [VH1-2] said, "I have learnt a lot from this interview and I will try from now onwards to use mobile

agricultural information services since they are so fast." Some respondents [8 word counts] expressed that MAIS were an innovative way of improving the extension services.

Some farmers [15 word counts] wanted to know when access to MAIS would be available. This was an indication that they were eager to have mobile agricultural information services as soon as possible. [MF2-2] asked, "When are we going to start receiving mobile agricultural information services?" This result was in-line with the qualitative results that the participant farmers were highly motivated for mobile agricultural information services for their agricultural growth and development.

Farmers valued Mobile Agricultural Information Services for rural development. Most participant farmers valued the importance of MAIS due to the challenges and limitations of the traditional educational methodologies used by the agricultural extension system. They raised concerns about a decline in the number of one-on-one farmer visits and the limited number of extension officers available to respond to the needs of the farmers [25 word counts]. [MF3-1] said, "I am eager to access mobile agricultural information services because extension officers have a big area to cover and do not respond to individual farmers' needs." The farmers felt that mobile agricultural information services would complement the current efforts to improve on extension and rural development.

Some participant farmers replied that mobile agricultural information services are an easy, fast and convenient way to disseminate agricultural information in the rural areas [14 words counts]. These intrinsic values supported the quantitative results that farmers were motivated to use mobile agricultural information services. A female farmer from Mpingu [FF1-1] said, "I hope that mobile agricultural information services will motivate them [farmers] to improve their farming enterprises quickly."

Research Question 4: What were the farmers' preferred agricultural information (topics, channels and sources) and willingness to pay for mobile agricultural information services?

4.2.4 Mobile Phone Technology Used by Participant Farmers

4.2.4.1 Respondents' preferred agricultural information services

The farmers were asked to provide their preferred topics for agricultural information services. The responses presented in Table 48 indicate that farmers desired information on soil fertility management (28%), market prices (16%) and crop varieties (10%). The top issues for Mitundu farmers were preferred soil fertility management (27%) and crop produce market prices (27%). Mpingu farmers also cited soil fertility management (29%) as an area of need. The second area of information need was crop varieties (13%).

Table 48:

Respondents' multiple responses on preferred topics for crop productions on MAIS

Topics on demand for crop production	Extension Planning Area (EPA)				Total (N=252)	
	Mpingu (n=128)		Mitundu (n=124)			
	Frequency	*Percent (%)*	*Frequency*	*Percent (%)*	*Frequency*	*Percent (%)*
Soil fertility management	37	28.91	33	26.61	70	27.78
Market price of produce	7	5.47	33	26.61	40	15.87
Crop varieties	16	12.5	10	8.06	26	10.32
Crop field management	13	10.16	9	7.26	22	8.73
Pest and disease management	8	6.25	11	8.87	19	7.54
Irrigation practices	12	9.38	6	4.84	18	7.14
Weather updates	9	7.03	2	1.61	11	4.37
Input prices	4	3.13	7	5.65	11	4.37
Fertilizer application	7	5.47	2	1.61	9	3.57
Climate change	4	3.13	3	2.42	7	2.78
Types of fertilizer	2	1.56	2	1.61	4	1.59
Types of chemicals	3	2.34	1	0.81	4	1.59
Processing & utilization	0	0.00	3	2.41	3	1.19
Tobacco nursery management	0	0.00	1	0.81	1	0.40
Agri-business	0	0.00	1	0.81	1	0.40
Other topics	6	4.69	0	0.00	6	2.48

Note: Multiple response results. Other topics includes specific technologies and technics used by farmers.

In terms of topics on livestock production, two-fifths (40%) of the farmer participants expressed the need for parasite and disease management information. The same results were obtained for farm management, and feeds and feeding, with each at six percent. No observable difference was noted between the two EPAs with the top three preferred topics in each region being parasite and disease management, farm management, and feeds and feeding (Table 49).

Table 49:

Respondents' multiple responses on preferred livestock production topics for MAIS

Livestock production	Extension Planning Area (EPA)				Total (N=252)	
	Mpingu (n=128)		Mitundu (n=124)			
	Frequency	*Percent (%)*	*Frequency*	*Percent (%)*	*Frequency*	*Percent (%)*
Parasites and disease management	50	39.06	50	40.32	100	39.68
Farm management	7	5.47	7	5.65	14	5.56
Feeds and feeding	6	4.69	8	6.45	14	5.56
Housing and construction	4	3.13	3	2.42	7	2.78
Improved Breeds of Livestock	5	3.91	0	0.00	5	1.98
Breeding information	4	3.12	2	1.61	6	2.38
Livestock insurance	0	0.00	3	2.42	3	1.19
Marketing of livestock	0	0.00	1	0.81	1	0.39

Note: Multiple response results

4.2.4.2 Respondents preferred communication channels for agricultural information

The farmer participants indicated that their preferred information and communication channels were mobile phone (99%), face-to-face (94%) and radio (80%). Mitundu had the

highest percentage of responses on mobile phone (100%), face-to-face (95%) and radio (86%) as compared to Mpingu. Mpingu had a higher percentage of farmers who relied on print media (16%) as a means of receiving information (Table 50).

Table 50

Respondents' multiple responses on preferred communication channels to deliver agricultural information

Preferred ICT Channel	Extension Planning Area (EPA)				Total (N=284)	
	Mpingu (n=144)		Mitundu (n=140)			
	Frequency	*Percent (%)*	*Frequency*	*Percent (%)*	*Frequency*	*Percent (%)*
Mobile phone	141	97.92	140	100	281	98.94
Face-to-face	133	92.36	133	95	266	93.66
Radio	106	73.61	121	86.43	227	79.93
Print media	16	11.11	11	7.86	27	9.51
TV	3	2.08	4	2.86	7	2.46
Internet	0	0	3	2.14	3	1.06
CDs and DVDs	0	0	1	0.71	1	0.35

Note: Multiple response results.

4.2.4.3 Respondents preferred agricultural information sources

Respondents were asked to identify their preferred sources of agricultural information. Overall, nearly all farmers preferred public extension agents (99%), some suggested lead farmers (35%) and others identified broadcasters (17%). Results were similar between the two EPAs

except Mitundu farmers were more receptive to broadcasters (22%) where as Mpingu farmers were slightly more favorable to NGOs (18; Table 51).

Table 51:

Participant farmers' multiple responses on preferred sources of information on MAIS

Preferred information sources	Extension Planning Area (EPA)				Total (N=282)	
	Mpingu (n=143)		Mitundu (n=139)			
	Frequency	*Percent (%)*	*Frequency*	*Percent (%)*	*Frequency*	*Percent (%)*
Public extension agents	141	98.60	137	98.56	278	98.58
Lead farmers	49	34.27	49	35.25	98	34.75
Broadcasters	17	11.89	30	21.58	47	16.67
Non-Governmental Organizations (NGOs)	26	18.18	20	14.39	46	16.31
Marketing agents	17	11.89	17	12.23	34	12.06
Researchers	11	7.69	9	6.47	20	7.09
Processing companies	7	4.89	10	7.19	17	6.03

Note: Multiple response results

4.2.4.4 Respondents preferred mobile media formats for agricultural information

In terms of formats for mobile agricultural information services, farmer participants mainly preferred voice calls (95%) and SMS text messages (88%). A few farmers expressed the need for short video clips (10%) and IVR (6%). Farmers did express that the format utilized should be based on the complexity of the message (Table 52).

Table 52:

Farmer participants' multiple responses on preferred mobile communication formats

Preferred mobile phone communication Channels	Extension Planning Area (EPA)				Total (N=281)	
	Mpingu (n=141)		Mitundu (n=140)			
	Frequency	*Percent (%)*	*Frequency*	*Percent (%)*	*Frequency*	*Percent (%)*
Voice calls	139	98.58	128	91.43	267	95.02
SMS text messages	123	87.23	123	87.86	246	87.54
Videos	13	9.22	16	11.43	29	10.32
IVR	13	9.22	4	2.86	17	6.05
Photos	1	0.71	2	1.43	3	1.07
Audio files	0	0.00	1	0.71	1	0.36
Mobile internet	0	0.00	1	0.71	1	0.36

Note: Multiple response results

4.2.9.5 Respondents willingness to pay for MAIS

When asked if they were willing to pay for mobile agricultural information, two-fifths (40%) of the respondents responded positively. It was interesting to note that over half (53%) of the farmer participants in Mitundu EPA indicated they were willing to pay for MAIS whereas only a quarter (28%) of the Mpingu farmers said they would pay (Table 53).

Table 53

Participant farmers' willingness to pay for mobile agricultural information services

Willingness to Pay for MAIS	Extension Planning Area (EPA)				Total (N=288)	
	Mpingu (n=147)		Mitundu (n=141)			
	Frequency	*Percent (%)*	*Frequency*	*Percent (%)*	*Frequency*	*Percent (%)*
Yes	41	27.89	74	52.48	115	39.93
No	106	72.11	67	47.52	173	60.07

Farmer participants who were willing to pay expressed willingness to pay for SMS text messages (97%), voice calls (80%) and video clips (26%). No difference in the type of services for which the farmers indicated they were willing to pay was observed between the two EPAs (Table 54).

Table 54

Respondents' multiple responses on payments for mobile format for MAIS

Mobile Channels	Extension Planning Area (EPA)				Total (N=115)	
	Mpingu (n=41)		Mitundu (n=74)			
	Frequency	*Percent (%)*	*Frequency*	*Percent (%)*	*Frequency*	*Percent (%)*
SMS text	41	100.00	70	94.59	111	96.52
Voice call	40	97.56	52	70.27	92	80.00
Videos	21	51.22	9	12.16	30	26.09
MMS	0	0.00	3	4.05	3	2.61
Mobile internet	0	0.00	1	1.35	1	0.87

Note: Multiple response results. MMS=Multimedia Messaging Services

The farmer participants willfully suggested suitable fees for each of the mobile agricultural information services. The overall mean fee for voice calls was MK63.10 (*SD* = 37.60), videos a mean fee of MK60.33 (*SD* = 29.10), audios a mean fee of MK36.67 (*SD* = 21.90) and SMS text messages a mean fee of MK15.95 (*SD* = 11.30). The farmer participants from Mpingu indicated a willingness to pay higher fees for videos (MK66.19), audios (MK39.38), and SMS text messages (MK18.71) as compared to Mitundu farmers (Table 55).

Table 55

Participant farmers' fees for various mobile agricultural information services

Statistics									
Mobile Communication formats	Extension Planning Areas (EPAs)								
	Mpingu			Mitundu			Total		
	n	*Mean* (MK)	*SD*	n	*Mean* (MK)	*SD*	N	*Mean* (MK)	*SD*
Voice calls	39	66.15	40.20	53	60.85	35.80	92	63.10	37.60
Videos	21	66.19	29.60	9	46.67	23.98	30	60.33	29.10
Audios	8	39.38	21.80	1	15.00	0.00	9	36.67	21.90
MMS	0	0.00	0.00	2	35.00	21.20	2	35.00	21.20
Podcast	1	20.00	0.00	3	23.33	5.80	4	22.50	5.00
SMS text	41	18.71	16.70	70	14.34	5.90	111	15.95	11.30
Mobile Internet Service	0	0.00	0.00	1	50.00	0.00	1	50.00	0.00

Note: Multiple response results. The means (*M*) and standard deviations (*SD*) are in Malawi Kwacha (MK). Conversion rate was $1 = MK580.

