UNIVERSITY FOR DEVELOPMENT STUDIES, TAMALE

MOBILE PHONE TECHNOLOGY AND EXTENSION SERVICE DELIVERY TO SMALLHOLDER FARMERS IN NORTHERN REGION OF GHANA

SADDIQUE ABUBAKARI KAILAN

2022

UNIVERSITY FOR DEVELOPMENT STUDIES, TAMALE

MOBILE PHONE TECHNOLOGY AND EXTENSION SERVICE DELIVERY TO SMALLHOLDER FARMERS IN NORTHERN REGION OF GHANA

BY

SADDIQUE ABUBAKARI KAILAN

(BSc. Computer Science and Management)

(UDS/MIC/0012/19)

THESIS SUBMITTED TO THE DEPARTMENT OF AGRICULTURAL INNOVATION COMMUNICATION, FACULTY OF AGRICULTURE, FOOD AND CONSUMER SCIENCES, UNIVERSITY FOR DEVELOPMENT STUDIES IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTER OF SCIENCE IN INNOVATION COMMUNICATION DEGREE

MARCH, 2022

DECLARATION

I hereby declare that, with the exception of references which have been duly cited and acknowledged, the work presented in this thesis, "MOBILE PHONE TECHNOLOGY AND EXTENSION SERVICE DELIVERY TO SMALLHOLDER FARMERS IN NORTHERN REGION OF GHANA" was done entirely by me in the Department of Agricultural Innovation Communication, University for Development Studies, Tamale and has not been submitted for the award of any other degree in this university or elsewhere.

Candidate signature: ……. Date: ……

Name: Saddique Abubakari Kailan

Supervisor

I hereby declare that this thesis preparation and presentation was under due supervision in accordance with the University for Development Studies' guidelines on thesis supervision.

Supervisor

Supervisor's Signature: ……. Date: ……

Name: Dr. Hudu Zakaria

ABSTRACT

The study assessed mobile phone technology and extension service delivery to smallholder farmers in northern region of Ghana. The study sought to examine agricultural information mostly accessed and shared by farmers and extension agents and the constraints they faced in disseminating and accessing extension services. The study was conducted in two districts in Northern Region namely Tolon District and Gusheigu Municipality. These districts were sampled because mobile phone technology in disseminating agricultural information have been employed in the districts for some years now. Through multi-stage sampling techniques 200 smallholder farmers, 100 from each district and 10 extension agents from each district who have been accessing and sharing extension service via the mobile phone. Both descriptive and inferential statistics were employed in analysing the data gathered for the study. Findings of the found that in generally farmers and AEAs surveyed have positive views, opinions, and attitudes about the use of mobile phone as a means of disseminating agricultural information. Farmers and AEAs indicated that they often accessed and shared market information, weather information, Information on pest disease control, information on credit sources and information on agro-chemical use. Most extension officers and farmers share and access agricultural information through phone calls, sending and receiving text SMS, sending, or listening to Voice SMS, watching pre-recoded videos on farm operations and social media platform. Among the AEAs surveyed high illiteracy rate among farmers and unstable network or high call dropout rate were ranked respectively as 1st and 2nd most severe constraints in using mobile phone. The study recommended that adult literacy among farmers should be promoted to improve literacy level among farmers to enable them effectively used their mobile phone to access extension services.

ACKNOWLEDGMENTS

I owed so many people tonnes of gratitude for their various contributions towards this work. My first and foremost thanks go to Almighty Allah for His grace and guidance which have brought me this far. My thanks. and gratitude also go to my supervisor Dr. Hudu Zakaria, who is also the Head of the Department of Agricultural Innovation Communication of the University for Development studies, for his guidance, suggestions, and contribution which have helped produced this thesis. My sincerely thanks also go to all lecturers in the Department of Agricultural Innovation Communication for the knowledge they have imparted on me.

I am also indebted to all the District Directors of the Departments of Agriculture in the Northern Region and their hardworking extension officers who availed themselves to provide information and data used in this thesis. Also, my sincere thanks all the six enumerators who assisted me collected data for this study.

My sincerer thanks also go to all the hardworking farmers who, despite their busy schedules, made time to response to my interviews during data collection stage of the study. I thank all individuals, institutions and organizations who have played various roles in the production of this work. I will forever remain grateful to you all.

DEDICATION

I dedicate this thesis to my mother Gladys Ahenkan Dogba (Lady in Red)

Table of Contents

LIST OF TABLES AND FIGURES

LIST OF TABLES

LIST OF FIGURES

ACRONYMS

ICT	Information Communication and Technology
NCA	National Communication Authority
AEAs	Agricultural Extension Agents
IFAD	International Fund for Agricultural Development
NGOs	Non-Governmental Organizations
MoFA	Ministry of Food and Agriculture
TAM	Technology Acceptance Model
GDP	Gross Domestic Product
GSS	Ghana Statistical Service
FAO	Food and Agricultural Organisation
PEOU	Perceived Ease of Use

CHAPTER ONE

1.0 INTRODUCTION

Background to the study

Information and Communication Technology (ICT), particularly the advent of mobile telephoning technology have come to be associated in our everyday life and in all aspect of society. Mobile telephoning is revolutionising and shaping how society is organize undertaking their activities in all fields, particularly in education, agriculture, business, commerce, and socialization (Nasir et al., 2019; Statista, 2019).

Globalization has been given more impetus through the mobile phone connectivity and rapid mobile penetration rates in both developed and developing economies. Statista (2019) observed that 62.9% of the global population owned and use mobile phone translating to 4.68 billion people. Therefore, no sector of the economy can be left behind in harnessing the benefits such as speed in information disseminations, convenience of access and connectivity, providing medium for payment and other economic transactions, that mobile phone penetration presents.

Ghana is one of the success stories of rapid growing mobile phone penetration rate in West Africa. According to Ghana's National Communication Authority (NCA) the mobile phone penetration rate in Ghana in 2016 is 131% (NCA, 2016) this had seen a growth of 69% in 2010 to 131% in 2016 and 140% in 2020 (O'Dea, 2020). Compared to her West African neighbour Cameroon which had witnessed mobile phone penetration rate increased by 39.3% from 2010 to 2019 to 81.76% (PTA, 2018),

The rapid mobile phone penetration growth had helped transformed many sectors of the economy through rapid communication, information dissemination, data gathering, institutional linkages and business transactions and payment systems. Agricultural sector, which provides employment for majority of Ghanaian in the rural areas, had also experienced

some transformation in extension service delivery, information dissemination regarding commodity pricing and access as a result of the advent of mobile phone and its rapid growth (MOFA, 2018)

Agriculture in Ghana, notwithstanding the fact that it is no longer the leading contributed to Ghanaian economy, continues to be seen as the mainstay of the Ghanaian economy and expected to play a key role in the economic transformation and industrialization agenda of the country (Estes & Sirgy, 2019; GSS, 2016; MOFA, 2018). In recent times the agricultural sector is contributing nearly one-fifth to Ghana's Gross Domestic Product (GDP), it however continues to serve as source of employment for almost half of the Ghanaian workforce (MoFA, 2017).

Agricultural sector in Ghana is characterized by smallholder farmers cultivating less than 2ha and keeping livestock such as ruminants, poultry, and non-ruminants. It is estimated that these smallholder farmers produce 80% of the country's agricultural production (MOFA, 2018; GSS, 2015). As observed in Akumbole, Zakaria and Abujaja (2019) citing data from MOFA (2012 and GSS (2016) that agriculture in Ghana is largely undertaken by rural smallholder farmers deploying rudimentary technologies in producing 80% of the country's agricultural production.

To achieve Ghana's industrialization and agricultural modernization agenda, there is the need to improve agricultural information dissemination to ensure adoption of improved technologies, high yielding crop varieties and mechanization of agricultural operations (MOFA, 2012). It is therefore, expected that agricultural extension service providers would adoptive innovative technologies in their efforts to disseminate agricultural information and facilitate adoption of improved technologies among smallholder farmers.

Within the context of research and development practices, several methods and techniques have been adopted in the dissemination of technology and appropriate innovative practice to

bring about desire social change among rural farming communities. The paradigm shift in innovation dissemination practice from a transfer of technology to a demand driven approach has been accompanied by a plethora of new extension methods implemented through a variety of institutional arrangements involving state institutions, private sector agencies, farmer-based organizations, and farming communities (David et al, 201). The advent of mobile telephoning and its rapid growing penetration presents more impetus for efficient and effective extension service delivery to wide range smallholder farmers more rapidly and conveniently.

As part of government of Ghana flagship programme of 'Farming for Food and Job' the capacity of extension service provided have been built to enable them employ ICT, particularly mobile phones, and other innovative technologies in delivery extension services to smallholder farmers (MOFA, 2018).

Through mobile phone technology SMS text and voice messages can easily be delivered to farmers in a more cost-effective and efficient way. Within the last decade both private and public extension services providers have been employing the use of mobile phone in disseminating agricultural information to farmers (MOFA, 2016). Deploying mobile phone or other IT communication device as a tool for delivery extension services would helped solve the problem of poor extension agent – farmer ratio which currently stand as 1: 1,500 (MOFA, 2016). Thus, one extension agent providing extension services to 1,500 farmers.

1.2 Problem statement

Agricultural sector in many countries is increasing being driven by knowledge, information and innovation generated through Research and Development (R&D) and be described as knowledge-based production system (Basnet & Bang, 2018). The modernization of agriculture through R&D as witnessed in the green revolution in Europe and other part of Asia and its links

with industrialization and national development was largely driven by knowledge and efficient dissemination of agricultural information.

The current extension service delivery through face-to-face interactions between extension agents and farmers had been found to be ineffective and less cost effective. This model of extension delivery is blamed for low level of technology adoption among smallholder farmers in Ghana. The situation is even worse considering low level of extension – farmers ratio of 1: 1.500 (MOFA, 2018).

