UNIVERSITY OF CAPE COAST

DETERMINANTS OF FARMERS' USE OF MOBILE PHONE TO ACCESS AGRICULTURAL INFORMATION IN AGONA – EAST DISTRICT OF CENTRAL REGION, GHANA

PIOUS AINOO CUDJOE

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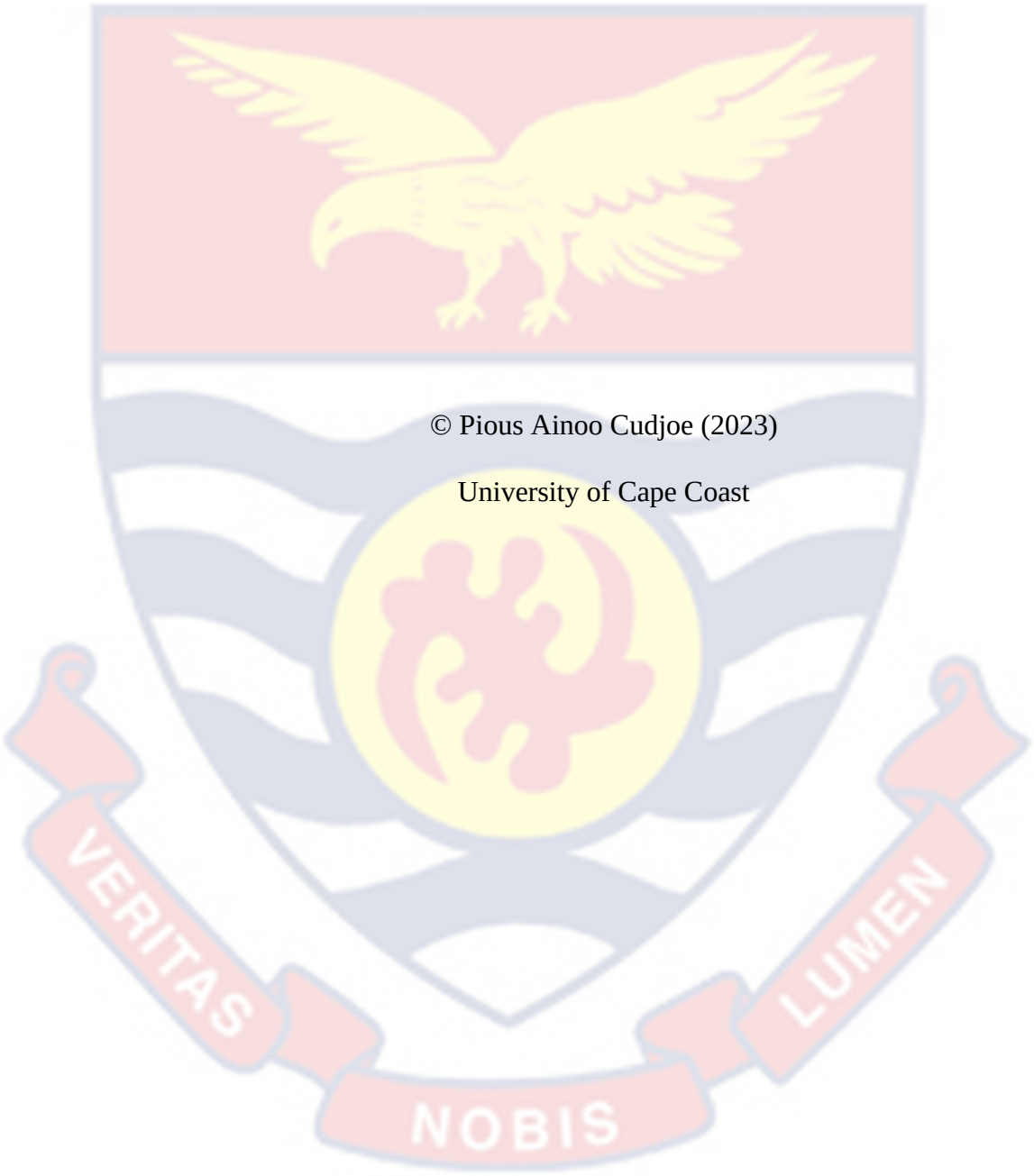

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DETERMINANTS OF FARMERS' USE OF MOBILE PHONE TO ACCESS AGRICULTURAL INFORMATION IN AGONA – EAST DISTRICT OF CENTRAL REGION, GHANA

BY

PIOUS AINOO CUDJOE

Thesis submitted to the Department of Agricultural Economics and Extension of the School of Agriculture, College of Agriculture and Natural Sciences, University of Cape Coast, in partial fulfillment of the requirements for the award of Master of Philosophy Degree in NGO Studies and Community Development

JUNE 2023

DECLARATION

Candidate's Declaration

I hereby declare that this thesis is the result of my own original research and that no part of it has been presented for another degree in this university or elsewhere.