4.2.9.6 Respondents opinions on preferred agricultural information and willingness to pay

The fourth research question was designed to capture farmers' preferred agricultural information (topics, channels and sources) and their willingness to pay for MAIS. One assertion supported the quantitative results that *Farmer participants wanted mobile agricultural information delivery systems that are accessible, current, relevant, timely, and dependable.* This was supported by four categories of respondents' demands: 1) provide MAIS to all farmers with mobile phones; 2) provide timely information and dependable services; 3) provide current, specific and dependable information services; and, 4) provide user-friendly media formats.

Provide MAIS to all farmers with mobile phones. A majority of respondents [150 word counts] expressed that all farmers with mobile phones should have access to mobile agricultural information services. For those farmers who cannot afford to pay, the respondents felt a plan needed to be developed to provide some level of access. The respondents acknowledged the need for free access to general information services for those who cannot afford to pay for such services. [MF4-1] said, "I free to see that most farmers in rural areas could not afford to pay for MAIS, so just maintain the current status where almost everyone access them for free."

Provide timely information and dependable services. The participant farmers indicated that useful information must be delivered in a timely and dependable manner [20 word counts]. Farmers expressed concern about the lack of timely and actionable information on the current MAIS. They suggested that information should be correlated between the specific enterprises and the seasonal calendar. A young farmer [MF3-2] said, "I called several times for one mobile agricultural information service, I was surprised to get a message on how to plant maize towards the end of a rainy season."

Though few respondents [5 word counts] voiced support for sustainable MAIS, it was reported that one donor-funded project was phased out without appropriate backup informational mechanisms in place. The farmers suggested that for all MAIS platforms to be successful they should involve the users as equal partners from project conceptualization to implementation. A female farmer [FF1-2] said, "I was getting some weekly SMS text messages from an organization I registered with but suddenly it stopped without any notice." A key informant confirmed to have overheard that the project phased out after three years.

Provide current, specific and relevant information services. The participant farmers indicated that up-to-date information is needed for both crops and livestock production [15 word counts]. This will enable them to make appropriate decisions on their farming enterprise. It was also suggested that the information should be current, relevant and actionable and tailored to the farmers' specific needs. A male lead farmer [MLF1-1] said, "We look for new information to learn how to do things differently and improve on our farming enterprises."

Provide farmer-friendly media formats. Participant farmers indicated they need MAIS information available in a variety of media formats [11 word counts]. The preferred media formats were SMS text messages to those with literacy skills [6 word counts] and voice calls or Integrated Voice Response (IVR) for farmers with limited literacy skills who used MAIS platforms [3 word counts]. A couple of farmers noted that video and audio files could be shared via Bluetooth or social media matching digital skills of the farmers [2 word counts]. Respondents suggested that the same message be developed into several media formats to provide farmers with choices based on their literacy and digital skills. [MF4-2] said, "I would be glad to receive SMS text messages and if there would be a possibility to access some illustrations through the videos on best farming practices from farmers elsewhere."

Research Question 5: What are the key challenges, suggestions for improvement and opportunities for farmers to access mobile agricultural information services?

4.2.5 Farmer Participants' Key Challenges and Opportunities for MAIS

4.2.5.1 Respondents' responses on challenges for MAIS

Farmer participants were asked if they faced challenges concerning mobile technology and mobile agricultural information services. The overall results in Table 56 indicate that 60% of the participants had challenges. Over two-thirds (70%) of the respondents from Mitundu EPA indicated they experienced challenges as compared to Mpingu where less than half (49%) reported experiencing challenges.

Table 56

Farmer participants' challenges on mobile technology and MAIS

Responses on challenges	Extension Planning Area (EPA)				Total (N=289)	
	Mpingu (n=147)		Mitundu (n=142)			
	Frequency	*Percent (%)*	*Frequency*	*Percent (%)*	*Frequency*	*Percent (%)*
Yes	72	48.97	100	70.42	172	59.69
No	75	51.02	42	29.58	117	40.31

4.2.5.2 Respondents' list of main challenges for MAIS

Most farmer participants indicated that their major challenges to accessing mobile agricultural information services were lack of awareness (45%), followed by a poor quality network (17%), limited electricity (11%), and lack of money (7%). Just over half (52%) of the respondents from Mpingu indicated that their main problem was lack of awareness. In Mitundu, poor network (25%) and lack of electricity (13%) were two noted problems (Table 57).

Table 57

Respondents' main challenges for mobile agricultural information services

Main Challenges on MAIS	Extension Planning Area (EPA)				Total (N=258)	
	Mpingu (n=124)		Mitundu (n=134)			
	Frequency	*Percent (%)*	*Frequency*	*Percent (%)*	*Frequency*	*Percent (%)*
Lack of awareness	64	51.61	51	38.06	115	44.57
Poor network	11	8.87	34	25.37	45	17.44
Electricity	11	8.87	18	13.43	29	11.24
Lack of money	13	10.48	7	5.22	20	7.75
High airtime cost	7	5.65	5	3.73	12	4.65
Costing of voice and SMS text messages	4	3.22	4	2.98	8	3.10
Lack of digital skills	4	3.22	4	2.98	8	3.10
Illiteracy	3	2.42	2	1.49	5	1.94
Lack of technological skills	3	2.42	1	0.75	4	1.55
Misconducts at battery charging points	1	0.81	3	2.24	4	1.55
Use of foreign languages	1	0.81	2	1.49	3	1.16
Outdated messages	0	0.00	2	1.49	2	0.78
Stopped sending	1	0.81	0	0.00	1	0.39

Note: Multiple response results

4.2.5.3 Farmer participants' opinions on challenge and opportunities for MAIS

The fifth research question has two assertions that supported the challenges and opportunities from the perspectives of the participant farmers. Firstly, *the participant farmers reported limited infrastructural capacity and marginal benefit to costs of mobile agricultural*

information services and secondly *the respondents suggested integrating MAIS into existing extension programs with more interactive approaches.* The two assertions were supported by three themes and quotations to validate the farmers' claims.

In the first set, the respondents were asked about the perceived challenges of MAIS in rural areas. It was asserted that '*Participant farmers reported limited infrastructural capacity and marginal benefit-to-costs of mobile agricultural information services.'* This was supported by three categories: 1) limited capacity of electricity; 2) limited capacity of mobile network; and, 3) marginal benefit-to-cost ratio. This was supported by quotations on each of the categories.

Limited capacity of electricity. Farmers reported that a significant issue hampering MAIS in remote areas is the lack of electricity [64 word counts]. Farmers recharge, for a fee, their phone at a trading center or a homestead close to their home that has electricity. In cases where they do not have enough money to recharge their phone, their instantaneous access to MAIS is severely limited. As a result, many farmers have extra batteries or a second mobile handset to alternate charging. Limited access to electricity has also prompted farmers to use mid-range phones with longer battery life.

> [FF2-1] said, "We do not have electricity in our homes so we pay Mk50.00 ($0.09) to charge mobile phones at the trading center. If we do not have enough money for charging then we stay with dead mobile phones in pocket."

The respondents also pointed out that frequent power outages (blackout) hinder phone recharging. This is a major threat for effectively using MAIS in rural areas where they have few alternative sources of power.

Limited capacity of mobile network. The participant farmers lamented over the poor quality of the network in some typical rural areas [64 word counts]. They reported missing important messages due to unavailability of network or network interruptions in voice call conversations. To combat this, farmers must periodically move to a spot where network reception is possible to enable receiving or making phone calls. A Village Headman from Mpingu [VH1-1] said, "It must be told to them (Mobile Network Service Providers) we need good quality mobile networks. We always have to search for an elevated place where we could clearly talk on the phone."

Limited benefit to cost ratio. A significant number of the farmers do not expect a positive benefit to cost ratio from using MAIS [109 word counts]. This is due to the high cost of prepaid recharge airtime. They indicated that affordable airtime charges are necessary which matches with the quantitative results. Some demanded that some of the services in almost all media formats be free.

In the second set of suggestions, the participant farmers requested that improvements be made to the available MAIS. It was asserted that *Participant farmers wanted to integrate MAIS into existing extension programs with more interactive approaches.* This was supported by the following three categories: 1) promote an integrated MAIS approach within the existing extension programs; 2) promote peer-to-peer interactions on MAIS; and 3) promote researcher-extension-farmer interactions through MAIS. These were supported by the following quotations.

Promote integrated MAIS into existing extension programs. Participant farmers suggested that there was a need to have MAIS fully supported by existing conventional extension systems [36 word counts]. Farmers who wanted some assistance to apply the information and validate the messages raised this. They desire to contact their nearest extension officer for

assistance, but often find an officer who is not aware of the messages sent. [FF2-1] said, “I still feel that extension officers should assist us to successfully use MAIS, since they live nearby.” It was also noted that other Information and Communication Technologies such as face-to-face, radio and print media should be used to support MAIS [15 counts]. The farmers noted that other mobile services such as mobile banking are very popular due to promotions on other media such as radio, TV, and print media.

Promote peer-to-peer interactions on MAIS. The participant farmers expressed that there is a need to mobilize farmers with the same farming enterprise(s) so they can share information accessed from MAIS [21 counts]. It was suggested that this could encourage joint learning processes and facilitate stronger feedback mechanisms to MAIS providers. The peer-to-peer groups could also serve as the information hubs for indigenous knowledge sharing platforms. [FF2-2] said, “It would be important to discuss the mobile messages with a group of other farmers with same interest to learn from their actions too.”

Promote researcher-extension-farmers interactions. The participant farmers demanded to be in contact with researchers as well as extension officers on appropriate information [9 word counts]. They felt that MAIS should be complemented with researcher and extension visits to farming communities. This would help farmers clearly understand new and complex information through a richer and deeper learning process that is only available in a face-to-face learning environment. A Group Village Headman from Mitundu [GVH1-1] said, “I have been observing that we do not have any research and extension collaborative visits. This would be an important option to give out our challenges which can be responded by MAIS.”

CHAPTER 5: CONCLUSIONS AND POLICY IMPLICATIONS

5.1 Introduction

This chapter contains conclusions that were drawn based on quantitative and qualitative analysis in relation to the five research questions and the conceptual and theoretical frameworks. The conclusions section presents a discussion based on importance of the results rather than following the order of research questions. This chapter also presents the recommendations discovered by researcher during analysis of results on: 1) mobile agricultural information services on existing extension programs; 2) the policy implications on Mobile for Development; and, 3) future studies based on limitations of this study. Following are the research study's purpose and research questions

5.2 Purpose of the Study

The purpose of this needs assessment study was to identify the potential for using mobile technology to provide agricultural information and advisory services to farmers in Lilongwe District of Malawi.

5.3 Research Questions

The research questions guiding this study were:

1. What types of mobile phone were farmers using and to what extent did they use the technology?

2. Were the farmers aware of mobile agricultural information services and to what extent do they use them with additional mobile services?

3. What were the farmer participants' motivations and optimism to use mobile agricultural information services?
4. What were the farmers' preferred agricultural information (topics, channels and sources) and willingness to pay for mobile agricultural information services?
5. What are the key challenges, suggestions for improvement and opportunities for farmers to access mobile agricultural information services?

5.4 Conclusions

5.4.1 Although farmers were aware of mobile money transfer services, they were not aware and were not using mobile agricultural information services (MAIS). Moreover, farmers with mobile phones need knowledge and skills to use MAIS.

The results revealed that farmers with mobile phones were not aware of mobile agricultural information services as compared to mobile money transfer services. This was a major finding on why farmers were not using mobile phones technology for farming business in rural remote areas. It also suggested that farmers were capable of using the same tool for farming-based mobile money transfers. The increased percentage of farmers using mobile phones for banking was a result of intensive promotions by Airtel money and TNM Mpamba. No such promotional programs currently exist for MAIS. Similar studied in the East African Region have found that farming communities have also embraced the use of mobile money transfer services such as M-Pesa, M-Sente, Z-Pesa, and Zap (Masuki et al., 2011), as well as mobile agricultural information services for agricultural business (Nyamba, 2012).