Mobile phone technology has become an important tool in bridging the low extension-farmer ratio and accelerating agricultural information dissemination. Studies in India and other countries where mobile phone is being deploying in the extension services delivery, demonstrates the effectiveness of mobile phone technology in agricultural information delivery (Surabhi & Mamta, 2016; Neha et al., 2018). Similar positive results of mobile phone use as tool for agricultural information delivery have been reported across the globe. Findings of Chhachhar and Hassan (2014) demonstrate the cost effectiveness of mobile phone in delivery extension information to rural farmers. Also, empirical studies by Baba (2017) indicated the role and effectiveness of mobile phone technology in agricultural extension services delivery. Similarly, Tadesse and Bahiigwa (2014) documented the positive effectives of mobile phone as a tool for extension delivery to smallholder farmers in Sub-Sahara Africa.

Therefore, for Ghana to achieve its agricultural modernization and industrialization agenda, there the need to revolutionized extension service provision by taking advantage of the growing access to Information Communication Technology devices, particularly mobile phones. The high level of mobile phone penetration rate in Ghana reaching over 100% to as high as 140% in 2015 as indicated in NCA (2016) presents opportunity for extension service providers in disseminating agricultural information to farmers.

Since the inception of government of Ghana flagship programme of Planting for Food and Job (PFJ), extension agents have been trained, equipped, and encouraged to use mobile telephoning technology in their extension service delivery approach to ensure wide coverage and efficient and effective agricultural information dissemination to smallholder farmers. The PFJ programme which was launched in 2017 have been in operation for five years now. The programme comes with fertilizer, seeds and pesticide subsidy in order enable smallholder farmers increase productivity of major stapple crops particularly maize, rice and soybean.

However, very little is known about how extension officers are deploying mobile phones in disseminating information to farmers and how farmers are accessing information via mobile phones and the challenges faced by the stakeholders in their efforts to ensure effective and efficient information dissemination via mobile phones. This study explores the use of mobile phone by extension agents in the dissemination of agricultural information to smallholder farmers and the preparedness and ability of smallholder farmers to access information via mobile phones.

1.3 Research questions

1.3.1 The general research question

The main research question is how do extension services and farmers view and use of mobile phone technology in accessing and sharing agricultural information?

1.3.2 Specific research questions

i. What are farmers and extension officers' perceived opinions, attitudes, and beliefs about the use of mobile phone technology in accessing and sharing information in the Northern Region?

ii. What information are usually shared and accessed by extension agents and farmers respectively via mobile phone technology in Northern Region?

iii. What is the level of accessibility and utilization of mobile phone technology by extension agents and farmers in the northern region?

iv. What constraints do extension agents and farmers faced in sharing and accessing agricultural information respectively via mobile phone in the northern region?

1.4 Research objectives

1.4.1 The general objective

- The main objective of the study is to examine the views and use of mobile phone technology in sharing and accessing agricultural information by extension agents and farmers respectively.

1.4.2 Specific research objectives

i. To assess farmers and extension officers' perceived opinions, attitudes, and beliefs about the use of mobile phone technology in accessing and sharing information in the Northern Region

ii. To analyse agricultural information usually shared and accessed by extension agents and farmers respectively via mobile phone technology in Northern Region.

iii. To examine the level of accessibility and utilization of mobile phone technology by extension agents and farmers in the northern region.

iv. To analyse the constraints faced by extension agents and farmers in sharing and accessing agricultural information respectively via mobile phone in the northern region.

1.5 Justification of the study

Smallholder farmers plays significant role in the production of food, raw materials, and other agricultural products in Ghana. The are key players in the agricultural value chain and a leading contributor to agricultural GDP and employment in Ghana (GSS, 2016). Since agriculture is a knowledge-based production system, the importance of effective and efficient dissemination of timely information to farmers cannot be over emphasized. It is therefore reasonable expected that any advancement in information technology such the advent of mobile phone technology, be utilized effectively in agricultural information dissemination and technology transfer.

This study will add to existing knowledge on effective and efficient approaches to extension service delivery and technology adoption among smallholder farmers. It will also provide information one hand how effectively or otherwise is extension agents deploying mobile phone technology in providing extension services to farmers. In the other hand information on farmers utilization of their mobile phones to access extension services will be provided in this study to guide policy makers and implementers of extension services.

Also, farmers' and extension agents' beliefs, perceptions, and attitude towards the use of mobile phone as tool for information sharing and dissemination will be provided in this study to further guide technology transfer approach. Mobile phone is increasingly being regarded as an effective tool for knowledge dissimilation, inclusive extension and financial service delivery and access to both rich and poor farmers, rural and urban dwellers as well.

Also, the challenges and constraints faced by smallholder farmers in harnessing the potential of mobile telephoning technology will be explored in this study. This will provide police makers and implementers of extension service to know these constraints and work out strategies to overcoming them in their efforts to harness the potential of mobile phone in ensure effective agricultural information dissemination.

1.6 Definitions of terms

Mobile phone technology: is a technology consist of a portable two way communication device that enable users to share voice calls, text messages video calls, data and applications.

Mobile phone usage: the deploying of portable mobile communication device in sharing information through the means of messages, voices calls, video calls SMS among other, that enable farmers to connect with extension officers. Therefore, mobile phone usage in this study means the use of mobile portable communication device called mobile phone to connect farmers and extension agents for agricultural information sharing.

Types of mobile phone use: This refers to the category of portable mobile communication device used by farmers such as analogue, digital, smart phone among others.

Smallholder farmer: referred to a farmer who cultivate less than 2ha of farmland and relied mainly on family source of labour for its farmer operations. This basically referred to substance farmers.

Agricultural extension service delivery: The process of disseminating and receiving agricultural information which usually occurs between extension agent and farmer. In Ghana agricultural extension service is mainly delivered as a public service usually carries out by the ministry of food and agriculture. However, there are private and non-Governmental owned and managed extension organizations which deliver extension services to farmers.

ICT: computerized technology or device/gadgets such as computer, mobile phone, television radio among other, which are basically used to aid information and communication process. Thus, any technology deploys to facilitate information communication process is referred to as Information Communication Technology (ICT).

Extension Agent (EA): referred to agricultural information delivery officer who main occupation is to disseminate agricultural information to farmer. They are also referred to as Agricultural Extension Agent (AEA).

1.7 Scope of study

Study is limited to smallholder farmers and agricultural extension agent using mobile phone to disseminate agricultural information in Northern region of Ghana. Also, only issues relating to agricultural information delivered via mobile phone were considered in the study. As such other sources and approaches of disseminating agricultural information such as face to face, farm demonstration, radio and television were considered in this study.

Limitation of the study

The results of the study are obtained through analysis of cross-section data, and such is time specific. As, the study is limited to cross-sectional or time specific data and only covered sampled smallholder farmers from Northern region of Ghana. Thus, the study is limited to smallholder farmers and extension agents using mobile in northern region of Ghana.

1.9 Organization of the study

In line with the University's guideline for thesis presentation, the thesis is organized in five chapters. Chapter one presents background to the study and also presents research problem, questions, and objectives of the study. Chapter two presents review of relevant literature and theories relating to the concepts being studied. Research methodology employed in carrying

out the study is described in detail in chapter three. Chapter three therefore, presents research design, sampling procedure, data collection methods and data analysis techniques employed. Chapter four presents results discussion and findings of the study. Presents findings addressing each of the objective set up in the study. Finally, chapter five, the final chapter presents conclusion and recommendation drawn from the findings of the study.

CHAPTER TWO

2.0 LITERATURE REVIEW

Introduction

In this chapter, relevant theories, and literature of the main concepts of this study is discuss with the view to draw inferences and comparison to the issues being studied.

2.1 Theoretical background

Mobile phone technology is now the most basic communication device use in daily life of most people across the globe for social interactions, business deals, data transfer and entertainment among others. But how do the global community come to accept this simple mobile phone device in their everyday communication, can be answered by examining the theories of technology acceptance, decision making and other relevant theories. As explained by Sirajul (2011) people accept new ideas through a series of complex mental process in which adoption is considered the final action. Some of the theories explaining the process leading to technology adoption is discussed in the proceeding subsection with the view to understanding the adoption of mobile phone technology in disseminating information to farmers.

2.1.1 Technology Diffusion Theory

Postulated by Rogers (2003) Technology Diffusion Theory (TDT) described the process through which a technology of an innovation is transmitted over time through channels within a social system. The TDT is built on four major components as: creativity, communication networks, time, and social structure. Through the process of creativity, technologies are created, which needs to be transmitted through communication networks which depends on societal structure before such technologies can be known and adopted (Rogers, 2003).

Therefore, TDT is a holistic process which described how technologies are created, and the knowledge or awareness of its existence are achieved through communication networks which are selected based on the understanding of the social structure of the society which individuals are expected to adopt the technology.

Rogers (2003) identified factors which affect technology adoption as 'technology related factors', 'perceptions and attitude towards the technology by potential adopters' and the 'processes through which the technology is generated. According to Rogers (2003), there are five characteristics of a technology or innovation which affect its adoption. He mentioned them as: relative benefit, compatibility, difficulty, trialability, and observability.

2.1. 2 The Technology Acceptance Model

Developed by Davis (1986) and further modified in Davis (1989) Technology Acceptance Model (TAM) postulate that technology acceptance is based on individual's perceptions about the Easiness to Use (PEOU) the technology and Usefulness (PU) of the technology. The two-construct postulate by this theory thus (PEOU and PU) means that Perceived usefulness refers to individuals' belief that the technology is user friendly and that its use would improve on their performance or productivity. Thus, if extension agents and farmers perceived the mobile phone use in sharing and accessing agricultural information to be easy and beneficial, they are likely to adopt its use otherwise they are not likely to adopt it. From these beliefs, perceived ease of use is a predictor of perceived usefulness.

Many studies (See Bouman et al., 2012; Ha et al., 2007; Hong et al., 2007) have employed TAM in modelling predictors of adoption in empirical studies and this have demonstrated the usefulness of this theory. Notwithstanding, some other researchers have identified the lapses

of TAM (see Kulviwat et al., 2007; Stern et al., 2007 and Nysveen et al., 2005) and therefore, argues that the use of TAM is insufficient to predict users intention and adoption behaviour.