Candidate's Signature: ..... Date:.....

Name: Pious Ainoo Cudjoe

Supervisors' Declaration

I hereby declare that the preparation and presentation of the thesis were supervised in accordance with the guidelines on supervision of thesis laid down by the University of Cape Coast.

Supervisor's Signature: ..... Date:.....

Name: Prof. Martin Bosompem

ABSTRACT

The use of mobile phones has become important in the agricultural sector. However, little is known about its level of use and the factors that affect its use to access agricultural information in Agona – District, Ghana. The study employed a descriptive correlational survey design to determine factors that affect farmers' use of mobile phone to access information. Multistage sampling technique and structured interview schedule were used to collect data from 182 farmers from 14 communities within the district. Frequencies, percentages, means, standard deviations and Independent Sample t- test and multiple regressions were used to analyze the data. The study showed that males were dominant in the use of mobile phone to access agricultural information. Farmer's knowledge and awareness of the use of mobile phone for agricultural information was relatively low. Majority of farmers agreed to benefiting from using mobile phone in receiving agriculture information. Financial services and reduced travel cost were the level of extent to which farmers use mobile phone. Again, high cost of call tariff and difficulty in texting message were the major challenges of using mobile phone. The five factors that best predict the extent of use of mobile phone by farmers were awareness of mobile phones, knowledge of mobile use, benefit of using mobile phones, farmers' educational level and type of mobile used.

The study recommends the need of telecommunication network companies and Ministry of Food and Agriculture to provide more training to farmers on the use of mobile phone for accessing agricultural information.

KEY WORDS

Access

Agricultural

Information

Mobile phone

Use

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DEDICATION

Professor Emeritus Apostle Kwadwo Safo Kantanka

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LIST OF ABBREVIATIONS

AEA	Agricultural Extension Agent
AMPS	Advanced Mobile Phone Service
CDMA	Code Division Multiple Access
FBO	Farmer Based Organization
GDP	Gross Domestic Product
GLO	Global Telecommunications Limited
GSMA	Global System for Mobile Communications Association
ICT	Information Communication Technology
ITU	International Telecommunication Union
LLC	Limited Liability Company
MoFA	Ministry of Food and Agriculture
MTN	Mobile Telecommunication Network
NCA	National Communication Authority
NGO	Non-Governmental Organization
SIM	Subscriber Identity Module
SMS	Short Message Service
URT	Ultra Revolutionary Technology

CHAPTER ONE

INTRODUCTION

Background of the Study

Agriculture information systems has over the years been a very critical and vital component of agriculture development and wellbeing processes of agricultural practitioners. From the creation of the world when people started cultivating crops and rearing of animals or livestock, farmers tried to look for information for their farming activities. No matter the location of the farmer and the type of agriculture activity the farmer engages in, the most basic searched information by these farmers has been their own knowledge and skills acquired to determine and predict the outcome of issues related to farming activities, which help them get basic agriculture data and facts for their agricultural activities. For example, farmers are in dire need to have knowledge and to know the best cultivation practices, sources of improved seeds, the quantity and the type of input to use as well as information about the weather and to determine when to grow their crops and also the availability of market to determine prices of goods, demand indicators and other information about their farming activities.

Several studies have established the relevance of agricultural information for enhancing agriculture production. Researches by Meyer (2015), Conley and Udry (2010), Gruber and Koutroumpis (2011) shown that agriculture information has constantly been a vial factor in the wellbeing and livelihood of any agrarian community and has since the inception of the world molded the manner of which farmers opine and work. Other researches have also identified that if farmers are well resourced with agriculture information,