Although Malawi's extension system has developed an IVR and SMS text messaging system (platforms), few farmers were aware of these mobile agricultural informational systems. The results also pointed out that even fewer farmers were using these services, even though offered to them for free. In other terms, there were no financial restrictions to using MAIS. While financially the barrier was removed, the farmers did indicate that they lacked the knowledge and basic skills to use, effectively, the MAIS currently being developed by Extension. This was in agreement with one of the resolutions from a workshop held in the Asia and the Pacific Regions in 2012, where awareness and capacity development (for farmers) were mentioned as critical solutions for successful MAIS (FAO, 2012).

This conclusion also supports the 'digital divide' on the second and third levels because of the inequalities on capability and outcomes for farmer with mobile technology access due to differences in awareness of MAIS (Wei et al., 2011). This applied to most farmers in Lilongwe who were not aware of both SMS text and IVR services preventing them from using the existing MAIS. Even for those farmers who indicated an awareness they reported only receiving messages on a few crop production practices. It was discovered that using Rogers', (2005) diffusion of innovation theory, we could analyses the categories of farmers adopting MAIS could assist in promoting the services from innovative to laggards at the local community level. The promotion of this service by the early adopters could be limited by their dissatisfaction or misunderstanding of the service and hence a reluctance to promote, by word-of-mouth, this new technology with other farmers. Farmers who revealed that they quit an IVR call because they thought they were getting charged verified this dissatisfaction and misunderstanding. Many of the farmers were still evaluating MAIS and could not share the information about the benefits of using the services such as free IVR messaging.

5.4.2 Farmers were motivated to use mobile technology and optimistic to access mobile agricultural information services for develop rural communities.

Farmers generally agreed with statements that reflected the utility value and economic benefits of using MAIS. In the Lilongwe context, farmers were motivated to use mobile technology for advisory services, input and output market transactions, weather information, and mobile banking services. They supported the mobile for development concept because it encompasses a holistic approach to rural livelihood (Duncombe, 2012; Svensson & Wamala, 2012). Farmers, in the study, were reluctant to share information they received via MAIS with other farmers. This may indicate they consider their mobile phone an individualized device, containing personal information rather than public information such as is implied when information is shared via radio. This result supported the evidence that mobile phone ownership and use is allied to an emerging individualized culture as opposed to group based approaches (Duncombe, 2012).

Farmers were interested and optimistic that MAIS could be used as a tool for rural development. The qualitative results indicated that the farmers recognized the potential for MAIS to improve the rural livelihood through direct communication, coordination and cost-effective transactions. This supported studies that concluded mobile phones are using innovative applications and services to transform lives and enhance rural and economic development (Duncombe, 2012; Aker & Mbiti, 2010).

On the other hand, farmers recognized that there are a limited number of public extension agents to cover a large working area and respond to the needs of all farmers. Most farmers expressed that MAIS should complement other extension service delivery methods since they are timely, reliable and less costly. Mobile agricultural information service providers and developers

should work to diversify their applications and increase their functionality to effectively support farmers at different agricultural production levels (Baumüller, 2012). However, some farmers wanted to know when they could begin accessing MAIS. This implied that the farmers surveyed were anxious to use MAIS as a new extension innovation but needed technical support (Aker & Mbiti, 2010).

Some of the farmers surveyed indicated that obtaining a handset was problematic. They indicated an interest in receiving a free mobile phone handset, as some farmers received from a grant-funded project. This was mainly a need voiced by farmers who could not afford the mid-range mobile handsets with enhanced capabilities such as expandable memory, FM radio, and Bluetooth for multimedia file sharing. This conclusion supports Eccles and Winfield's expectancy-value motivation theory (Wigfield & Eccles, 2000); and the 'Digital Divide' concept (Wei et al., 2011). First, expectancy-value motivation theory focuses on utility values and cost beliefs. Values cited by the farmers included: 1) usefulness and appropriateness for creating awareness; 2) transferring knowledge about agriculture technologies; and 3) facilitating market transactions of MAIS. This was in agreement with the conclusion that farmers feel more comfortable with mobile technology and adapting to new things (Fu & Akter, 2011). Farmers believed that MAIS was less expensive to implement (frequency, travel cost, time, and incidentals) as compared to traditionally conducted extension meetings. When farmers were asked about the effectiveness of the two methodologies, they indicated that, in their view, there is no difference between the two methodologies on agricultural productivity and rural livelihood. With each methodology seen as equally effective, the impact of a particular methodology will rely heavily on the farmer's motivational level. This conclusion supports the 'digital divide' conceptual theory on the second and third levels where the differences in farmers' motivation

will lead to inequalities in their capabilities to effectively use mobile agricultural information services negatively impacting their agricultural operation (Wei et al., 2011). This will lead to those with a high level of motivation being innovators and potentially benefitting from the more accessible agricultural information while the less motivated will likely lag failing to use MAIS, hindering them in growing and developing their farming operations and communities.

5.4.3 Farmers purchased and used mid-range mobile phones for voice and SMS text messages on a daily and weekly-basis, respectively.

The results analysis concluded that most farmers purchased their own mid-range phones with a few receiving them as gifts from relatives or projects. This confirms a report by Donovan, (2011), that most farmers own mobile phones of different brands and capabilities that are relevant for agriculture. In contrast, Malawian farmers are lagging behind the world on the use of mobile agricultural applications powered by smart phones (FAO, 2012). It was also concluded that the mobile media formats commonly used by farmers for their communications were voice calls and SMS text messages on a daily and weekly basis, respectively. A study conducted by Katengeza, found that some institutions like MACE, were using SMS text message mobile media formats and were ready to deliver MAIS through IVR format in Malawi (Katengeza, 2012). The analysis also concluded that farmers were not using other mobile phone capabilities, such as the FM radio, personal digital assistant, multi-media player, camera and mobile internet. This finding was attributed to several challenges like lack of basic skills (literacy and digital) and limitations of mobile technology (battery life and high associated costs) indicated in Chapter 4.

The first conclusion supports the ‘digital divide’ conceptual model. According to the study by Wei et al., (2011), digital divide was categorized into three levels: first level, access to technology; second level, capability inequalities; and third level, outcome inequalities. In this

study, the emphasis was mainly on the second and third levels of the digital divide model because all of the participant farmers owned a mobile phone. Farmers who lack the capabilities to effectively use mobile technology fall in the second level of the 'digital divide' and their limited abilities affects their outcomes (third level) reducing their benefit from MAIS. However, the literacy test results indicated that most farmers with mobile phones (87%) were literate and comprehended the content. The key issue that needs to be addressed is enhancing the farmer's digital skills since mobile technology continues to advance and most farmers are lagging behind.

5.4.4 Farmers preferred and nearly half were willing to pay for MAIS that deliver voice and text messages in a timely, relevant, current, and dependable manner.

It was concluded that farmers preferred mobile agricultural information to be supplemented by a variety of informational channels such as face-to-face, radio, television, Internet, CD-ROMs and print media. This was in agreement with the idea that, as new agricultural communications technologies brought changes in extension systems that has been historically dominated by face-to-face interactions and paper-based information systems among major agricultural extension providers (Simuja, 2012). Making reliable data available using mobile phone-based information services has paved the pathway for expanding this technology into other information dissemination content areas, such as agriculture, in rural areas (FAO, 2012). In previous studies the reported farmers' preferred mobile media formats were also voice and text messages as channels within MAIS (Simuja, 2012; Katengeza, 2012). This result validates by the farmers' current usage of mobile phones in Lilongwe.

Farmers preferred the extension service as a source of information and MAIS provider. This is because farmers trust the information when provided in face-to-face settings with an extension agent whereas the level of trust in mobile technology delivered information is less.

Therefore, if public extension (who farmers trust) was the source of the information delivered via mobile-based technology than farmers may more likely utilize MAIS. This result agrees with Duncombe's (2012) findings that historically trust levels and the complexity of information needs of the farmers are better when they feel more personally connected to the information provider. In Malawi, the public extension system remains the largest agricultural information provider in terms of staff and coverage at the national level (Masangano & Mtinda, 2012). This implies that, the Department of Agricultural Extension Services under the Ministry of Agriculture, Irrigation and Water Development is in an ideal position to spearhead the development and validation of appropriate content for mobile agricultural information services. It can also collaborate with other public and private institutions to execute effective mobile agricultural information services.

It was also concluded that the farmers want agricultural information that is timely, relevant, current and dependable and are willing to pay for the MAIS, if they perceive the benefits to outweigh the cost of the service. This supports the fact that farming is an information intensive sector that requires awareness of the best practices and technical know-how to assist in making appropriate decisions at all productivity levels (Fu & Akter, 2011; FAO, 2013). The results were in agreement with the notion that mobile agricultural information services have the potential not only to reduce information and transaction costs, but also allow regular and timely access when needed (Baumüller, 2012). This conclusion implies that farmers are motivated to use agricultural information when the information is useful and can be applied to productively manage their system, to enhance market access and to make financial decisions.

This conclusion supports the Expectancy-value of motivation and Blumler and Katz's Use and Gratification Theory (Blumler & Katz, 1974). Firstly, the farmers expected MAIS

would provide them with frequent, relevant, timely and dependable services. Such a system would motivate them to use the agricultural information for their knowledge and desired actions. In Malawi's context, this translates to improving the current MAIS system so that it provides information that is matched with specific farming tasks at a particular time of the season. Secondly, the Use and Gratification Theory focuses on how people use media for all sorts of their needs and gratifications (Ruggieo, 2000). The farmers clearly stated, based on their experiences, the types of services desired and that the information must be timely and actionable to meet their needs and satisfaction. They also reported that they were willing to pay for MAIS that could satisfy their cognitive, personal integrative and tension-free needs in the short and long term to improve on their productivity and rural livelihood. For example, some farmers expressed their dissatisfaction with the current IVR services because it took them too long to navigate through the leading parts to get to the three-minute voice message. In other cases, the farmers expressed their desire for the information to be delivered via multiple mobile media formats, thus making the information available in a user-friendly format (i.e., videos and step-by-step audio instruction on agronomic practices) to suit rural information needs.

5.4.5 Farmers reported three major challenges: 1) lack of knowledge of mobile agricultural information services (MAIS); 2) marginal benefits to costs of using mobile technologies and MAIS; and, 3) limited capacity of infrastructures (i.e., electricity and mobile networks) to support the use of mobile technologies.

Lack of knowledge of mobile agricultural information services was the most commonly reported limitation among farmers with mobile phones. For those farmers who reported being aware of MAIS they indicated they were not knowledgeable on how to use the existing MAIS.

Numerous farmers cited learning about the MAIS informally and expressed interest in learning more about the existing MAIS from the study. This concurs with other studies (Aker, 2011; FAO, 2012; Duncombe, 2012). Baumüller (2012) that found a number of challenges associated with the use of mobiles agricultural information services, such as the lack of basic skills (literacy and digital) and limited knowledge on the use of various mobile agricultural platforms (i.e., integrated voice response systems). Per this discovery, for farmers to effectively utilize MAIS they will need training to provide a basic level of knowledge and information on how to operate the technological systems.

The study found that farmers shared concerns about the costs of MAIS and expressed a need for information shared via mobile phones to be free or at a reduced cost. At present, farmers perceived there was a marginal benefits to costs ratio for using mobile agricultural information services. This is likely because there was limited knowledge on the current MAIS programs and the potential benefits they could offer their family, community, and them. According to Baumüller (2012), issues worth consideration with MAIS in rural areas include providing the service to those who are marginalized and poor, restricted by distance, lower in social standing, and limited in their ability to pay for MAIS. An associated cost of doing business besides the cost of accessing MAIS was the cost of maintaining the mobile phone.