2.1.3 The Use and Gratification Theory

The Uses and Gratifications Theory (UGT) is a postulation seeking to explain individual media search behaviour and its implications on individuals' satisfaction or otherwise of information sought from media (Katz et al., 1974). According to UGT, information consumers do not engage passively in media sifting, but rather actively seek out media outlets in meeting their information needs. As such they are able to make decision as to which media outlets help them in meeting their individual daily information requirement that offers the satisfaction they desire (Katz et al., 1974). Rubin (2009) observed that individuals use media for "personal direction, relaxation, change, information, and identity formation,". This he observed informed individual media searches and information seeking in order to meet their needs for direction, relaxation, change, information, or identity.

Five main assumptions underpinned USGT. These are (1) the audience is assumed to be actively seeking media, (2) the audience is assumed to have free will, (3) media options are competing for needs, (4) the audience can accurately evaluate their decisions, and (5) no judgments can be made against a particular medium (Katz et al., 1974). These assumptions demonstrates that media consumers are actively seeking out the best media outlets to satisfy their daily needs, and as such will choose a media outlet that offer them the satisfaction they are seeking for. Rubin (2009) identified distraction, personal relationships, personal identification, and surveillance needs as the four basic needs of media consumers. When individual seek for media outlet to diverse or get way from such issues worrying their daily lives then they are seeking media for distraction away from their worries of problems or emotional release. Similarly, when individual seek media outlet to feel socially connected to

another, then they are desiring personal relationship. However, when consumers acquire personal values and identification through the media channel, they are able to meet their personal identity needs. When attempting to comprehend their surroundings then users are fulfilling surveillance needs (Rubin, 2009).

SGT are mostly used in media impact studies which seeks to understand the impact of media outlet in helping individual achieve one or more information needs (Rubin, 2009). The theory is also in predicting individuals' media choices and also modelling individual information needs (Anderson, 2013).

Wimmer & Dominick (1994) observed that UGT was first studied in the 1970s, earlier studies in 1940s have used theories resembling the UGT in the advent of radio, comic books, and widely circulated newspapers. Bae (2018) also observed that UGT have been used to investigate the types of content that meet viewers' social and psychological needs, as well as the gratifications that attract and retain audiences to a given media outlet. Through the application UGT studies have discovered that certain media outlets do not only offered information to audiences, but also a sense of protection and structure to their everyday lives (Bae, 2018; Jenkins, Ford & Green, 2018).

Until the 1970s, researchers applying the concept of gratifications focused on the satisfactions expected rather than gratification desired by seekers of media outlets (Katz et al., 1973; McQuail, 1984). In the 1970s, there was a change in science, and researchers started to focus on audience motivations. Katz et al. (1973) compiled a list of needs met by media use: to test one's reasons against others, as users seeks media outlets to obtain knowledge and information to guide their everyday life within their cultural context and it prepares them to demand upward mobility, or to be informed about the integrity and usefulness of their positions.

The UGT has been revived by the recent emergence of computer-mediated communications as users now actively search for contents in various electronic media via the world wide web

through the internet, social media sites, search engines, information hubs, information repositories, among others (Kietzmann et al., 2011). This theory is seen by many current researchers as a valuable approach to studying the Internet based media outlets and sources (Anderson, 2004; Marshall & Rossman, 2014; Fink, 2019).

Many studies in recent times have underscored a wide range of gratifications that the Internet can provide, including (Papacharissi & Rubin, 2000; Lee & Ma, 2012; Dolan et al., 2016; Billings et al., 2018) and such have applied UGT its empirical examinations. Some of the studies focused on various aspects of gratifications such as Knowledge gathering (Pawar & Sharda, 1997; Llodrà-Rieraet al, 2015; Gabara, 2017) interaction with others (Casale & Fioravanti, 2015; Paul et al., 2016; Romero et al., 2017) convenience (Weinberg et al., 2015; Nolin & Olson, 2016; Moganedi & Mtsweni, 2017) and surveillance (Weinberg et al., 2015; Nolin & Olson, 2016; Moganedi & Mtsweni, 2017).

2.2 ICT in Extension Service Delivery

The Information Communication and Technology (ICT) plays very important role in our day to day lives and has shape all aspects of society in business and commence, agriculture, health, education among others. Generation, gathering and dissemination of information and data have received much impetus in the advent of ICT and its applications. Agriculture as a knowledge-based production system have been impacted positively through application of ICT in all aspects of its production (Raju 2019; Sireesha, Rao, and Raju, 2019).

Studies such as Sireesha, Rao, and Raju, (2019) indicated that, in order to transform the agricultural sector ICT must be deployed in the transmission and sharing of information data to ensure efficiency and cost effectiveness in agricultural information service delivery. For

over two decades now, the World Bank (2007) have demonstrated the tremendous positive impacts ICT can have in agricultural development and its consequential effects on sustainability and poverty reduction.

With the application of ICT, particularly mobile telephoning technology extension agents would be able to disseminate information rapidly and timely to guide farm operations of smallholder farmers. Mobile phones use in disseminating weather information and forecast to have farmers have been identified as one of the critical areas that mobile phone extension have been impacted positively (Amir, Peter, and Muluken, 2014; Chisama, 2016; Sireesha et al., 2019).

A study by Chisama (2016) which investigated farmers' use of mobile phone technology for agricultural information services in Lilongwe District, found extension agents most used phone calls, Integrated Voice Response (IVR), Short Message Service (SMS) and Voice SMS in disseminating agricultural information to farmers. The study observed that these channels are very reliable in disseminating timely information such weather forecast, input, and prices among other to farmers to enable them take decision regarding their farm operations.

Similarly, study done by Amir et., al (2014) which investigated the role of mobile phones in accessing agricultural information by smallholder farmers in Eastern Hararghe Zone of Oromia regional state of Ethiopia found that majority of rural farmers preferred mobile phone usage in extension delivery because of its timeliness, accessibility, and convenience.

2.3 Knowledge in Mobile Phone, Accessibility and Network Usage

Increasingly mobile phone use in extension service delivery is becoming one of the preferred and reliable channels for disseminating relevant information to smallholder farmers. Mobile phone has been one of the fastest growing communication technologies in Ghana and the world

at large. Because of it wide coverage and high level penetration, extension services delivered via mobile phone is certainly regarded as an instrument of choice by many farmers in the rural areas. As observed in Williams, Nwagwu and Seromi (2015) mobile phone device is generally regarded as cheap, easy to manage, power efficient and encourages personalized interactions. As such it is becoming the most preferred medium of communication, information sharing and data transmission among individuals and institutions. Through mobile phone connectivity farmers are able to access market price very easily across wide geographical area and such are able to compare prices in making informed decisions. Inigo et al., (2014) and Mittal et al., (2010) also reported that mobile phones contribute greatly to agricultural and animal husbandry information dissemination. Hayrol et al. (2009) reviewing various studies concluded that ICT, especially mobile phone, had emerged as one of the widely accepted and adopted instruments in most parts of the world to ease the information communication process among farming communities. Mittal and Tripathi (2009) reported that mobile phone use in accessing market information is empowering farmers and playing a key role in lowering transaction costs and raising the income levels of farmers.

2.4 Mobile phone coverage in the world, Africa and in Ghana

Mobile phone connectivity is growing in the world as well as in Africa as more and more people buy mobile phone devices and get connected by phone telephoning service provider. The number SIM card connections expressed as percentage of the total population of a country or region is referred to as Mobile Penetration. This is usually used to measure mobile phone connectivity and growth and serve as a basis for comparison among countries or regions.

Global statistics of mobile phone connection is estimated as 8.3 billion subscriptions in 2019 (Technology & Telecommunications, 2020). This shows a growth of approximately 393 million subscriptions from 2018 to 2019. With global population of 7.7 billion as at 2020 with

8.3 billion subscriptions mobile subscriptions demonstrated that more phone connectivity exceeds the number people living in the globe.

Africa had experienced steady increased in her mobile phone the penetration rate over the last decade. According to National Communication Authority (NCA) Ghana had experienced rapid growth of mobile phone users with penetration rates increasing from 69% in 2010 to 140% in 2020 (NCA, 2016; Statista, 2020).

2.5 Mobile Phone connectivity service providers in Ghana

Access to telecommunication and use of mobile phone among Ghanaian in this age is now part of the socioeconomic lives of majority of Ghanaian. Ownership and access to a handheld mobile device is now increasingly becoming part of the necessities of lives among the adult population of Ghana. To provide network to ensure connectivity of these handheld mobile telecommunication devices, there three major service providers operating in Ghana. However, according to National Communication Authority (NCA, 2016), there were six networks operating in Ghana as at 2016 which included MTN, Vodafone-Ghana, Airtel/Tigo, Glo and Expresso. But Glo and Expresso have been outcompeted from the market leaving only MTN, Vodafone-Ghana and Airtel in the telecom industry in Ghana.

CHAPTER THREE

3.0 METHODOLOGY

Introduction

This chapter present descriptions of how the research was carried out. It covered study area, description of research design, sampling procedure employed, data collection methods used, and analysis of data gathered.

3.1 Study Area

The study was carried out in northern region of Ghana which estimated as 70,384 square kilometres of land space and located in northernmost part of Ghana sharing boundaries with with the Upper East and the Upper West regions to the north, the Brong Ahafo and the Volta regions to the south, Togo to the east, and Côte d‟Ivoire to the west (GSS,2013).

Northern region of Ghana generally has a dry climatic condition with monomodal rain fall pattern spread between January and March as generally dry season and June to December as generally rainy season. As a result, the temperatures in these areas are usually high, averaging 34^{o}C in the dry seasons with the lowest temperatures being experienced from December to late February, during which the North-East Trade winds (harmattan) passes (GSS, 2014, & SNMA, 2015). The vegetation cover of the area is generally characterized by mainly grassland interspersed with guinea savannah woodlands and shrubs with major trees being sheanut, dawadawa, acacia and baobab trees.