there is higher tendency of increasing their crop yield which could in turn affect their livelihood positively. (Mchomba, 2012; Mertz, Mbow, Reenberg, & Diouf, 2009); (Fofona, Abdoulaye, Coulibaly, Sanogo, & Longyintou, 2010). This shows that the achievement of any agricultural activity be it planting, pre and post-harvest and marketing must have a great connection to the right usage of agricultural information. As evidence have proved the stance of better yield of crops through proper information delivery, most farmers especially those on African continent are deficient to precise and relevant agricultural information. This has led to the constant reduction of agricultural production of crops in Africa thereby minimizing the livelihood of farmers and the development of African continent. The sphere of agriculture in developing countries is mostly qualified by low inputs, subsistence farming where farmers produce to feed families and themselves and small scale. (Ferris, 2005). Production of agricultural goods is very low because of the modified access to advance agricultural engineering or technology including Information Communication Technology (ICT) and advance mechanical tools and equipment for agricultural activities which turn to dissemble market participation. A lot of farmers are not better informed about the prices of commodities in different market and they also don't have contacts to possible buyers of their produce. Because of this, most farmers engage in subsistence farming where they consume what they produce with their families and sell the remaining to traders around or the common market. (Mchomba, 2012) .

Crucially, lack of access to agricultural data has been a challenging account for a state of inactive improvement of agrarian operation in developing countries and this has made smallholder farmers vulnerable to various dangers

and uncertainties during planting, pre and post harvesting, transportation and marketing of their agricultural produce. (Foster & Rosenzweig, 2010); (World Bank,2008); (Arokoyo, 2003; (Lwoga, Stilwel, & Ngulube, 2010)

In recent times, mobile phones are now used as tool to bridge the information gap of the declamatory part of rural population. In other part of the world, mobile phones are enormously used to extradite agricultural information to farmers and users (Bwalya, Asensu-Okyere, & Tefera, 2012) and this has helped users of mobile phone to reduce the cost involved in accessing information.

A report by Aker (2011) reveal that mobile phones have importantly lower communication and information cost for farmers who access information for their farming activities. The opportunities provided by mobile phones to farmers does not only assist them to communicate and obtain access to information but also the use of mobile phone help farmers to access information for their farming activities. Columbus (2010) was of the accession that mobile phone has alleviated communication among farmers from other communities not only for accessing agricultural information. Experience from most countries signal that, speedy development of Information Communication Technology has fantastically improved information sharing practice of agriculture (Bwalya, Asensu-Okyere, & Tefera, 2012).

For some reasons provided, a basic account of agrarians' inability to access agricultural information has been poor use of Information Communication Technologies (ICT) (Arokoyo, 2003); (URT, 2008); (WorldBank, 2008). ICT has largely been reckoned as one of the drivers for convinced change in agricultural and rural development. (World Bank, 2016)

and (ITU, 2016). Further studies by Prahalad (2004) and Jensen (2007) shows that where mobile phone is well used in agriculture information for farming activities, farmers have been able to access information such price, weather and best farming practices such as application of fertilizer and improved seeds for growing crops. When farmers are well informed with this information, they stand the chance of increasing their livelihood. With basic necessary information, farmers become able to better plan for their operations and make solid strategic decisions. (Reddy, 2004); (Meera, Jhamtani, & Rao, 2006) and (Mittal, Gandhi, & Tripathi, 2010).

In a relative panty research in Ghana by Boadi, Boateng, Hinson, & Opoku (2007); Ofosu-Asare (2011) and Salia, Nsowah- Nuamah, & Steel (2011) show that farmers and fishermen benefit from mobile phone usage for agricultural activities. Boadi, Boateng, Hinson, & Opoku (2007) uncovered those farmers in rural Eastern and Central Regions in Ghana respectively get good information flow, improved marketing, functional effort and cost of saving for using mobile phones. However, Ofosu-Asare (2011) study converge a point on cocoa producing farmers in Bono, Western North, Ashanti and Eastern Regions which happens to be the four leading cocoa producing regions of the country. In his study, he found out that 61% of cocoa farmers who owned mobile phones and use it for agricultural activities by ordering for agricultural input and liaison for purchasing clerks have seen reduction in their transportation cost. Furthermore, a study by Salia, Nsowah- Nuamah, & Steel (2011), reveal that fishermen have expanded their markets and are able to make reasonable decisiveness using mobile phones. In a current study by Nanteaw, Anaglo, & Boateng (2015), concluded that mobile phone technology as a tool

suffice a facilitator of relation and a medium for the interchange of forward-looking ideas especially among pineapple farmers. The study reveals a high infiltration rate of 95% among pineapple farmers as against 27% among cocoa farmers, a situation which made pineapple farmers more innovative than cocoa farmers.