Many farmers shared challenges with limited capacity of the infrastructure. Farmers rated limited access to electricity as the most critical challenge for MAIS because it can cause them to miss voice calls when the battery of mobile phone is dead and they find going to a business to recharge the phone extremely inconvenient. Another significant concern was the poor quality of the network, which limits the accessibility, and effectiveness of the MAIS. With a poor network, farmers were forced to physically move to a point where they can receive a cellular signal

permitting reception of a clear message via IVR. The poor network can be even more challenging for female farmers as they may be less likely to use innovative access strategies such as climbing to the top of a tree to search for mobile network signal (Baumüller, 2012). The lack of electricity affects many rural farmers who have to travel to trading centers where they spend considerable time charging their phones. The cost for charging a phone is also a significant problem for farmers. If the farmers do not have sufficient funds to recharge their phone, they may miss important messages during times when their phone is not operational.

This conclusion supports the 'digital divide' on the first and second levels (access and capability divide) due to infrastructure limitations and lack of knowledge and expectancy-value theory on marginal benefits for the costs. Firstly, the limited infrastructural capacity contributes to the marginalization of the farmers in rural areas where mobile networks are a problem. They struggle accessing MAIS due to technological challenges as data from Mitundu EPA verified. On the second level of 'digital divide', those with limited knowledge on the use of MAIS platforms were lagging behind as they were unable to access the available agricultural information. The limited infrastructural capacity and MAIS knowledge tends to create, in the farmers, low motivational levels because they are unaware of the potential associated cost-benefits. The negative impact of these limitations were noted when farmers reported not using Esoko, a free SMS text-based platform because of limited infrastructural capacities and knowledge.

5.4.6 Farmers expressed the need for an integrated mobile agricultural information service using interactive two-way approaches within existing extension programs.

The farmers expressed that the current MAIS platforms provides one-way information flow through both IVR and SMS text messages. An integrated system combining MAIS with the

traditional Extension system would provide the opportunity for a farmer to seek clarifying information from an Extension agent or researcher on a message originally delivered using MAIS. It was found that as the complexity of agricultural information increases and new services are implemented the demand grows for more urgent and integrated services with broader support from extension agents and researchers (Baumüller, 2012). It should be noted that mobile agricultural information initiatives, those being developed beyond the extension services capabilities are being implemented to support the existing traditional information sharing platforms. For example, a Call Center[3] was commissioned in 2015 by Farm Radio Trust in Lilongwe where experts respond instantly to farmers' information needs on various topics.

Farmers also shared that there was an opportunity for MAIS to facilitate group sharing of ideas among farmers as they discuss ways to apply the content conveyed in IVR or SMS messages. This was referred to as Farmers Information Hubs[4] by one of the projects delivering climate information in Malawi's southern district of Balaka. This was conceptualized to gather indigenous knowledge and share new MAIS-provided information.

Although farmers indicated a preference for MAIS, they expressed an interest in new services being promoted through other communication channels such as radio, TV, print media and face-to-face. Farmers noted that mobile money services were promoted heavily on other media and as a result gained a lot of popularity unlike the agricultural information services. Some farmers suggested that MAIS should be integrated with the above-mentioned communication channels for successful message delivery.

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[3]*Call Center* is a virtual service providers to farmers through phone calls

[4]*Farmers Information Hubs* are farmer clubs that discuss issues presented by media on farming

This conclusion supports the digital divide at the third level where output inequalities can be reduced by peer-to-peer information sharing, calling experts and use of alternative communication media. There is a need to find new and innovative ways to deliver appropriate messages and engage farmers. In the context of Malawi, the existing MAIS were operating in isolation and the farmers were not provided a mechanism to ask important questions. Integrating MAIS with other communication channels and incorporating a human presence, whether researcher or extension agent, will provide for a stronger and more consistent system. Secondly, it supports the use and gratification theory where farmers receive gratification through a more responsive and engaging MAIS that provides timely agricultural information. The farmers in the study express a level of unhappiness with the MAIS not being connected more closely with extension agents and researchers to whom the farmers turn when clarifying information is needed on information they have received via SMS test messages.

5.5 Recommendations for Practices

The following recommendations were made based on the six conclusions of the study as above. The recommendations for practice on mobile agricultural information services (MAIS) were directed to all extension providers and Public Private Partnership (PPP) for successful MAIS delivery in Lilongwe district.

It is recommended that mobile agricultural information service providers create awareness among rural farming communities about their services employing the same strategies used for promoting mobile money transfers services. This should be done since MAIS are a relatively new innovative extension service delivery. According to Rogers (2003) adoption of innovations, only the innovators use technological information since they have information

seeking behavior. Awareness campaigns using interpersonal, radio, television, and print communication in more time dimensions would lead to more awareness among the farmers to use MAIS, assisting them to make informed decisions. The opinion leaders (ones using MAIS) would assist to promote MAIS amongst their peers if they were satisfied with these new extension services. The analysis of the results indicated the need for external interventions to boost awareness of MAIS providers, importance of services, business models and mobile media formats used.

It is recommended that extension service providers register farmers with mobile phones and develop a database to be used by MAIS service providers. The farmers' profiles would assist MAIS match their information with the timely and appropriate needs of the farmers. The updated database could be populated through various strategies such as extension meetings, local field days, market days, farmers clubs, and community centers. This should be done in partnership with local leaders and mobile network service providers. The same can be done to promote MAIS to extension officers, lead farmers and farmer clubs via Bluetooth, social media and web-based tools.

Mobile agricultural information service providers should develop messages in formats suitable for farmers' mid-range and basic mobile phones. Ideally, farmers would be able to access agricultural information using the most appropriate mobile-based media (i.e., voice calls, SMS text messages, videos and audios). The messages uploaded should be up-to-date, delivered on a daily and weekly basis, and available in multimedia formats as demanded by the farmers for their choices and uses. MAIS should also be made more accessible to underprivileged farmers who are unable to pay for them to make critical farm decisions.

Extension service providers must provide both crop and livestock production information on MAIS formats in a sustainable manner. The majority of the farmers were not satisfied with existing MAIS. There is a need to establish a variety of business models that will meet the needs of all farmer categories. MAIS providers should be encouraged to develop and distribute relevant agricultural information that may be retrieved easily for the benefit of the farmers.

It is recommended that extension service providers develop new and innovative program to enhance the knowledge and skills of farmers so they can effectively use existing MAIS. There is a need to train and motivate farmers to use their mobile phone's digital capabilities to access MAIS. The trainings must be done using participatory or farmer-to-farmer approaches in the local facilities to avoid negative perceptions about the complementary innovative approaches. The visual aids and experiential learning materials should be developed for farmers with different learning abilities to understand the concepts and theories for their future use. There is a need to enlighten farmers on the advantages and cost-benefits of using MAIS.

It is recommended farmers have a second battery for their phone to overcome current mobile technology power challenges. A battery typically costs between MK 2500-6000 ($4-10). This would substantially increase the likelihood that farmers will have access to messages and other digital-based information, while alternating recharging the batteries. Additionally, extension practitioners should encourage farmers to use alternative charging sources such as solar power to recharge mobile phone batteries in rural areas.

It is recommended that mobile network service providers (MAIS) improve the quality of their network in rural areas, such as Mitundu and Mpingu. Improving network capacities would increase the probability of farmers being able to access timely and important agricultural

information. For MAIS to reach a large percentage of rural Malawian farmers cellular providers must boost the reach and reliability of their network.

Lastly, it is recommended that MAIS providers collaborate with extension service providers to deliver integrated mobile agricultural information services using interactive two-dimensional approach in a harmonized manner. Farmers want opportunities to comment or get clarifications on agricultural information accessed from MAIS. Expert opinions and facts from researchers, extension officers and lead farmers should be provided in support of the new innovative extension system since farmers still value face-to-face and radio communications. MAIS providers should also seek input and feedback from farmers on diverse topics, appropriate messages, and key sources of agricultural information for success of MAIS.

5.6 Implications for Policy

5.6.1 Implications on Extension Service Delivery and ICT Policy for Agriculture

- The Agricultural Extension System must fully embrace the National ICT policies, incorporating them into existing programs while developing mobile phone communication strategies specific for rural farmers.

- It is recommended that a new policy on mobile agricultural information services be developed that is in-line with Malawi's National Extension Policy of 2003. This will assist in guiding and directing all players opting for a mobile phone-based extension provision to combine their efforts to advance appropriate development agendas in rural farming communities. Previous studies conducted by Katengeza in 2012 and Simuja in 2013 expressed the same need to formulate new policies in terms of mobile marketing

systems. The policy should also include the roles of various players in ensuring provision of timely, relevant, current and sustainable MAIS to all including the resource poor farmers with access to mobile phones.

- The Department of Agricultural Extension Services (DAES) must continue providing leadership in establishment of an integrated MAIS that incorporates a two-way interactive approach. It should be noted that the department formulated the National Agricultural Content Development Committee for ICT (NACDC) in collaboration with private and public sectors. In that regards, DAES has a rich history and farmers' trust to coordinate harmonized delivery of agricultural information through innovations such as mobile phones.

- The extension system should form a coalition of public and private entities to explore the feasibility of establishing phone-charging stations that would be more conveniently located for the farmers and which offer recharging services at a price that farmers can afford.

5.6.2 Implication on Policies for Mobile Service Providers

- Mobile Service Providers should help farmers navigate the limited capacity of the infrastructure (i.e. electricity and mobile networks) to support the use of mobile technologies. MAIS providers must invest in alternative energy sources such as solar power to provide farmers with the capability to charge their phones on a regular basis as battery life and recharging services were two limitations cited by farmers with mobile phones.

- Public and private entities need to invest in alternative energy sources (i.e., solar power and multiple batteries or power-bank batteries) to enable farmers the capability to charge their phones on a regular basis. Battery life and recharging services were two limitations cited by farmers to the use of mobile phones to obtain agricultural information.
- Extension should create a coalition, to include cellular and agricultural information providers, to create a plan for implementing MAIS services designed to meet the needs of a range of farmers with different levels of ability to pay. This study found that a majority of the farmers indicated they had limited resources that would enable them to afford the existing MAIS.

5.7 Recommendations for Future Research Studies

In the researcher's view, this study was the first of its kind to looked at the potential of using mobile phone technology to access agricultural information services to farmers in Malawi' Lilongwe District. It is hoped that the study provided foundational information that can be used by various practitioners including researchers, extension service providers, mobile network operators and policy makers to improve MAIS in Malawi. However, the following limitations were faced and therefore established a need for recommendations for further research.

Recommendation #1: Since the survey involved only participant farmers who represented Malawi's Lilongwe District, the results of this study cannot be generalized beyond the Lilongwe District. To achieve a representative sample the two selected EPAs were randomly selected from nineteen in the district. It is therefore recommended that future studies on MAIS in Malawi should consider selecting more EPAs in other parts of Malawi for more generalizability on the farmers' use of MAIS and their information needs.

Recommendation #2: The second limitation was on representation of all the farmers with mobile phones from the two randomly selected research sites. The problem was that there was no existing registry or formal database of farmers with mobile phones at the EPA or District levels. The study's target population was identified by conducting a compilation exercise of all the farmers with mobile phones in all ten (10) Sections to represent the two EPAs. For credibility of the results, the local extension officers and local leaders were tasked with compiling a list of all farmers with phones in their areas. However, not all farmers were registered since due to time limits and long distances to typical rural areas. The researcher conducted a verification exercise to establish the exact numbers. It was determined that at least 80% of the farmers with mobile phones were captured and included on the list that formed the basis from which a random sample of participants was selected. Future studies, for better representations and generalizability, should identify existing databases or if they are not available, independent, unbiased personnel should be utilized to create a list of farmers with mobile phones.