Substance agriculture, rearing of domestic livestock mainly, goats, sheep, cattle, local poultry, and fishery are the main livelihoods of majority of the people in northern region. Crops such as yam, maize, rice, millet, groundnut, guinea corn, cowpea and soybeans beans are the main crops grown in this area. Notwithstanding the areas is regard as a food basket of the country

particularly, yam, maize, and rice which are use for preparing major food staples eaten across the country (MOFA 2016). As such this informed the choice of this area as the study area.

Information gathered from the Regional Department of Agriculture, out of the sixteen (16) District in the region, mobile phone technology as means of delivery extension services had been excessively deployed in the two districts namely Tolon District and the Gushiegu Municipality. As such these districts met the pre-selection requirement and therefore the district were selected as the studied districts.

3.2 Research design

This study sought to examine mobile phone usage in delivery extension services with the purpose of describing the situation of the deployment of mobile phone as a tool of reaching to smallholder farmers. As such descriptive survey design with cross-sectional data were used for the study. Since the study sought to describe the situation of mobile phone use in extension service delivery, both qualitative and quantitative data from primary and secondary sources were gathered for the study.

The design was considered appropriate because it would aid in the description of mobile phone usage in delivery extension service because, descriptive survey design is an enquiry process that mostly employed in gathering data from a population in order to describe or examine important factors such as demographic and socio-economic, behaviours, attitudes, experiences, and knowledge about the population (Kelley, Clark, Brown and Sitzia 2003).

3.3 Sampling Technique

The target population for this study was smallholder farmers and extension agents using mobile phone for receiving and sharing agricultural information. From the departments of agriculture in the two districts, data on extension agents using mobile phone to disseminate extension

services to farmers and farmers who were sourcing their agricultural information via mobile phone were obtained. From the list, ten extension agents from each district who have been trained to use mobile phone and other ICT devices for extension service delivery and have been practicing for some years were sampled.

Also, from the list of farmers sourcing agricultural information via mobile phone and through the application of Krejcie & Morgan table (Krejcie & Morgan, 1970) one hundred (100) smallholder farmers sourcing agricultural information via mobile phone from each district were sampled.

Thus, in all 20 Agricultural Extension Agents (AEAs) and 200 smallholder farmers were the sample for this study.

3.4 Data collection process

The smallholder farmers surveyed were interviewed with the use of interview guide while semi-structured questionnaires were developed and administered to the AEAs. Also, key informant interviews were conducted among the experience famers, AEAs and Heads of Department of Agriculture the two districts.

3.4.1 Type and Sources of Data

Also, secondary data from records of the MOFA, the district assemblies, departments of agriculture, regional office of MOFA among other sources were relied on for secondary data to back the primary data collected during the field survey. Through this process, both qualitative and quantitative data were collected to address the objectives of the study.

The questionnaires developed was checked for content validity by my supervisor and other senior members of the department. The questionnaires were also pre-tested before they were used for the actual data collection.

3.5 Data Analysis

The data collected were entered into SPSS and analysed by application of descriptive and inferential statistics.

For objective one, which sought 'to assess farmers and extension officers' perceived opinions, attitudes, and beliefs about the use of mobile phone technology in accessing and sharing information in the Northern Region' was achieved by the used of Likert scale format to elicit farmers' opinions, attitudes, and beliefs about mobile phone usage to share and access agricultural information. A five-point Likert scale ranging from 1 = strongly agree, 2 = agree, 3 = neutral, 4 = disagree and 5 = strongly disagree on some statement portraying respondents' perceptions, opinions, attitudes, and beliefs.

For objective two which sought 'to analyse agricultural information usually shared and accessed by extension agents and farmers respectively via mobile phone technology in Northern Region' were analysed by descriptive statistic such frequency distribution. Also, thematic analysis obtained through content analysis was applied on the narrative gathered on agricultural information usually sourced via mobile phone.

Similarly, for objective three which sought 'to examine the level of accessibility and utilization of mobile phone technology by extension agents and farmers in the northern region' was achieved through frequency distribution and content analysis.

Finally objective four which sought 'to analyse the constraints faced by extension agents and farmers in sharing and accessing agricultural information respectively via mobile phone in the northern region' was analysed on using descriptive statistics and Kendall's coefficient of concordance. Respondents were asked to rank the constraints in order of severity and Kendall's co-efficient of concordance applied to examine the level of agreement among the rank scores. The (W) is an index that measures the ratio of the observed variance of the sum of ranks to the

maximum possible variance of the ranks. Kendall's coefficient of concordance is therefore given by the formula:

$$W = \frac{12S}{m2n(n2-1)} \quad \text{..... (3.1)}$$

Where

K = Kendall's coefficient of concordance

S = Sum of squares statistics

m = Denotes number of respondents (sample size)

n = Number of listed constraints

The coefficient of concordance (W) is tasted for significance by using the chi-square formula with a significant value of 0.05(5%). The chi-square formula is given by:

$X^2_{(N-1)} = K\ (N-1)\ W$ ..... (3.2)

Where

K = the degree of freedom

N = number of listed constraints

The tests of hypotheses are:

H_0: the rankings of the constraints do not agree

H_1: the rankings of the constraints agree

The decision role is that:

The H_0 will be rejected if the calculated test statistics is greater than the tabulated test statistics i.e., tcal>ttst, and vice versa.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

Introduction

This chapter presents results and discussion of the study findings. It is organized into sub-sections with the first section 4.1 presents findings on socio-demographic characteristics of the respondents while section 4.2, 4.3, 4.4 and 4.5 presents discussions of findings addressing respectively objective 1, 2, 3 and 4 of the study.

4.1 Demographic characteristics of farmers

Analysis of the sex distribution of smallholder farmers surveyed, as shown in the Table 4.1 indicates that most (71%) of the respondents were male while 29% of the men being female. Although it has been established that women played critical role in agriculture but because of gender biased and discrimination in terms of ownership and control of household resources, their contributions are often not acknowledged or captured adequately in empirical studies.

Also, majority (60%) of the 200 farmers surveyed, were within their youth age bracket of 30 – 45 years with 15% of them being younger than 30 years while only 5% were older than 60 years.

In terms of educational background, many (40%) of the 200 respondents surveyed had no formal schooling background, while 42% had completed primary school education and 11% having secondary, vocational, or technical educational level.

Most (80%) of the 200 farmers surveyed were married with only 10% being single, 2% and 8% were respectively divorced and widowed respectively. This reflective of the Ghana Statistical services sixth round Living standard survey (GSS, 2016).

Table 4.1: Demographics Characteristics of farmers

Demographic of Respondents		Frequency	Percent (%)
Sex of Respondent	Male	142	71.0
	Female	58	29.0
	Total	**200**	**100.0**
Age of Respondents	Below 30 years	30	15.0
	30-45 years	120	60.0
	46-60 years	40	20.0
	Above 60 years	10	5.0
	Total	**200**	**100.0**
Educational Status	No formal Schooling	80	40.0
	Primary school	84	42.0
	JHS/Middle school	22	11.0
	Secondary/voc/Tech.	12	6.0
	Tertiary	2	1.0
	Total	**200**	**100.0**
Marital status	Married	160	80.0
	Single	20	10.0
	Divorced	4	2.0
	Widowed	16	8.0
	Separated	0	0.0
	Total	**200**	**100.0**
Farming Experience	Less than 5 years	21	10.5
	5 -10 years	63	31.5
	More than 10 years	116	58.0
	Total	**200**	**100.0**

Source: Analysis of Field Survey Data, 2021

Marriage among rural farming communities have been identified as an aspects of family life in society and also in terms of getting access to family labour which critical in undertaken agricultural operations such as land preparation, sowing, weed control, harvesting, and post-harvest activities (Sanjeev, 2016

Also, majority (58%) of the respondents having farming for more than 10 years and as such can be said to most experienced in farming practices. Only 10.5% of them had less than 5 years' experience in farming and 31.5% having 5 – 10 years' experience in farming.

4.1.2 Socio-demographic characteristics of AEAs

As presented in the Table 4.2, majority (80%) of the AEAs surveyed were male while only 20% of them were female. It is often argued that the gender gap in access to information by smallholder farmers is partly attributed to low female extension agents. In rural communities, male extension agents might avoid meeting women farmers because of ethical, moral or, social sensitivity issues. As such having female extension agents would have help in bridging information gap between male and female farmers.

Majority (80%) of the extension agents surveyed were 45 years or younger with 30% being younger than 30 years and 50% falling between 30 to 45 years. However, 10% of the agents surveyed were between 46 to 60 years as presented in the Table 4.2.

The extension agents surveyed were highly educated with majority (80%) having degrees (40%) or diploma (40%). Only 20% of them were certificate holders. They also, very experience in delivery extension services to farmers. As shown in the Table 4.2, many (40%) had between 5 to 10 years' experience as extension agents while 30% having more than 10 years' experience as extension agents.

Table 4.2: Demographics Characteristics of AEAs

Demographic of Respondents		Frequency	Percent (%)
Sex of AEEs	Male	16	80.0
	Female	4	20.0
	Total	**20**	**100.0**
Age of AEA	Below 30 years	6	30.0
	30-45 years	10	50.0
	46-60 years	4	20.0
	Total	**20**	**100.0**
Educational level	College (certificate)	4	20.0
	Diploma	8	40.0
	Degree	8	40.0
	Total	**20**	**100.0**
Marital status	Married	16	80.0
	Single	4	20.0
	Total	**20**	**100.0**
Experience in extension delivery	Less than 5 years	6	30.0
	5 -10 years	8	40.0
	More than 10 years	6	30.0
	Total	**20**	

Source: Analysis of Field Survey Data, 2021

4.2 Farmers' and AEAs' opinion and attitude towards mobile phone extension

This section presents results and discussion about farmers' and AEAs' opinions and attitudes towards the use of mobile phone for accessing and sharing agricultural information. As such this section provides information addressing objective one of this study which sought 'to assess farmers and extension officers' perceived opinions, attitudes, and beliefs about the use of mobile phone technology in accessing and sharing information in the Northern Region'.

4.2.1 Farmers' opinions about social media use for accessing and sharing information

With a Five-point Likert scale, farmers' opinions about mobile phone use for accessing and sharing agricultural information were assessed on statements shown in the Table 4.3 and their mean score and standard deviation calculated.

As shown in the Table 4.3, farmers generally agreed with the statement 'Mobile phone help access extension information easily' with mean score of 3.56 (SD = 0.707), while being uncertain or not sure about the statement 'Farmers are able to manage knowledge better using their phone' with mean score of 3.01 (SD = 0.644). Thus, while farmers have opinion that mobile use can help them access extension information more easily, they were not sure about their ability manage knowledge better with their mobile phones.

Also, while farmers generally agreed with the statement 'Mobile phone use allowed farmers to easily reach AEAs for enquiries' with average score of 3.89 (SD = 0.502), they were not sure about the statement 'Farmers are able create and share information easily using their phones' with an average score of 2.73 (SD = 0.643). Thus, the farmers surveyed were of the view that the use of mobile phone can easily allowed them to reach AEAs for enquiries, they however, could not tell whether they would be able to create and share information easily through mobile phone.

Table 4.3: Descriptive Statistics for Farmers' opinions about mobile phone use

Statement	Mean	Std. Deviation
Mobile phone help access extension information easily	3.56	0.707
Farmers are able to manage knowledge better using their phone	3.01	0.644
Mobile phone use allowed farmers to easily reach AEAs for enquiries	3.89	0.502
Farmers are able create and share information easily using their phones	2.73	0.643
Mobile phone use in accessing information is cost-effective	3.90	0.547
Information on share through mobile phone have wide outreach	1.99	0.614
Mobile phone use can easily create interactive learning	2.31	0.430
Mobile phone can make learning interesting and attractive	3.84	0.559
Mobile phone can effectively convey messages which are easy to understand	3.66	0.484
Overall Score	**3.21**	**0.57**

Source: Analysis of Field Survey Data, 2021; Scale: 1 = strongly agree, 2 = agree, 3 = neutral/not sure, 4 = disagree and 5 = strongly disagree.

Similarly, farmers surveyed were of the opinion that mobile phone use in extension service delivery is cost-effective registering a mean score of 3.90 (SD = 0.547) on the statement 'Mobile phone use in accessing information is cost-effective' as shown in the Table 4.3. they however, disagreed with the statement 'Information on share through mobile phone have wide outreach' with a mean score of 1.99 (SD = 0.614). Similarly, the farmers surveyed disagreed with the statement 'Mobile phone use can easily create interactive learning' with a mean score of 2.31 (SD = 0.559). Thus, respondents surveyed have the opinion that mobile phone use cannot easily create interactive learning.

But notwithstanding, they were of the opinion that mobile phone use in extension service delivery can make learning interesting and attractive with a mean score of 3.84 (SD = 0.559) on the statement 'Mobile phone can make learning interesting and attractive'. They also, agreed with the statement that 'Mobile phone can effectively convey messages which are easy to understand' with a mean score of 3.66 (SD = 0.484).

4.2.2 AEAs' Opinion about the use of mobile phone

AEAs opinions and views on the use of mobile phone for extension service delivery was also assessed on a five-point Likert scale and presented in the Table 4.4. As shown in the Table 4.4, generally the AEAs surveyed had positive views and opinions on the use of mobile phones for extension service delivery scoring and overall average score of 4.20 (SD =0.604) indicating agreed, on all the statements portraying positive views on the use of mobile phone for extension service delivery.

Specifically, with average score of 4.26 (SD = 0,607) the AEAs surveyed agreed with the statement 'Mobile phone help access extension information easily' indicating their positive view on mobile phone being helpful in delivery extension services easily. Similarly, they agreed with the statement 'AEAs are able to manage knowledge better using their phone' indicating approval of their ability to better management agricultural knowledge and information using their mobile phones.

Also, generally the AEAs surveyed agreed that mobile phone usage make is easy for farmers to reach them for enquiries. As shown in the table 4.4, with average score of 4.09 (SD = 0.502) respondents generally agreed with the statement 'Mobile phone use allowed farmers to easily reach AEAs for enquiries' demonstrating the effectiveness of mobile phone technology in ensuring effective and efficient accessibility of agricultural information among farmers.

The statement 'AEAs are able create and share information easily using their phones' with a means score of 4.73 (SD = 0.743) indicates that AEAs surveyed strongly agreed with the view that AEAs can effectively create and share information easily using mobile phone. This

demonstrates the level of confidence AEAs had about their ability to effectively create and transmit agricultural information to farmer more rapidly using mobile phone technology. Thus, mobile phone technology can be leveraged upon for rapid knowledge creation, management, and transmission between AEAs and farmers to ensure effective knowledge driven farming practice.

Also, the statement 'Mobile phone use in accessing information is cost-effective' received a strong agreement rank among the AEAs surveyed with average score of 4.90 (SD = 0.747). This indicates that the AEAs surveyed are of the opinion that mobile phone use for extension service delivery could help reduce service and as such regarded as cost-effective means of providing service to farmers.

Table 4.4: Descriptive Statistics for AEAs' opinions about mobile phone use

Statement	**Mean**	**Std. Deviation**
Mobile phone help access extension information easily	4.26	0.607
AEAs are able to manage knowledge better using their phone	4.01	0.544
Mobile phone use allowed farmers to easily reach AEAs for enquiries	4.09	0.502
AEAs are able create and share information easily using their phones	4.73	0.743
Mobile phone use in accessing information is cost-effective	4.90	0.747
Information on share through mobile phone have wide outreach	3.99	0.914
Mobile phone use can easily create interactive learning	3.21	0.230
Mobile phone can make learning interesting and attractive	3.94	0.659
Mobile phone can effectively convey messages which are easy to understand	4.69	0.494
Overall Score	**4.20**	**0.604**

Source: Analysis of Field Survey Data, 2021; Scale: 1 = strongly agree, 2 = agree, 3 = neutral/not sure, 4 = disagree and 5 = strongly disagree.

4.3 Agricultural information usually share and access on mobile phone

This section presents findings of the study dealing with agricultural information usually shared by AEAs and those accessed by farmers. As such this section addresses the second objective of the study which states 'to analyse agricultural information usually shared and accessed by extension agents and farmers respectively via mobile phone technology in Northern Region'.

Meeting agricultural information needs of farmers is very imperative in facilitating technology adoption and improved farming practice which are essential for agricultural development, particularly among smallholder and resource poor farmers (Dankwah & Hawa, 2014).

ICT use in agricultural extension delivery, particularly mobile phone' is expected to facilitate farmers' access to information and ensure timely and efficient delivery of agricultural information for improved farming practice and productivity among smallholder farmers. As such this study analysed information usually disseminated by AEAs via mobile phone and those farmers usually accessed with their phones.

Both farmers and AEAs were asked about the information they usually accessed and share via their mobile phones and analysis of their responses is presented in the Figure 1. As shown in the figure 4.1, agricultural information usually shared and accessed via mobile phone were market information, agro-chemical use, weather information, information on pest and disease control and credit sources for farming financing.

As shown in the Figure 4.1, almost all farmers (92%) and AEAs (95%) said they have been accessing and sharing market information via their mobile phones. Market information is the most frequent information shared and accessed through mobile phone by AEAs and farmers alike. During a key informant interview, one of the AEAs from Tolon District observed that farmers usually called for find out input prices, particularly fertilizer, weedicide, and improved seeds. He further observed that, because of the subsidy on some of the farm inputs

like fertilizer, seeds and agro-chemicals, farmers usually called via their mobile phones to know the price and also the modality for accessing subsidised inputs.

Also, farmers make enquiries about market prices of their produce by using their mobile phones to connect with market women or extension officers to access information on the prices of their produces in various markets. One of the farmers surveyed, explained that they often used their phones to call various markets to find out the prices of their produce before selling them. By this they explained that their bargaining power is enhanced to get good market for their produce.

Similarly, majority of the farmers (88%) and AEAs (96%) indicated that they often accessed and shared weather information via their mobile phones. The AEAs usually sent out text and voice SMS on weather information, particularly weather forecast on rainfall and other climatic condition, to farmers to enable them to plan their farming operations. The weather information on rain forecast the most frequent shared and accessed weather information as explained by the farmers and AEAs surveyed. Famers surveyed considered the weather information on rain forecast as the most useful and reliable information transmitted via mobile phones. They explained that they often look out for this information to plan when to prepare their lands, sow their seeds and apply weedicide to control weeds.

Also, information on pest and disease control were also the most frequent information shared by extension officers and accessed by farmers through the use of mobile phone technology. As shown in the Figure 4.1, majority (78%) of the 200 farmers surveyed said they often accessed information on how to control pest and disease on their fields by using their information to connect with extension officers or their colleague farmers to enquire about control measures. Similarly, almost (91%) all of the 20 AEAs surveyed said they often shared information on pest and disease control to farmers via the use of mobile phones.

However, information on credit sources was the least information shared and accessed by AEAs and farmers through the use of mobile phone technology. As shown in the Figure 4.1 only 29% of the AEAs surveyed said they often shared information on credit sources to farmers. Similarly, only 32% of the farmers surveyed said they often accessed information on credit sources via their mobile phones.