Recommendation #3: The process of translating the English questionnaire into Chichewa, and testing and adapting the questions for better understanding of the farmers was tedious and took too much time. Various language experts were involved to ensure that each aspect of the tool was the same as the context of the study. The translated tools were pretested and utilized with the participants and then coded back to proper English for easy data entry process. It is therefore important for future studies to employ other ways of balancing the language or content in the instruments to cut the translation costs to suite Malawian context. This might include computer applications or language replacement charts to aid the process.

Recommendation #4: The study used a cross-sectional survey method that documented the information at one point in time. This has some shortfalls since data was collected during

commencement of a new cropping season (2015) and at a time when there was some disease outbreaks affecting chickens and pigs. It is therefore recommended that future studies be conducted using a longitudinal survey approach to minimize the impact of seasonal farming influences and specific agricultural events on the farmers' responses.

Recommendation #5: There was limited application of the diffusion of innovation theory as well as use and gratification theory since they were not considered during the research design stage. Both theories were used, to a lesser extent, in the explanations focused on the farmers' awareness of MAIS and how they felt about existing mobile services. Future MAIS-focused studies should incorporate, in the early stages of the research design process, these theories since they were deemed applicable.

Recommendation #6: It was also noted that use of the Survey research methodology presented some typical limitations to capturing all the agricultural information needs of farmers with mobile phones. The researchers in this study implemented a mixed modes research design to triangulate the quantitative data and address other shortcomings of the Survey research design. It is therefore recommended that, qualitative studies should be conducted to obtain more in-depth information and to build solid Mobile for Development (M4D) theories.

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APPENDICES

APPENDIX A: Approval Letters to Conduct Research Study

PURDUE
UNIVERSITY

HUMAN RESEARCH PROTECTION PROGRAM
INSTITUTIONAL REVIEW BOARDS

To:	ROGER TORMOEHLEN AGAD 215
From:	JEANNIE DICLEMENTI, Chair Social Science IRB
Date:	03/27/2015
Committee Action:	Approval
IRB Action Date	03/27/2015
IRB Protocol #	1412015516
Study Title	Farmer's Use of Mobile Technology For Agricultural Information and Advisory Services in Lilongwe District of Malawi
Expiration Date	03/26/2016

Following review by the Institutional Review Board (IRB), the above-referenced protocol has been approved. This approval permits you to recruit subjects up to the number indicated on the application form and to conduct the research as it is approved. The IRB-stamped and dated consent, assent, and/or information form(s) approved for this protocol are enclosed. Please make copies from these document(s) both for subjects to sign should they choose to enroll in your study and for subjects to keep for their records. Information forms should not be signed. Researchers should keep all consent/assent forms for a period no less than three (3) years following closure of the protocol.

Revisions/Amendments: If you wish to change any aspect of this study, please submit the requested changes to the IRB using the appropriate form. IRB approval must be obtained before implementing any changes unless the change is to remove an immediate hazard to subjects in which case the IRB should be immediately informed following the change.

Continuing Review: It is the Principal Investigator's responsibility to obtain continuing review and approval for this protocol prior to the expiration date noted above. Please allow sufficient time for continued review and approval. No research activity of any sort may continue beyond the expiration date. Failure to receive approval for continuation before the expiration date will result in the approval's expiration on the expiration date. Data collected following the expiration date is unapproved research and cannot be used for research purposes including reporting or publishing as research data.

Unanticipated Problems/Adverse Events: Researchers must report unanticipated problems and/or adverse events to the IRB. If the problem/adverse event is serious, or is expected but occurs with unexpected severity or frequency, or the problem/even is unanticipated, it must be reported to the IRB within 48 hours of learning of the event and a written report submitted within five (5) business days. All other problems/events should be reported at the time of Continuing Review.

We wish you good luck with your work. Please retain copy of this letter for your records.

Ernest C. Young Hall, 10th Floor - 155 S. Grant St. - West Lafayette, IN 47907-2114 - (765) 494-5942 - Fax: (765) 494-9911

Figure 3, Approval letter from Purdue University IBR

Tel : 01750 384
Fax : 01750 384
Email: skankwamba@yahoo.com

Communication should be addressed to:
The Director of Agricultural Extension Services

DEPARTMENT OF AGRICULTURAL EXTENSION SERVICES, P.O. BOX 30145, LILONGWE, MALAWI

16th January, 2015

The Chair for Social Sciences IRB
Human Research Protection Program
Purdue University
Ernest C. Young Hall, Rm 1032
155 S. Grant Street
West Lafayette, IN. 47906-2114

Dear Sir/Madam

PERMISSION FOR MR. BENJAMIN FRANKLIN CHISAMA TO CARRY OUT RESEARCH ON THE FARMERS USE OF MOBILE PHONE TECHNOLOGY FOR AGRICULTURAL INFORMATION AND ADVISORY SERVICES IN LILONGWE, MALAWI

This is to confirm that Mr. Benjamin Franklin Chisama has been permitted to carry out research with farmers in Lilongwe District on the topic Farmers Use of Mobile Phone Technology for Agricultural Information and Advisory Services. The topic was approved by his MS. Thesis Committee members at Purdue University on 16th December, 2014.

Mr. Chisama works as Technology Dissemination Officer in the Department of Agricultural Research Services under Ministry of Agriculture, Irrigation and Water Development. He is back in Malawi to conduct his research as part of the requirements to fulfill his MS Degree in Youth Development and Agricultural Education at Purdue University. The study is culturally acceptable among the rural farming communities within Lilongwe District. In Malawi, many farmers are using mobile phones technology on daily basis to get agricultural information from various sources. This study will provide new information on how the farmers are accessing agricultural information via mobile phones. This will enable both public and private advisory systems to improve their services to suite farmers needs.

Your assistance in this regards will be highly appreciated as the finding of the study will help Ministry of Agricultural, Irrigation and Water Development to promote effective use of mobile phones among farmers for increased productivity and income in Lilongwe District.

Stella Kankwamba

Figure 4, Approval letter from DAES Malawi

APPENDIX B: Research Instrument Used (English version)

Farmer's Use of Mobile Phone Technology for Agricultural Information Service in Lilongwe District, Malawi

Introduction

I want to thank you for taking your time to meet with me today. My name is _____ and I would like to talk to you about your use of mobile phone technology for agricultural information and services. The outcome is going to assist the Department of Agricultural Extension Services as a public service provider in developing flexible approaches to disseminate agricultural information through information and communication technologies such as mobile phone. For you to participate in this study you must be 18 years or older. Do you meet this criterion? [ ] Yes [ ] No

The interview should take a maximum of forty-five minutes (45min). You must feel free not to respond to a question(s) that you do not want to; you are also free to drop from the interviews at any time you feel like you are no longer interested participating in the research. All the responses will be kept confidential. This means that your interview responses will only be shared with the principle investigator and any information included in the report does not disclose the identity of participants. Do you have any questions about what I have just explained? [ ] Yes [ ] No

Participation is voluntary and if you are not willing to participate there is no penalty or loss of benefit to which you are entitled as a smallholder farmer of Lilongwe District. If you have quarries or more information about the research please contact the principle Investigator or Co-investigator on the addresses give below:

Principal investigator contacts

Roger Tormoehlen, PhD
Youth Development and Agricultural Education
615 W. State Street
West Lafayette, IN 47907
Phone: +1 765 494 8422
Fax: +1 765 496 1152
Mobile: +1 765 714 4941
Email: torm@ppurdue.edu

Co-investigator contacts

Benjamin F. Chisama
Department of Agricultural Research Services
P.O. Box 30779
Lilongwe 3
Malawi
Phone: +265 1 707 123
Mobile: +265 999 667 728
Email: bchisama@gmail.com

Section A: Demographic Characteristics

Name of EPA: _____ Name of Section: _____ Name of TA: _____

Name of Village: _____ Age: _____ Gender: 1. Male 2. Female Household Number: _____

1.	What is your marital status? (*Select option*)	1. Single 2. Married 3. Divorced	4. Widowed 5. Separated 6. Others (specify):_____
2.	What is your education level? (*Select only one option*)	0. None 1. Primary School 2. Secondary school	4. Post-secondary 5. Others (Specify):_____
3.	What is your main occupation? (*Select only one option*)	1. Farming 2. Off-farm casual work 3. Fulltime employment	4. Small Business owner 5. Student 6. Other (Specify) _____
4.	Do you hold a leadership position in your community? (*If no, go to Q6*)	1. Yes	0. No
5.	*If yes*, what leadership position do you hold? (*Select one or more option*)	1. Village Head 2. Chief's Advisor 3. Lead farmer 4. Community Based Organization Leader 5. Farmer Club 6. Member of Political party	7. Member of Religious 8. Village Development Committee Member 9. School Committee member 10. Volunteer teacher 11. Women's group leader 12. Volunteer on health 13. Others (Specify) _____

Literacy Test			
6.	Can you read or write? (*Select one option*; *if neither go to Q10)*	1. Read only 2. Write only 3. Both read 0. Neither read nor write	
7.	*If you read,* would you mind reading aloud an SMS text messages? (*If yes go to 16)*	1. Yes	0. No
8.	Readability Observation (*If pass go to Q10*)	Score 1. Pass	0. Fail
9.	*If a fail,* Who assist you to read the messages? (*Select one or more options*)	0. None 1. Spouse 2. Children 3. Friends	5. Household members 6. Neighbors 7. Teachers 8. Others (Specify)

Section B: Farm Characteristics								
10.	How long have you been farming? (*Write down the number of years*)	_____ (years)						
11.	What is your main reason for farming? (*Select only one option*)	1. Food 2. Cash 3. Other (Specify): _____						
12.	What is the total land size of your farm? (*Write down the total land size)*	No.	Parcels	Area (Acres)		No.	Parcels	Area (Acres)
		1.				4.		
		2.				5.		
		3.					Total	

13.	What is your major farming enterprise? (*Select one)* (If selected both (3) go to Q 15)	1. Crop production 2. Livestock production			3. Both 4. Others (specify):_____			
14.	What have been your major crops enterprises for the past three seasons? (*Select one or more options and indicate the land size grown per year*) Types of cropping systems S=Sole cropping I=Intercropping	Name of Crop:	Area Grown (Acres):	Cropping System	Name of Crop:	Area Grown (Acres):	Cropping System	
		1. Tobacco:	_____	S/I	7. Cassava	_____	S/I	
		2. Maize:	_____	S/I	8. Sunflower	_____	S/I	
		3. Groundnuts	_____		9. Dimba crops	_____		
		4. Soybean	_____	S/I	10. Fruit orchards	_____	S/I	
		5. Common bean			11. Others			
		6. Cowpeas	_____	S/I	(Specify: ___	_____	S/I	
15.	*From the list above*, which is the major crop enterprise? (*Write down the response*)							
16.	What have been your major types of livestock reared for the past three seasons? (*Select one or more option and indicate the total number of livestock raised in three seasons*)	Type	Number		Type	Number		
		1. Dairy cattle	_____		7. Chickens	_____		
		2. Beef cattle	_____		8. Ducks	_____		
		3. Goats	_____		9. Rabbits	_____		
		4. Sheep	_____		10. Guinea pigs	_____		
		5. Pig	_____		11. Guinea fowl	_____		
		6. Donkeys	_____		12. Other (Specify):__	_____		
17.	*From the list above*, which is the livestock enterprise? (*Write down the response*)							