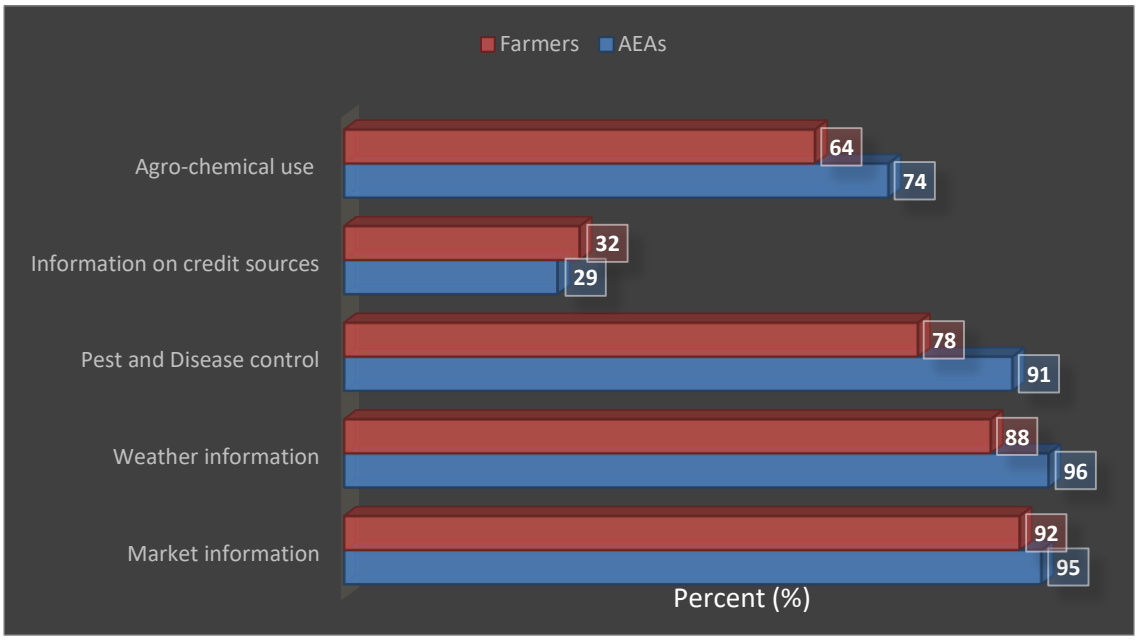

Figure 4.1: Information usually share and accessed via mobile phone

Source: Analysis of field data, 2021

4.4 level of accessibility of mobile phone by AEAs and Farmers

This section presents findings of the study on accessibility of AEAs to mobile phone technology in disseminating and accessing agricultural information. It addresses the third objective of this study which sought 'to examine the level of accessibility and utilization of mobile phone technology by extension agents and farmers in the northern region'

Analysis of farmers response to how the access information delivered through mobile phone revealed a wide-ranging means form listening to voice SMSs to reading or asking someone to read and translate to them text SMSs to researching on the internet sites and social media platforms. Although this study defined accessibility to mobile phone as having use right and being able to source information delivered via mobile phone, analysis of the surveyed data indicated that all the 200 farmers and the 20 AEAs interviewed owned mobile phone devices ranging from analog keypad phones to sophisticated smart phones with high level inter connectivity.

4.4.1 Means of accessing information via mobile phone

Analysis of AEAs and farmers responses to the question how do often share or accessed information via mobile phone is presented in the Figure 4.2. As shown in the Figure most extension officers and farmers share and access agricultural information through phone calls, sending and receiving text SMS, sending, or listening to Voice SMS, watching pre-recoded videos on farm operations and social media platform such as Whasappt, Facebook, Youtube, twitter among others.

As shown in the figure 4.2 all the 20 AEAs and the 200 farmers surveyed said they often make or received calls to access or share extension information, while only 43% of the farmers said they also often send or receive test messages via their phone, all the 20 AEAs said they often sent out text messages containing agricultural information to farmers. In overcoming illiteracy as a barrier to accessing text messages, the farmers explained that those of them who are illiterate are often assisted by a household member or neighbour in reading and translating the content in their local language for them to understand and applied.

For voice SMS, as shown in the Figure 4.2, only 52% of farmers and 78% of AEAs said they have been using as means of accessing and sharing extension information. Voice SMSs are

often used to help overcoming limitation posed by illiteracy which makes difficulty for some farmers to access text messages. Also, because voice SMSs are often in their local language farmers are able to listen to it and understand the content.

Similarly pre-recoded videos of best farming practice are often share mostly via social media platform or other means of transmitting video information via mobile phone to farmers. As shown in the Figure, 69% of the AEAs surveyed and only 43% of farmers said they have ever use this means in sharing and accessing agricultural information. Some of the farmers who do not own smart phones explained that they often watch such videos from their colleagues' phones. Similarly, social media platforms also, serve as medium for disseminating and accessing extension information. However, only 12% of the 200 farmers surveyed said they have ever used this medium in accessing agricultural information while 45% of the 20 AEAs surveyed said they have ever used it to disseminate extension information.

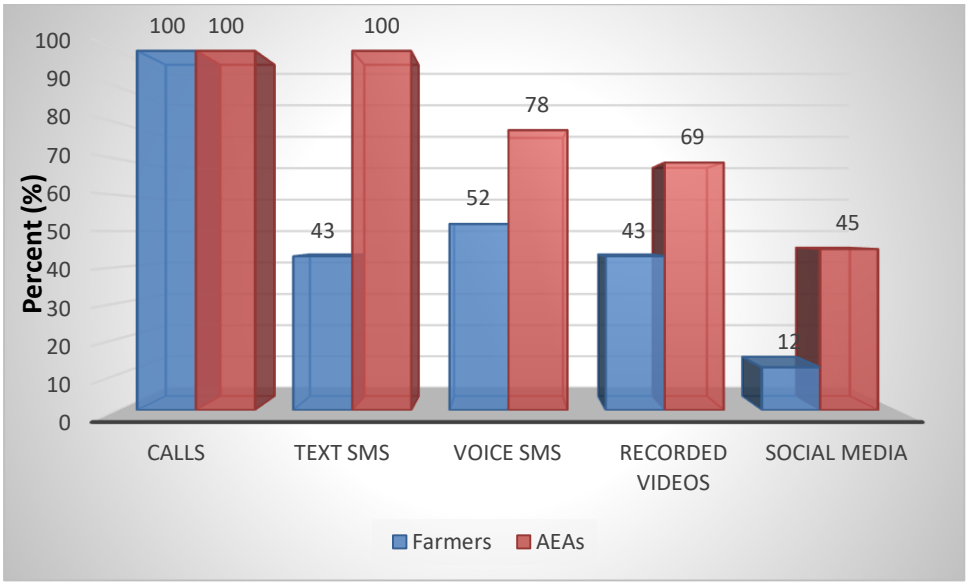

Figure 4.2 Bar graph showing means of accessing information via mobile phone

Source: Analysis of field data, 2021

4.5 Constraints faced by farmers and AEAs in using mobile phone for extension service

This section presents findings of the study on the constraint farmers and AEAs faced in accessing and delivery agricultural information via mobile phones. This, therefore, addresses the fourth objective of the study which sought 'to analyse the constraints faced by extension agents and farmers in sharing and accessing agricultural information respectively via mobile phone in the northern region'

4.5.1 Constraints faced by farmers in using mobile phone

During the key informant interviews conducted a list of constraints or challenges faced in accessing extension services via mobile phone was generated from the responds of the key informants. The 200 farmers were then asked to rank the list of constraints in order of severity based on their experience and perspective. The rank scores were subjected to Kendall's co-efficient of concordance to assess the level of agreement among the rank scores of the respondents and a mean ranks scores were used to determine the most severe constraints and the least. Results of the Kendall's test and mean rank distribution in shown in the Table 4.5

The constraints mentioned included farmer inability to read and understand text messages due to high level of illiteracy among farmers, high call tariffs and data for internet, limited knowledge about mobile phone use, lack of stable power to charge mobile phones, limited mobile network coverage, high cost of smart phone, poor network and high call dropout rate among others.

As shown in the Table 4.5 with Kendall's W of 0.76 and Chi-square value of 86.290 (P = 0.000) indicates that there is 76% agreement among the rank scores assigned by the respondents and that the agreement is significant at less than 1% level of significant.

Table 4.5 Distribution of farmers rankings of constraints in mobile phone usage

Constrains	Mean Rank	Ranking
Inability to read and understand text SMS	3.28	1st
High cost of smart phone	4.50	4th
Limited information delivered via mobile phone	6.67	8th
Lack or poor electricity/power in charging mobile phone	5.23	6th
Limited mobile network coverage	4.83	5th
Unstable reception or high call dropout rate	6.40	7th
High cost of mobile phone management	7.02	9th
High cost of airtime/data (High call tariffs)	3.38	2nd
Limited knowledge about mobile phone usage	3.68	3rd
No of observation	200	
Kendall's W	0.760	
Chi-Square	86.290	
Degree of freedom	8	
Asymp. Sig.	0.000	

Source: Field Survey Data, 2021.

Farmers' inability to read SMS was ranked as the most severe constraints to the deployment of mobile phone for extension services delivery, followed by high cost of airtime/data (high call tariffs), limited knowledge of mobile phone usage was ranked the third most severe constraint. Also, the fourth rank constraint was high cost of smart phones, while limited mobile network coverage and lack or poor electricity/power for charging mobile phones were respectively ranked as the 5th and 6th constraints. However, unstable reception or high call dropout rate,

limited information delivered via mobile phone and high cost of mobile phone management were respectively ranked as the 7th, 8th, and 9th constraints. Thus, the three least constraints in using mobile phone to accessing agricultural information in the two districts surveyed.

4.5.2 Constraints faced by AEAs in using mobile phone

From the key informant interviewed conducted with two experience extension officers in the two districts, nine constraints were identified as limiting extension officer ability to deploy mobile technology in extension service delivery. They included high illiteracy rate among farmers, poor internet connectivity, limited logistics, mobile phones and accessories, poor farmers' capacity to manage information via phone, lack of motivation of extension officers using mobile phone technology, lack of institutional support, poor mobile network coverage, high call tariffs among others.

During the interviews with the 20 AEAs, they were asked to rank the constraints in order of severity and rank scores subjected Kendall's co-efficient of concordance test. The results of the test and distribution of mean rank is shown in the table 4.6.

As shown in the Table 4.6, with Chi-square value of 76.320 (P = 0.000) and Kendall's co-efficient of concordance W = 0.56, it implies that 56% of the rank scores agreed and that the rank score agreement was significant at less than 1% level of significant.

As shown in the table 4.6, while high illiteracy rate among farmers and unstable network or high call dropout rate were ranked respectively as 1st and 2nd most severe constraints, limited logistics, mobile phone device and other accessories and poor mobile and Poor internet connectivity and accessibility were rank respectively as the 8th and 9th constraints.

Table 4.6 Distribution of AEAs rankings of constraints in mobile phone usage

Constrains	**Mean Rank**	**Ranking**
High illiteracy rate among farmers	3.28	1st
Poor mobile network coverage in rural communities	4.50	4th
Limited logistics, mobile phone device and other accessories	6.67	8th
Poor farmers' capacity to manage information via phone	5.23	6th
Lack of motivation from superiors	4.83	5th
Lack of institutional support	6.40	7th
Poor internet connectivity and accessibility	7.02	9th
Unstable reception or high call dropout rate	3.38	2nd
Higher call tariffs	3.68	3rd
No of observation	20	
Kendall's W	0.560	
Chi-Square	76.320	
Degree of freedom	8	
Asymp. Sig.	0.000	

Source: Field Survey Data, 2021.

Similarly, poor mobile network coverage in rural communities was ranked the 4th constraint while lack of motivation, poor farmers' capacity to manage information via phone and lack of institutional support were respectively ranked as 5th,6th, and 7th constraints in decreasing order of severity.

CHAPTER FIVE

5.0 SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Introduction

In this chapter the findings of the study are summarized, and conclusions and recommendation based on the major findings are stated. It has three subheadings as summary, conclusion, and recommendations.

5.1 Summary

This sub-section presents summary of the major findings of the study. Here findings addressing the specific objectives of the study is highlighted.

5.1.1 Farmers and AEAS Opinions and attitude about mobile phone use in extension

The farmers surveyed generally were of the view that mobile phone can help them access extension information easily and efficiently. They were, however, not confidence of their ability to better manage and share knowledge via mobile phone. Regarding reaching to extension officers for enquiries, mobile phone usage farmers observed would allow them to easily reach AEAs for enquiries and quick and prompt response. Thus, the farmers surveyed were of the view that the use of mobile phone can easily allowed them to reach AEAs for enquiries, they however, could not tell whether they would be able to create and share information easily through mobile phone by themselves.

Similarly, farmers surveyed were of the opinion that mobile phone use in extension service delivery is cost-effective, but they were, however, sceptical about its outreach and its ability to interactive learning

AEAs surveyed generally have positive opinions and attitude towards the use of mobile phone for extension delivery. They were generally of the view that mobile phone has been handy in enabling them easily disseminate extension information to farmers. The AEAs were also of the view that they are able to manage knowledge better using their phone' indicating approval of their ability to better management agricultural knowledge and information using their mobile phones. In also, to ensure rapid and prompt response to farmers enquiries, the 20 AEAs surveyed approved of the mobile phone use as the tools to ensure such prompt response. The AEAs were also of the view that mobile phone technology in extension service delivery will make is easy for farmers to reach them for enquiries in get quick response to problems.

The AEAs were sure of their ability to easily create and share information via mobile phone demonstrating the level of confidence AEAs had about their ability to effectively create and transmit agricultural information to farmer more rapidly using mobile phone technology. Thus, mobile phone technology can be leveraged upon for rapid knowledge creation, management, and transmission between AEAs and farmers to ensure effective knowledge driven farming practice.

5.1.2 Extension information often access and disseminated via mobile phone

In general farmers and AEAs indicated that they often accessed and shared market information, weather information, Information on pest disease control, information on credit sources and information on agro-chemical use. However, information on credit sources was the least shared and accessed by AEAs and farmers through the use of mobile phone technology. Market information and weather information is the most widely accessed and shared information on mobile phone technology. Market information is the most frequent information shared and accessed through mobile phone by AEAs and farmers alike. Extension agent explained that farmers usually called to find out input prices, particularly fertilizer, weedicide, and improved seeds. He further observed that, because of the subsidy on some of the farm inputs like

fertilizer, seeds and agro-chemicals, farmers usually called via their mobile phones to know the price and also the modality for accessing subsidised inputs.

Also, farmers make enquiries about market prices of their produce by using their mobile phones to connect with market women or extension officers to access information on the prices of their produces in various markets. One of the farmers surveyed, explained that they often used their phones to call various markets to find out the prices of their produce before selling them. By this they explained that their bargaining power is enhanced to get good market for their produce.

The AEAs usually sent out text and voice SMS on weather information, particularly weather forecast on rainfall and other climatic condition, to farmers to enable them to plan their farming operations. The weather information on rain forecast the most frequent shared and accessed weather information as explained by the farmers and AEAs surveyed. Famers surveyed considered the weather information on rain forecast as the most useful and reliable information transmitted via mobile phones. They explained that they often look out for this information to plan when to prepare their lands, sow their seeds and apply weedicide to control weeds.

Also, information on pest and disease control were also the most frequent information shared by extension officers and accessed by farmers through the use of mobile phone technology. Farmers surveyed said they often accessed information on how to control pest and disease on their fields by using their information to connect with extension officers or their colleague farmers to enquire about control measures.

5.1.3 Ways of delivery information via mobile phone

Most extension officers and farmers share and access agricultural information through phone calls, sending and receiving text SMS, sending, or listening to Voice SMS, watching pre-recoded videos on farm operations and social media platform such as Whasappt, Facebook, Youtube, twitter among others.

Most farmers and AEAs surveyed said they often make or received calls to access or share extension information, send, or receive test messages via their phone. The AEAs said they often sent out text messages containing agricultural information to farmers. In overcoming illiteracy as a barrier to accessing text messages, the farmers explained that those of them who are illiterate are often assisted by a household member or neighbour in reading and translating the content in their local language for them to understand and applied.

Voice SMS was also the most frequent medium use by AEAs and farmers in transmitting information via mobile phone used to help overcoming limitation posed by illiteracy which makes difficulty for some farmers to access text messages. Also, because voice SMSs are often in their local language farmers are able to listen to it and understand the content.

Similarly pre-recoded videos of best farming practice are often share mostly via social media platform or other means of transmitting video information via mobile phone to farmers. Some of the farmers who do not own smart phones explained that they often watch such videos from their colleagues' phones. However, social media platforms were the least medium for disseminating and accessing extension information.

5.1.4 Constraints in using mobile phones for extension delivery

Farmers' inability to read SMS was ranked as the most severe constraints to the deployment of mobile phone for extension services delivery, followed by high cost of airtime/data (high call

tariffs), limited knowledge of mobile phone usage was ranked the third most severe constraint. Also, the fourth rank constraint was high cost of smart phones, while limited mobile network coverage and lack or poor electricity/power for charging mobile phones were respectively ranked as the 5th and 6th constraints. However, unstable reception or high call dropout rate, limited information delivered via mobile phone and high cost of mobile phone management were respectively ranked as the 7th, 8th, and 9th constraints. Thus, the three least constraints in using mobile phone to accessing agricultural information in the two districts surveyed.

For AEAs high illiteracy rate among farmers and unstable network or high call dropout rate were ranked respectively as 1st and 2nd most severe constraints, limited logistics, mobile phone device and other accessories and poor mobile and Poor internet connectivity and accessibility were ranked respectively as the 8th and 9th constraints. Similarly, poor mobile network coverage in rural communities was ranked the 4th constraint while lack of motivation, poor farmers' capacity to manage information via phone and lack of institutional support were respectively ranked as 5th,6th, and 7th constraints in decreasing order of severity.

5.2 Conclusion

In generally farmers and AEAs agent surveyed have positive views, opinions, and attitudes about the use of mobile phone as a means of disseminating agricultural information. The farmers surveyed were however, not confidence of their ability to better manage and share knowledge via mobile phone.

Farmers and AEAs indicated that they often accessed and shared market information, weather information, Information on pest disease control, information on credit sources and information on agro-chemical use. However, information on credit sources was the least shared and

accessed by AEAs and farmers through the use of mobile phone technology. Market information and weather information is the most widely accessed and shared information on mobile phone technology.

Most extension officers and farmers share and access agricultural information through phone calls, sending and receiving text SMS, sending, or listening to Voice SMS, watching pre-recoded videos on farm operations and social media platform such as Whasapp, Facebook, Youtube, twitter among others.

Farmers' inability to read SMS was ranked as the most severe constraints to the deployment of mobile phone for extension services delivery, followed by high cost of airtime/data (high call tariffs), limited knowledge of mobile phone usage was ranked the third most severe constraint while the cost of management mobile phone device was ranked the least constraints faced by farmers in accessing information via mobile phone.

Among the AEAs surveyed high illiteracy rate among farmers and unstable network or high call dropout rate were ranked respectively as 1st and 2nd most severe constraints, limited logistics, mobile phone device and other accessories and poor mobile and Poor internet connectivity and accessibility were ranked respectively as the 8th and 9th constraints

5.3 Recommendations

Based on the findings of the study, the following recommendation are made:

1. The district assembly in collaboration with Non formal education division and the department agriculture should strengthen adult literacy classes among famers to help improve their literacy level. This will enable them to effectively utilize their mobile phone to access extension services

2. Department of agriculture should consider building the capacity of AEAs in mobile phone extension delivery
3. Department of agriculture should help equip AEAs with the necessary tools and accessories to enable them to deploy mobile phone in disseminating extension services.
4. There should be effective collaboration with AEAs and farmers in the deployment of mobile phone in extension service delivery. As farmers have been connected for mobile extension delivery are not aware of it.
5. National Communication Authority should ensure that mobile network operators improve their mobile network coverage to rural communities to ensure farmers have access to their services.

REFERENCES

Katz, E., Levin, M. L., & Hamilton, H. (1963). Traditions of research on the diffusion of innovation. *American sociological review*, 237-252.

Rubin, A. M. (2009). Uses-and-gratifications perspective on media effects. In *Media effects* (pp. 181-200). Routledge.

Anderson, A. (2013). *Media, culture and the environment*. Routledge.

Akumbole, AJ, **Zakaria, H** and Adam, H (2019). Underlying Constructs of Small-Holder Farmers' Perceptions and Attitude towards Improved Maize Technology in Bawku West District of Ghana. *Journal of Agricultural Extension*, 23(3); pp 41-56

Davis FD (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. MIS Q 1989; 13:319-40.