Section C: Socio-Economic Characteristics			
18.	What is your primary source of income? (*Select one option*)	1. Selling crop produce 2. Selling livestock 3. Casual labor 4. Renting out land	5. Small business 6. Regular salary/wages 7. Others specify: _____
19.	How much money do you make in a year?	Malawi Kwacha (MK)_____	
20.	What type of valuable assets do you have? (*Select one or more options*)	Asset / No./ House	Asset / No./ House
		1. Radio _____ 2. Television set _____ 3. Mobile phone _____ 4. Bick house roofed & Iron sheet _____ 5. Bicycle _____ 6. Moto bike _____ 7. Ox-carts _____ 8. Cars _____ 9. Axes _____	10. Hoes _____ 11. Ploughs _____ 12. Wheel burrows _____ 13. Treadle pump _____ 14. Motorized pumps _____ 15. Water cane _____ 16. Sickle _____ 17. Panga knife _____ Other (Specific): _____ _____

Section D: Mobile Phone Technology		
21.	Do you have a mobile phone? (*Select only one option*)	1. Yes 2. No
22.	If more than one, how many phones do you have? (*Indicate the number*)	_____
23.	What is the brand name(s) of the mobile phone(s)? (*Indicate the brand name of the phones used most*)	1. _____ 2. _____ 3. _____

24.	Which category of mobile technology is the handset? (*Read out the options and select one)*	1. Basic cell phone 2. Mid-range phone 3. Smartphone 4. Others (Specify): _____
25.	What are the functionalities or applications does your mobile phones have? (*Select one or more options*)	1. Voice Call 2. SMS text message 3. Multimedia player 4. Bluetooth 5. Personal Digital Assistance 6. Radio FM 7. MMs 8. Wi-Fi 9. Phone camera 10. GPS 11. Expandable memory 12. Internet 13. Social media apps 14. Other (Specify):_____

26. How often do you use the mobile phone's functionalities mentioned in 26?
(Check a column number with selected options from below)

Scoring Scale
1=never, I don't use
2=once per month
3=two to three times per month
4=once a week
5=two to three per week
6=once a day
7=two to three times per day
8=more than four times per day

Mobile functionalities	1	2	3	4	5	6	7	8	Reasons
1. Voice Call									
2. SMS text message									
3. Multimedia player									
4. Multi-recorders									
5. Bluetooth									
6. MMS									
7. Wi-Fi									
8. GPS									
9. MMS									
10. Phone camera									
11. Expandable Memory									
12. Internet									
13. Social media apps									
14. Other (Specify):									

27.	How did you acquire your handset (*Select one or more options*)	1. Gift for a relative 2. Purchased 3. Given by an organization 4. Others (Specify)
28.	Which mobile network(s) did you subscribe to? (*Select one or more options*)	1. Airtel 2. TNM 3. Access Mobile 4. Others (Specify): _____
29.	Which one do you prefer and why? (*Select one or more options*)	Preferred Mobile Network / Reasons 1. Airtel _____ 2. TNM _____ 3. Access Mobile _____ 4. Others (Specify) _____

Section E: Farmer's Access to Mobile Agricultural Information Services (MAIS)			
30.	Have you received any agricultural information on mobile phone in the past three months? (*If no, go to Q35)*	1. Yes	0. No
31.	Who were the sources of agricultural information that you received on mobile phone? (*Select one or more options*)	1. Extension agents 2. Agro-dealers 3. Lead-farmers 4. Processors	5. Family or friends 6. Researchers 7. NGOs 8. Others (Specify): _____
32.	Do you know the institutions providing mobile phone agricultural information services in your area? (*If no, go to Section H, Qn.54)*	1. Yes	0. No

33.	What are the names of the institutions providing MAIS? (*Select one or more options)*	1. Ministry of Agriculture (DAES) 2. Malawi Agricultural Commodity Exchange (MACE) 3. Tobacco Association of Malawi (TAMA) 4. Market Links 5. Malawi Milk Producers Association (MMPA) 6. Land O-Lakes 7. NASFAM 8. Concern World Wide 9. Airtel 10. TNM 11. Others (Specify) _____
34.	What are the names of the MAIS (*Select one or more options*)	1. Esoko 2. 3-2-1 3. ACE Mobile Market Information Service 4. Membership SMS texts messages 5. Organizational Websites 6. Others (specify): _____
35.	How did you learn about mobile agricultural information services? (*Select one or more options)*	1. Extension Agent 2. MAIS Representative 3. Friends 4. Family 5. Farmer meetings 6. Agro-dealers 7. Radio 8. TV 9. Newspapers 10. Other (Specify): _____
36.	Did you subscribed to any SMS text services? *(Select one option) [If no, go to Q 42]*	1. Yes 0. No
37.	Mention the name(s) of SMS text messaging platform? *(Write down the name)*	
38.	How did you join SMS platform? *(Select one or more options)*	1. Extension Agent 2. Lead farmers 3. MAIS Representative 4. Friends 5. Family 7. Radio 8. Agro-dealers 9. Mobile phone 10. TV 11. Other (Specify): _____

39.	What type of information did you accessed through SMS text messaging? (*Select one or more options*)	Information on crops	Information on Livestock
		1. Reminder on field activities 2. Soil fertility management 3. Crop varieties 4. Fertilizer application rates 5. Types of fertilizer 6. Pest and disease management 7. Alerts of outbreak of pest and diseases 8. Weather updates 9. Market prices 10. Crop insurance cover 11. Transport system 12. Irrigation practices 13. Field management 14. Financing 15. Others (Specify)_____	1. Reminders of daily activities 2. Housing of livestock 3. Improved breeds 4. Controlled breeding programming 5. Pest and disease management 6. Outbreaks of pest and diseases 7. Pasture management 8. Market prices 9. Livestock insurance cover 10. Transport systems 11. Banking and financing services 12. Livestock distribution system 13. Others (Specify)_____
40.	Did you pay for SMS text message services? (*Select one or more options*)	1. Yes	0. No
41.	How much did you pay for SMS text services? *(Write down the response)*		
42.	Did you have any challenges concerning SMS text message services? *(Select one or more options)*	1. Yes	0. No
43.	Did you subscribed to any Integrated Voice Response (IVR) services? *(Select one option) [If no, go to Q 60]*	1. Yes	0. No
44.	Mention the name(s) of Integrated Voice Response (IVR) platform? *(Write down the response)*		
45.	How many times did you use IVR services? *(Write down the response)*		

46.	How did you join IVR platform? *(Write down the response)*	1. Extension Agent 2. Lead farmers 3. MAIS Representative 4. Friends 5. Family	7. Radio 8. Agro-dealers 9. Mobile phone 10. TV 11. Other (Specify): _____
47.	What type of information did you accessed through SMS text messaging? *(Select one or more responses)*	Information on crops 1. Reminder on field activities 2. Soil fertility management 3. Crop varieties 4. Fertilizer application rates 5. Types of fertilizer 6. Field pest and disease management 7. Alert of outbreak of pest and diseases 8. Weather updates 9. Market prices 10. Crop insurance cover 11. Transport system 12. Irrigation practices 13. Field management 14. Financing 11. Others (Specify): _____	Information on Livestock 1. Reminders of daily activities 2. Housing of livestock 3. Improved breeds 4. Controlled breeding programming 5. Pest and disease management 6. Outbreaks of pest and diseases 7. Pasture management 8. Market prices 9. Livestock insurance cover 10. Transport systems 11. Banking and financing services 12. Livestock distribution system 13. Others (Specify)): _____
48.	Did you pay for IVR messaging services? *(Select one response)*	1. Yes	0. No
49.	How much did you pay for IVR services? *(Write down the figure)*	(MK)_____	
50.	Were you satisfied with IVR messaging services and why? *(Write down the response)*		
51.	Do you know other mobile information service apart from agricultural ones? *(Select one option)*	1. Yes	0. No

52.	What are the types of other mobile information services? *(Select one or more responses)*	1. Mobile Banking 2. Mobile Insurance 3. Mobile Health 4. Sports massaging	5. Weather services 6. Mobile web-based services 7. Membership 8. Others (Specify): _____
53.	How did you know about other mobile agricultural information services? *(Select one or more responses)*	1. Extension Agent 2. Lead farmers 3. MAIS Representative 4. Friends 5. Family 6. Radio	7. Agro-dealers 8. Mobile phone 9. TV 10. Other (Specify): _____
54.	Did you join the membership of other mobile phone services? *(Write down the response)*	1. Yes	0. No
55.	What are the names of services joined? *(Write down the response)*	_____	
56.	How did you register for the services? *(Select one of more responses)*	1. Mobile Service Representative 2. Mobile phone	4. Web-based registry 5. Others (Specify): _____
57.	Did you access agricultural information through alternative channels of communication? *(Select one response)*	1. Yes	0. No
58.	Which alternative form of communication did you access agricultural information? *(Select one or more responses)*	1. Face to face 2. Radio 3. TV 4. News papers	5. Computer 6. Internet 7. Others (Specify): _____

59.	What type of information did you access through alternatives channels? *(Select one or more responses)*	1. Reminders of activities 2. Conservation practices 3. Soil management 4. Pest and disease outbreaks 5. Alerts on weather 6. Crop varieties 7. Fertilizers 8. Pesticides 9. Processing and Utilization	10. Livestock management 11. Mobile Banking 12. Commodity prices 13. Climate change 14. Agricultural Insurance 15. Transport alternatives 16. Farming Business Management 17. Irrigation 18. Other (Specify):_____
60.	Who were the sources of alternative information? *(Select one or more responses)*	1. Extension agents 2. Lead farmers 3. Agro-dealers 4. Friends 5. Family	6. Broadcasters 7. Researchers 8. Non-Governmental Organization 9. Others (Specify):_____

Section J: Farmers Perceptions on Motivations						
61.	To what extent do you agree with the following statements on the use of mobile agricultural information services:	*Not at all*	*A little*	*Somewhat*	*Quite a bit*	*Absolutely*
i.	Mobile agricultural information services can be used to provide useful agricultural information.	1	2	3	4	5
ii.	Mobile agricultural information services can be used to provide appropriate advisory services.	1	2	3	4	5
iii.	Mobile agricultural information services would be providing trustworthy information.	1	2	3	4	5
iv.	Mobile agricultural information services would be a convenient way of getting any type of agricultural information when needed.	1	2	3	4	5
v.	Mobile agricultural information services would provide a two-way interaction between farmers and information sources.	1	2	3	4	5
vi.	Mobile agricultural information services would be a reliable source of complex information.	1	2	3	4	5
vii.	Mobile agricultural information services would be the way to validate the information from multiple sources.	1	2	3	4	5
62.	To what extent do you agree with the following statements on costs-benefits of mobile agricultural information services:	*Not at all*	*A little*	*Somewhat*	*Quite a bit*	*Absolutely*
i.	Mobile phones are less expensive way of getting agricultural information.	1	2	3	4	5
ii.	Mobile phones would increase the frequency of getting the information.	1	2	3	4	5
iii.	Mobile agricultural information services would save time of sourcing the new information.	1	2	3	4	5
iv.	Mobile agricultural information services would improve my decision making for my farm.	1	2	3	4	5

v.	Mobile agricultural information services would help me expand my information-sharing network.	1	2	3	4	5
vi.	Mobile agricultural information services would improve linkages with local and external markets.	1	2	3	4	5
vii.	Mobile agricultural information services would increase my productivity.	1	2	3	4	5
viii.	Mobile phones would improve the rural livelihood.	1	2	3	4	5

Section I: Farmer's Challenges on the Access MAIS			
63.	Do you have any challenges accessing mobile agricultural information services? *(If no, go to Qn. 55)*	1. Yes	0. No
64.	*If yes*, what challenges do you face accessing mobile agriculture information services? (*Select one or more options)*	1. Lack of electricity 2. Poor Network coverage 3. Additional costs 4. Financial resources 5. Digital skills 6. Lack of awareness	7. Language on the technology 8. Illiteracy 9. Up-to date information 10. Privacy and security 11. Others (Specify) _____