Davis FD (1986). A Technology Acceptance Model for Empirically Testing New End-User Information Systems: Theory and Results. Massachusetts, United States: Sloan School of Management, Massachusetts Institute of Technology; 1986.

Amir, M., Peter, N. & Muluken, W. (2014). The role of mobile phones in accessing agricultural information by smallholder farmers in Ethiopia. RUFORUM Working Document Series (ISSN 1607-9345) No. 14 (1): 395-402. Available from http://repository.ruforum.org

Baba S. S. (2017). The Role and Effectiveness of Mobile Phone Technology in Agricultural Extension Services Delivery in the Northern Region, Ghana. Feed The Future Ghana Agricultural Policy Support project (APSP). USAID.

Ministry of Food and Agriculture (MOFA) (2016). Agricultural Sector Progress Report 2015. Ministry of Food and Agriculture (MOFA), GOG, Accra.

Ministry of Food and Agriculture (MOFA) (2012). Performance of the Agricultural Sector in Ghana: 2006-2012. Gross Domestic Product (GDP) At 2006 Prices by Economic Activity: 2006-2012. Ministry of Food and Agriculture (MOFA), GOG, Accra.

Ministry of Food and Agriculture (MOFA) (2011). "Agriculture in Ghana: Facts and Figures (2010)." Statistics, Research, and Information Directorate. Accra, Ghana

Ghana statistical Service (2010). Population and housing census. Accra: Ghana statistical Service.

Saunders, M., Lewis, P., and A. Thornhill, (1997) *Research Methods for Business Student*s. Pearson Professional Limited, London.

National Communications Authority (NCA), (2016). Quarterly Statistical Bulletin on Communications in Ghana. Volume 1 Issue 2.

Surabhi Mittal and Mamta Mehar, (2012). How mobile phones contribute to growth of small farmers? Evidence from India. International Maize and Wheat Improvement Center (CIMMYT), New Delhi, India.

Sirajul M.I (2011). Adoption of mobile phones among the farmers; A case study from rural Bangladesh. Örebro University, Swedish Business School, MSc in Informatics program.

Williams E. Nwagwu and Opeyemi Seromi (2015). ICT Use in Livestock Innovation Chain in Ibadan City in Nigeria. Africa Regional Centre for Information Science, University of Ibadan, Nigeria.

Technology & Telecommunications, (2020). Number of Mobile Phone (cellular) Subscriptions Worldwide from 1993 to 2019.

Sirajul M. Islam and Ake Grondlund (2011). Factors Influencing the adoption of mobile phones among the farmers in Bangladesh; theories and practices.

Peter & Alimah (2016), Livestock Technology/Vaccine Delivery. Cowtribe Technology, Ltd. www.cowtribe.com.

APPENDICES

APPENDIX A: QUESTIONNAIRE FOR FARMERS

MOBILE PHONE TECHNOLOGY AND EXTENSION SERVICE DELIVERY TO SMALLHOLDER FARMERS IN NORTHERN REGION OF GHANA

You are hereby assured that this questionnaire is to solicit information from you for academic research purpose. The study entitled 'Mobile Phone Technology and Extension Service Delivery to Smallholder Farmers in Northern Region of Ghana' is being conducted in partial fulfilment for the award of MSc in Innovation Communication in the Department of Agricultural Innovation of the University for Development Studies, Tamale, Ghana

Thank you.

SECTION A. BIODATA OF FAMERS

1. Sex of respondent 1 = Male [ ] 2 = Female [ ]

2. Age of respondent 1 = Below 30 years [ ] 2 = 30-45 years [ ] 3 = 46-60 years [ ] 4 = Above 60 years [ ]

3. Marital status. 1= Married [ ] 2 = Single [ ] 3= Divorced [ ] 4= Widowed [ ] 5= Separated [ ]

4. Level of formal schooling? 1= No formal education [ ] 2 = Primary school [ ] 3 = JHS/Middle school [ ] 4 = Secondary/vocational institute [ ] 5 = tertiary [ ]

5. Household size? 1= Less than 3 [ ] 2= Between 3-5 [ ] 3= Between 5-8 [ ] 4= Between 8-12 [ ] 4 =Between 12-18 [ ] 5 = Between 18-25 [ ] 6= Above 25 [ ] (No. of people in HH…….)

6. For how long have you been farming? 1 = Less than 5 years ago [ ] 2 = 5-10 years ago [ ] 3 = More than 10 years ago [ ] (No. of years as a farming……..)

Section B. Opinions and attitude towards mobile phone extension

7. Indicate your level of agreement or otherwise on the following statement? (1=Strongly Agree {SA}, 2= Agree {A}, 3=Neutral {N}, 4= Disagree {D}, 5=Strongly Disagree {SD}). Tick your

Statement	Response				
	SA	A	NS	D	SD
Inability to read and understand text SMS					
High cost of smart phone					
Limited information delivered via mobile phone					
Lack or poor electricity/power in charging mobile phone					
Limited mobile network coverage					
Unstable reception or high call dropout rate					
High cost of mobile phone management					
High cost of airtime/data (High call tariffs)					
Limited knowledge about mobile phone usage					

Section C. Mobile Phone use in extension service access among farmers

9. Do you use mobile phone to access agricultural information? 1 = Yes [ ] 2 = No [ ]

10. Which of the following means do normal use in accessing extension service?

A) Phone calls [ ]

B) Text messaging (SMS) [ ]

C) Voice messages (SMS) [ ]

D) Recorded Videos [ ]

E) Social Media platforms [ ]

(Multiple response: tick as many as are applicable)

11. Do you usually obtain the types of agricultural information you need for your farming activities through the use of mobile phone? 1 = Yes [ ] 2 = No [ ]

12. Which of the following agricultural information do you usually used your mobile phone to access? (Multiple response: tick as many as are applicable)

Information	Tick
Market information	
Weather information	
Pest and Disease control	
Information on credit sources	
Agro-chemical use	

D: Constraints faced by farmers in using mobile phone to access extension services

13. Rank the following constraints you often face in using mobile phone to access extension service in order of severity? (Multiple response, tick as many as are applicable)

Constrains	**Ranking**
Inability to read and understand text SMS	
High cost of smart phone	
Limited information delivered via mobile phone	
Lack or poor electricity/power in charging mobile phone	
Limited mobile network coverage	
Unstable reception or high call dropout rate	
High cost of mobile phone management	

High cost of airtime/data (High call tariffs)	
Limited knowledge about mobile phone usage	

THANK YOU

APPENDIX B: QUESTIONNAIRE FOR AEAs

MOBILE PHONE TECHNOLOGY AND EXTENSION SERVICE DELIVERY TO SMALLHOLDER FARMERS IN NORTHERN REGION OF GHANA

You are hereby assured that this questionnaire is to solicit information from you for academic research purpose. The study entitled 'Mobile Phone Technology and Extension Service Delivery to Smallholder Farmers in Northern Region of Ghana' is being conducted in partial fulfilment for the award of MSc in Innovation Communication in the Department of Agricultural Innovation of the University for Development Studies, Tamale, Ghana

Thank you.

SECTION A. BIODATA OF FAMERS

1. Sex of respondent 1 = Male [ ] 2 = Female [ ]

2. Age of respondent 1 = Below 30 years [ ] 2 = 30-45 years [ ] 3 = 46-60 years

3. Marital status. 1= Married [ ] 2 = Single [ ] 3= Divorced [ ] 4= Widowed [ ] 5= Separated [ ]

4. Level of formal schooling? 1= College/certificate [ ] 2 = Diploma [ ] 3 = Degree [ ] 4 = Secondary/vocational institute [ ] 5 = tertiary [ ]

65 For how long have you been working as extension agent? 1 = Less than 5 years ago [ ] 2 = 5-10 years ago [ ] 3 = More than 10 years ago [ ] (No. of years as a farming……..)

Section B. Opinions and attitude towards mobile phone extension

6. Indicate your level of agreement or otherwise on the following statement? (1=Strongly Agree {SA}, 2= Agree {A}, 3=Neutral {N}, 4= Disagree {D}, 5=Strongly Disagree {SD}). Tick your

Statement	Response				
	SA	A	NS	D	SD
Mobile phone help access extension information easily					
AEAs are able to manage knowledge better using their phone					
Mobile phone use allowed farmers to easily reach AEAs for enquiries					
AEAs are able create and share information easily using their phones					
Mobile phone use in accessing information is cost-effective					
Information on share through mobile phone have wide outreach					
Mobile phone use can easily create interactive learning					
Mobile phone can make learning interesting and attractive					
Mobile phone can effectively convey messages which are easy to understand					

Section C. Mobile Phone use in extension service access among farmers

7. Do you use mobile phone to share/disseminate agricultural information to farmers? 1 = Yes [ ] 2 = No [ ]

8. How long have you been using mobile phone to disseminate agricultural information to farmer? …….years

9. Which of the following means do normal use in sharing/disseminating extension service?

A) Phone calls [ ]

B) Text messaging (SMS) [ ]

C) Voice messages (SMS) [ ]

D) Recorded Videos [ ]

E) Social Media platforms [ ]

(Multiple response: tick as many as are applicable)

10. Do you usually meet the information needs of your farmers through the use of mobile phone? 1 = Yes [ ] 2 = No [ ]

11. if no, why? ……

……..

12. Which of the following agricultural information do you usually disseminate via mobile phone to farmers? (Multiple response: tick as many as are applicable)

Information	Tick
Market information	
Weather information	
Pest and Disease control	
Information on credit sources	
Agro-chemical use	

D: Constraints faced by farmers in using mobile phone to access extension services

13. Rank the following constraints you often face in using mobile phone to disseminate extension service in order of severity? (Multiple response, tick as many as are applicable)

Constrains	**Ranking**
High illiteracy rate among farmers	
Poor mobile network coverage in rural communities	
Limited logistics, mobile phone device and other accessories	
Poor farmers' capacity to manage information via phone	
Lack of motivation from superiors	
Lack of institutional support	
Poor internet connectivity and accessibility	
Unstable reception or high call dropout rate	
Higher call tariffs	

THANK YOU