65.	Which one do you consider to be the most significant challenge? (*Assign a rank to the option given)*	Option	Rank	Reasons
		1. Lack of electricity 2. Poor Network coverage 3. Lack of awareness 4. Financial resources 5. Digital skills 6. Language on the technology 7. Illiteracy 8. Up-to date information 9. Others (Specify): _____	_____ _____ _____ _____ _____ _____ _____ _____ _____	_____ _____ _____ _____ _____ _____ _____ _____
66.	What should be done to deal with the indicated challenges? *(Write down the reasons in the next column)*			

Section F: Farmer's Agricultural Information Needs and Means of Access			
67.	Do you have any specific agricultural information needs to help you in farming? (*Select one options*) (*If no, go to section F, Q69)*	1. Yes	0. No
69.	*If yes*, what type of information would you need? (*Select one or more options from crops and livestock*)	Crops Information 1. Reminder of activities 2. Crop varieties 3. Land preparation 4. Soil fertility management 5. Field crop management 6. Conservation Agriculture 7. Types of fertilizers 8. Pest and disease management 9. Fertilizer application rate 10. Post-harvest management 11. Processing and utilization 12. Output market prices 13. Input market prices 14. Weather information 15. Climate change 16. Irrigation practices 17. Nursery management 18. Agri-business management 19. Financial services 20. Other (Specify): _____	Livestock Information 1. Improved livestock breeds 2. Livestock management 3. Housing and construction 4. Feeds and feeding 5. Parasite and disease management 6. Alert on pest and disease outbreaks 7. Controlled breeding techniques 8. Marketing of livestock's 9. Livestock insurance 10. Transportation systems 11. Other (Specify): _____

70.	What is the main type of information need on crops and or livestock production? *(Write down one or more responses)*	Crop Information	Livestock Information
71.	When would you need agricultural information most? (*Select one options*)	Crop information 1. All the time 2. Before season commencement 3. During the season 4. At the end of the season 5. On specific Operation 6. Other (Specify): _____	Livestock information 1. All the time 2. Before enterprising 3. Mid-season 4. End-season 5. On special Other (Specify): _____
72.	What would be the main communication channel for you to get access agricultural information? (*Select one or more options*)	1. Face to face 2. Radio 3. Television 4. Mobile phone 5. CDs and DVDs	6. Computers 7. Internet 8. Newspapers 9. Other (Specify) _____
73.	What is your best channel for accessing agricultural information? (*Rank from the best to the least option*)	Option Rank 1. Face to face _____ 2. Radio _____ 3. Television _____ 4. Mobile phone _____ 5. CDs and DVDs _____	Option Rank 6. Computers _____ 7. Internet _____ 8. Newspapers _____ 9. Other (Specify) _____
74.	How many times do you needed to access information during a period of one month? (*Write number of times farmers need information per month*)		
75.	Do you really need the information timely? (*If yes, go to Section G, Qn. 84)*	1. Yes	0. No

76.	*If yes*, why? (*Select one options*)			
77.	Do you like to pay for the mobile agricultural information services (MAIS)? *(Select one response)*	1. Yes	0. No	
78.	Why would you pay or not pay for MAIS? *(Write down one or more responses)*			
79.	What are the suggested fees for each form of communication of MAIS? *(Select one or more responses and write down the payment modes)*	Communication Format	Amount	Payment mode
		1. Voice Calls	_____	_____
		2. SMS Text messages	_____	_____
		3. Integrated Voice	_____	_____
		4. Audio files	_____	_____
		5. Podcast	_____	_____
		6. Videos	_____	_____
		7. MMS	_____	_____
		8. Mobile internet	_____	_____
		9. Others (Specify)	_____	_____

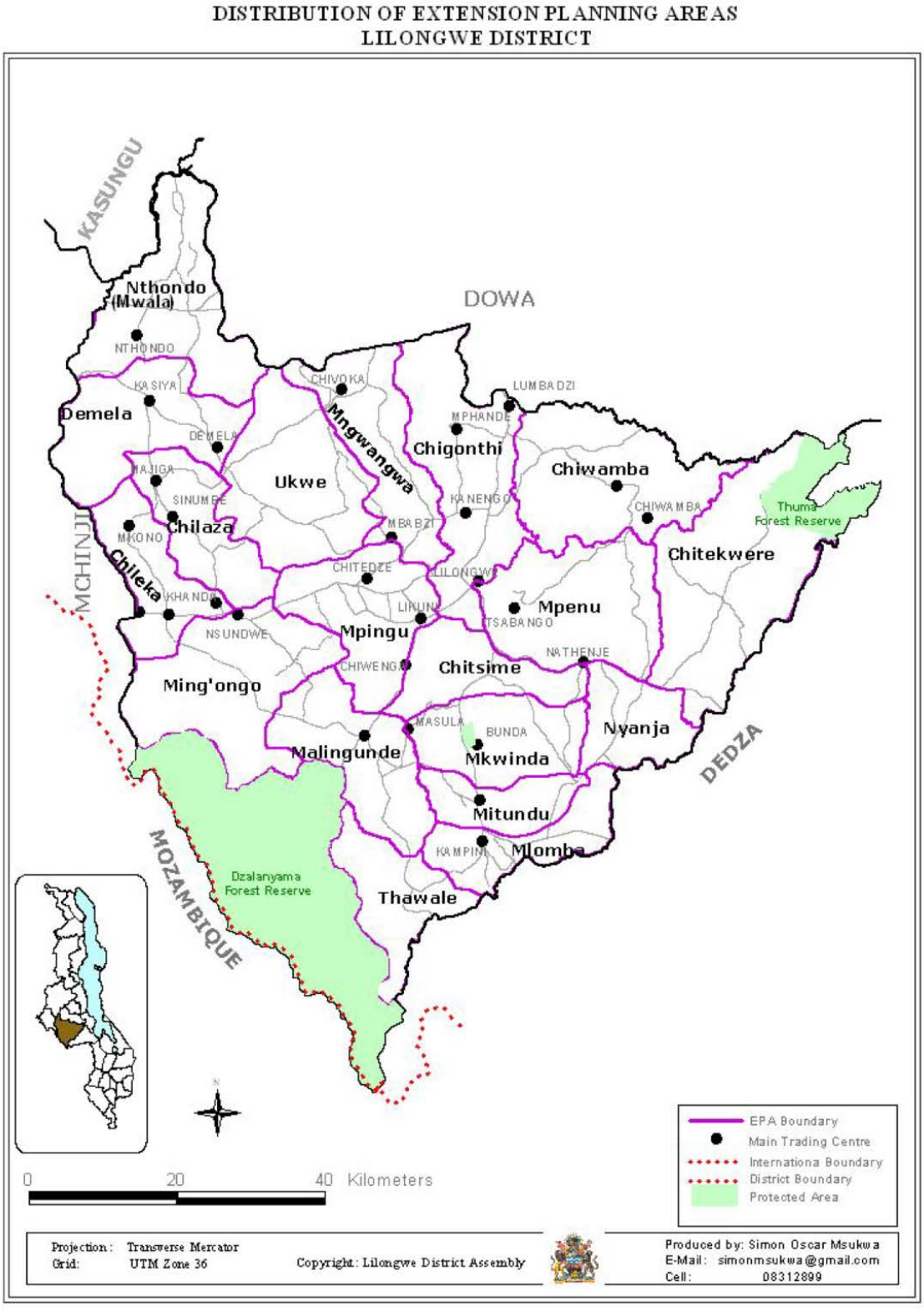
Section H: Farmers' Suggestions and Opinion		
80.	Do you have any suggestion on how to improve mobile agricultural information services? (*Select one option)*	1. Yes No
81.	What improvements would you like to see on mobile agricultural information services being offered? *(If no that is the end of the interview)*	
82.	*If yes*, which mobile phone channel would be most appropriate for you to access mobile agricultural information services? (*Select the one or more options, rank the responses and give reasons)*	Option Ranking Reasons 1. Voice Calls _____ _____ 2. SMS text _____ _____ messages _____ _____ 3. MMS _____ _____ 4. Videos files _____ _____ 5. Audio files _____ _____ 6. Emails _____ _____ 7. Photos _____ _____ 8. Others (Specify): _____ _____
83.	Do you have any comment or question relating to this study?	

Ending remarks:
Thank you for taking part in this survey. Your contribution will assist us to improve the quality of agricultural extension services in Malawi.

APPENDIX C: Maps for Study Location

Source: Nations Online Project, 2009.

Figure 5, Map of Malawi with 28 Districts



Source: District Assemble Report, 2001 (pp,)

Figure 6, Map of Extension Planning Areas in Lilongwe District

APPENDIX D: Extra Results

Table 58

Responses on land size allocated to crops grown in acres

Statistical									
Crops	Extension Planning Area (EPA)								
	Mpingu			Mitundu			Total		
	N	Mean	*SD*	N	Mean	*SD*	N	Mean	*SD*
Maize	149	1.54	1.13	141	1.82	1.00	290	1.67	1.08
Tobacco	9	1.00	0.43	77	1.39	0.99	86	1.39	0.95
Ground nuts	120	0.87	0.48	123	1.17	0.71	243	1.02	0.62
Soybean	49	1.00	0.62	72	1.12	0.67	121	1.06	0.65
Common beans	10	0.88	0.49	7	1.21	0.57	17	1.05	0.53
Dimba crops	17	1.00	0.46	36	0.99	0.69	53	1.00	0.62
Cowpeas	3	0.83	0.29	0	0.00	0.00	3	0.83	0.29
Sweet potato	8	0.59	0.27	6	0.75	0.27	14	0.66	0.27
Bambara nut	1	0.50	0.00	1	0.50	0.00	2	0.50	0.00
Pop corn	0	0.00	0.00	1	0.50	0.00	1	0.50	0.00

Note: Means and standard deviation are in acres.

Table 59

Participating farmers employed cropping system

Crop	Cropping system	Extension Planning Area (EPA)				Total	
		Mpingu		Mitundu			
		Frequency	*Percent (%)*	*Frequency*	*Percent (%)*	*Frequency*	*Percent (%)*
Tobacco	Sole cropping	9	100.00	75	98.68	84	98.82
	Irrigated	0	0.00	1	1.32	1	1.18
	Total	9	100.00	76	100.00	85	100.00
Maize	Sole cropping	132	89.79	132	92.96	264	92.31
	Inter-planting	15	10.20	7	4.92	19	6.64
	Irrigated	0	0.00	3	2.11	3	1.05
	Total	147	100.00	142	100.00	286	100.00
Ground nuts	Sole cropping	113	94.95	121	100.00	234	97.50
	Inter-planting	6	5.04	0	0.00	6	2.50
	Total	119	100.00	121	100.00	240	100.00
Soybean	Sole cropping	32	66.67	60	85.71	92	77.97
	Inter-planting	16	33.33	10	14.29	26	22.03
	Total	48	100.00	70	100.00	118	100.00
Common beans	Sole cropping	3	42.85	5	71.43	8	57.15
	Inter-planting	4	57.14	2	28.57	6	42.86
	Total	7	100.00	7	100.00	14	100.00
Cowpeas	Sole cropping	3	100.00	0	0.00	3	100.00
Dimba crops	Sole cropping	1	8.33	0	0.00	1	2.78
	Inter-planting	5	41.67	11	45.83	16	44.44
	Irrigated	6	50.00	13	54.17	19	52.78
	Total	12	100.00	24	100.00	36	100.00

Note: Multiple response results. Sole cropping = single cropping system. Inter-planting = more crops planted in a field. Dimba cropping = small-scale irrigated land along riverbanks.

Table 60

Participant farmers' mean distribution for main livestock

Statistics									
Livestock	Extension Planning Area (EPA)						Total		
	Mpingu			Mitundu					
	n	Mean	*SD*	n	Mean	*SD*	N	Mean	*SD*
Chickens	118	11.49	10.40	123	13.39	12.00	241	12.46	11.30
Goats	76	3.18	1.90	89	3.84	2.60	165	3.54	2.30
Pigs	39	4.41	2.70	48	4.88	4.00	87	4.67	3.50
Beef Cattle	4	3.25	1.90	22	3.27	1.90	26	3.27	1.70
Pigeons	6	21.00	20.80	8	28.25	20.79	14	25.14	20.30
Duck	6	2.50	1.90	3	3.00	1.00	9	2.67	1.60
Sheep	5	2.80	2.10	4	3.75	2.40	9	3.22	2.10
Dairy Cattle	3	5.00	2.90	4	2.50	1.30	7	3.71	2.40
Donkeys	2	3.00	1.41	4	2.75	0.50	6	2.83	0.753
Fish	0	0.00	0.00	1	200.00	0.00	1	200.00	0.00

Note: N = total number of livestock n = total frequency of farmers per EPA

Table 61

Participant farmers' possession of various assets

Categories	Household assets	Extension Planning Area (EPA)				Total (N=291)	
		Mpingu (n=149)		Mitundu (n=142)			
		Frequency	*Percent (%)*	*Frequency*	*Percent (%)*	*Frequency*	*Percent (%)*
Information & Communication Technologies (ICT)	Mobile phones	149	100.00	142	100.00	291	100.00
	Radio	99	66.44	122	85.92	221	75.95
	TV sets	19	12.75	19	13.38	38	13.06
	DVD players	9	6.04	16	11.26	25	8.59
Farm implements and tools	Hoes	139	93.29	136	95.77	275	94.50
	Axes	96	64.43	111	78.17	207	71.13
	Panga knife	8	5.37	33	23.24	41	14.09
	Shovels	4	2.68	27	19.01	31	10.65
	Wheelbarrows	16	10.74	11	7.75	27	9.28
	Treadle pumps	3	2.01	16	11.27	19	6.53
	Slashers	4	2.68	11	7.75	15	5.15
	Sickle	1	0.67	15	10.56	16	5.50
	Motorized pump	2	1.34	2	1.41	4	1.37
	Knapsack sprayers	0	0.00	2	1.41	2	0.69
Transport and mobility	Push bikes	106	71.14	132	92.96	238	81.79
	Ox-carts	6	4.03	26	18.31	32	11.00
	Motor bikes	10	6.71	17	11.97	27	9.28
	Cars	1	0.67	3	2.11	4	1.37
Infrastructure	Brick houses +iron sheets	95	63.76	82	57.75	177	60.82
	Solar	2	1.34	8	5.63	10	3.44
	Electricity	2	1.34	2	1.41	3	1.03

Table 62

Mean distribution of various assets in the study areas

Statistics									
House Hold Assets	Extension Planning Area (EPA)								
	Mpingu			Mitundu			Total		
	N	Mean	*SD*	n	Mean	*SD*	N	Mean	*SD*
Mobile Phones	148	1.51	0.78	141	1.43	0.74	289	1.47	0.76
Radios	98	1.29	0.61	122	1.21	0.53	220	1.25	0.57
TV	19	1.21	0.54	18	1.06	0.24	37	1.14	0.42
DVD players	9	1	0.00	12	1.00	0.00	21	1.00	0.00
Hoes	140	3.67	2.06	136	3.97	2.04	276	3.82	2.05
Axes	96	1.20	0.50	111	1.22	0.46	207	1.21	0.47
Panga knife	8	1.25	0.46	33	1.64	0.96	41	1.56	0.90
Shovel	3	1	0.00	16	1.31	0.48	19	1.26	0.45
Wheel burrow	16	1	0.00	11	1.09	0.30	27	1.04	0.19
Treadle pump	3	1	0.00	7	1.57	1.51	10	1.40	1.27
Slasher	4	1	0.00	11	1.00	0.00	15	1.00	0.00
Sickle	1	1	0.00	15	1.13	0.35	16	1.12	0.34
Motorize pump	2	1	0.00	2	1.00	0.00	4	1.00	0.00
Water canes	4	2	0.82	27	2.41	1.6	31	2.35	1.52
Sprayers	0	0	0.00	2	1.00	0.00	2	1.00	0.00
Push bikes	106	1.36	0.67	132	1.50	0.92	238	1.44	0.82
Ox-carts	6	1	0.00	26	1.08	0.27	32	1.06	0.25
Motor bikes	10	1.1	0.32	16	1.13	0.50	26	1.12	0.43
Car	1	1	0.00	3	1.00	0.00	4	1.00	0.00
Houses + iron sheets	93	1.04	0.20	81	1.17	0.59	174	1.10	0.43
Solar panels	2	1	0.00	8	1.12	0.35	10	1.10	0.32

Note: Multiple response results

Table 63

Participant farmers' types of mobile phone brands

Brands of Mobile Phones	Extension Planning Area (EPA)				Total (N=287)	
	Mpingu (n=147)		Mitundu (n=140)			
	Frequency	*Percent (%)*	*Frequency*	*Percent (%)*	*Frequency*	*Percent (%)*
Nokia	55	36.91	83	58.87	138	47.75
iTel	70	46.98	25	17.73	95	32.87
Techno	27	18.12	26	18.44	53	18.34
ZTE	20	13.42	17	12.06	37	12.80
Samsung	15	10.07	21	14.89	36	12.47
Corn	0	0.00	8	5.67	8	2.79
Donado	5	3.36	2	1.42	7	2.42
Huwel	4	2.68	2	1.42	6	2.08
KGTEL	2	1.34	3	2.13	5	1.73
Not known	1	0.67	3	2.13	4	1.38
Vodaphone	2	1.34	1	0.71	3	1.04
Oking	2	1.34	1	0.71	3	1.04
MTN	2	1.34	1	0.71	3	1.04
MTL	1	0.67	1	0.71	2	0.69
Blackberry	1	0.67	1	0.71	2	0.69
G.Five	2	1.34	0	0.00	2	0.69
Smart Profit	1	0.67	1	0.71	2	0.69
ZamTel	2	1.34	0	0.00	2	0.69
MobTel	1	0.67	0	0.00	1	0.35
LG	0	0.00	1	0.71	1	0.35
ForU	1	0.67	0	0.00	1	0.35
Asser 201	0	0.00	1	0.71	1	0.35
Enet	1	0.67	0	0.00	1	0.35

Note: Multiple Response

Table 64

Mobile applications available in three mobile categories

Mobile Applications	Mobile phone categories		
	Basic phone	Mid-range phone	Smart-phone
Voice calling	✓	✓	✓
SMS text messaging	✓	✓	✓
Personal Digital Device (PDA)	✓	✓	✓
FM Radio		✓	✓
Audio players		✓	✓
Voice recorders		✓	✓
Video players		✓	✓
Video recorders		✓	✓
Bluetooth		✓	✓
IM		✓	✓
Camera		✓	✓
Bluetooth		✓	✓
Internet		✓	✓
Memory card slot		✓	✓
Social media		✓	✓
File manager		✓	✓
Mobile app store		✓	✓
GPS			✓
Wi-Fi			✓

Source: Chisama, 2014

Table 65

Respondents' multiple responses on reasons for preferred Mobile Network Operators

Reasons	Extension Planning Area (EPA)				Total (N=255)	
	Mpingu (n=130)		Mitundu (n=125)			
	Frequency	*Percent (%)*	*Frequency*	*Percent (%)*	*Frequency*	*Percent (%)*
More Friends	36	27.69	44	35.20	80	31.37
Cheaper airtime	28	21.54	19	15.20	47	18.43
Just like it	14	10.77	16	12.80	30	11.76
Quality of network	12	9.23	18	14.40	30	11.76
First service register with	10	7.69	11	8.80	21	8.24
Given that way	11	8.46	7	5.60	18	7.06
Loyalty	10	7.69	8	6.40	18	7.06
Airtime Bonuses	2	1.54	2	1.60	4	1.57
Family members	2	1.54	0	0.00	2	0.78
Meant for one provider	1	0.77	0	0.00	1	0.39
Other network not working	1	0.77	0	0.00	1	0.39
Lost other service number	1	0.77	0	0.00	1	0.39
Airtime Loan Services	1	0.77	0	0.00	1	0.39
Airtime availability	1	0.77	0	0.00	1	0.39

Note: Multiple response results

Table 66

Respondents' multiple responses on topics accessed from additional sources of information

Information offered by other sources	Extension Planning Area (EPA)				Total (N=291)	
	Mpingu (n=149)		Mitundu (n=142)			
	Frequency	*Percent (%)*	*Frequency*	*Percent (%)*	*Frequency*	*Percent (%)*
Crop Varieties	28	18.79	40	28.17	68	23.36
Field Management	63	42.28	60	42.25	123	42.27
Livestock Management	21	14.09	32	22.54	53	18.21
Post-harvest management	28	18.79	18	12.68	46	15.81
Market prices	18	12.08	23	16.20	41	14.10
Weather updates	19	12.75	17	11.97	36	12.37
Conservation Agriculture	6	4.03	9	6.33	15	5.15
Input prices	3	2.01	8	5.63	11	3.78
Manure making	1	0.67	10	7.04	11	3.78
Utilization and Value Addition	2	1.34	7	4.93	9	3.09
Agribusiness Management	7	4.70	1	0.70	8	2.75
Irrigation practices	3	2.01	3	2.11	6	2.06
Nursery management	0	0.00	3	2.11	3	1.03
Climate change	2	1.34	0	0.00	2	0.69
Time of planting	2	1.34	0	0.00	2	0.69
Banking Facilities	0	0.00	1	0.70	1	0.34
Irrigation farming	1	0.67	0	0.00	1	0.34

Note: Multiple response results

Table 67:

Respondents' mean distribution on motivational reasons for using MAIS

Statistics									
House Hold Assets	Extension Planning Area (EPA)								
	Mpingu			Mitundu			Total		
	n	Mean	*SD*	n	Mean	*SD*	N	Mean	*SD*
Relevance	148	4.81	0.67	140	4.52	1.23	288	4.67	0.99
Appropriateness	148	4.33	1.09	139	4.17	1.20	287	4.24	1.15
Reliability	148	3.99	1.35	140	3.86	1.54	288	3.93	1.44
Timeliness	146	4.45	1.04	140	4.19	1.13	286	4.32	1.09
Two-way interactivity	147	4.35	1.07	140	3.93	1.46	287	4.15	1.29
Complexity	146	3.84	1.41	140	3.98	1.30	286	3.91	1.35
Validity	147	4.34	1.02	139	4.37	2.84	286	4.24	1.17
Less costly	147	4.69	0.89	139	4.37	2.84	286	4.24	1.17
Frequency	145	4.21	0.89	139	3.76	0.96	284	3.99	0.95
Fastness	143	4.57	0.75	138	4.42	1.05	281	4.50	0.91
Decision making	145	4.33	1.04	138	4.31	1.07	283	4.32	1.05
Information sharing	145	3.84	1.15	138	3.20	1.03	283	3.53	1.14
Marketing	147	4.58	0.87	138	4.43	1.17	285	4.51	1.02
Profitability	145	4.50	1.00	136	4.52	1.03	278	4.56	1.00
Livelihood	145	4.65	0.76	133	4.46	1.20	278	4.56	1.00