According to Population and Housing Census (2010), reveals that the proportion of agricultural household who engage in crop farming represent 97% of a total population of 85,920 and out of this population only 36.8% own mobile phone Agona East District. The study also reveals that majority 44% of males than female 30.6% own mobile phone in Agona East district. There is no known study in the literature on the smallholder farmer use of mobile phone for agriculture activities in Agona East District which is a major contributor of agricultural produce in the Central Region of Ghana. Again, little is known about the challenges associated for using mobile phones for agricultural information for farming activities. This has necessitated the study on the smallholder farmer use of mobile phone for agricultural information activities in Agona- East District of Central Region of Ghana.

Statement of Problem

Obviously, there are extreme excess of literature available to show that mobile phone technology has all-encompassing scope of applications in diverse commercial enterprise activities including agriculture. (Boadi, Boateng, Hinson, & Opoku, 2007), (Wu & Wang, 2005), (Frempong, 2009) and (Sey, 2011). The invention of mobile phone technology has been beneficial means of circulating information to all degree of people and activities in and out of the country (May & Hearn, 2005). Clearly, mobile phone is apparently one of the

most precious technologies that afford people starter to the services they demand to create more hopeful future. One of the good things about mobile phone in Ghana is that, the subscription is everywhere and the rate of its incursion in farming communities are developing strongly.

Despite of growing of mobile phone in rural communities, African farmers however are not adequately applying the inherent capacity of mobile phone for their agriculture activities. It could be realized that there is inequality between mobile phone subscriptions which is progressively being acquired at one hand and farmers process of taking up this innovation into their farming activities at the other hand. Hence, smallholder farmers in Ghana nevertheless endure from poor and unseasonable access to agricultural information. Deficiency to seasonable access to information is one of the restraints to smallholder agricultural production in developing country's population (Jensen, 2007). It is easily perceived that support is critical for both delivery and sustainability of mobile services. A study by Gollakota (2008) reveal that information exclusively is not enough to farmers and so there must be a proposed approximate structural and fiscal solutions for more sustenance as well.

Some studies have directly and obviously stated that if farmers need to successfully advance in agriculture, there must be a support to shape their effort to the application of mobile phones for their farming activities. (Duncan, 2013). This therefore point out that it is important to give a helping hand to users of mobile phone to communicate agricultural information to improve farmers livelihood and for them to be capable to purchase mobile information services. Notwithstanding, the primary challenge is the cognition and the type of

assistance farmers demand and the stakeholders to support the farmers in a way they can efficiently use mobile phones to access agricultural information for improved and sustained agricultural activities.

Most rural communities are challenged with getting access to network connectivity as telecommunication companies in the country are reluctant to extending their services to these rural communities. Even when there is network connectivity, it can only be accessed at a spot and out of the spot the connection is lost. Accessibility and usage of the internet in this communities are even more difficult.

Educational facilities and systems operated within farming communities are very appalling. Members within these farming communities cannot get access to modern information and I.C.T equipment to improve the quality of mobile phone usage. According to Akanlisikum (2014) reveal that, it is vital to note that there has been enormous growth in digital technology especially the cellular telephone industry in Ghana. Today, cell phone is longer a rich man's preserve accessory in Ghana. Cell phone penetration rate in Ghana has increased to 85.5% in August 2011.

However, researchers across the globe have conducted studies on the numerous potentials that mobile phones have to offer. Alexander, Siderides, Koukouli, & Antonopoulon, (2010) & WorldBank (2007) have revealed that the agriculture sector in Ghana has fall behind relative to the number of people who have access to communication services and the ways which these services could be used and Agona East is of no exception. Several studies by Aker (2010); Jensen (2010); Arokoyo (2005); Overa, (2006) have shown the significant contribution of mobile phone in agricultural productivity which has led to the

improvement of livelihood, poverty reduction, crop yield and increased income in agrarian communities but this massive and tremenduous contribution is yet to be realized in Agona-East District for accelerated economic growth and poverty reduction. For instance a study conducted by Kwakwa, (2012) on mobile phone usage by micro and small scale enterprises in Akuapem North District in Ghana shown an improvement of communication with customers, increase of profit, increase savings and lower of operational cost has helped smallholder farmers through the use of mobile phone. Furthermore, a study by Overa, (2006) revealed that traders who use mobile phone in Ghana have improved their communication between traders and suppliers. However, most of these studies have been conducted in other sectors that partially relate to agriculture sector, but not in smallholder farmers especially vegetable farmers in Agona-East District of Ghana.

However, there has been numerous impacts of digital technologies on development with evidences everywhere, but little seem to be known on smallholder farmer use of mobile phone for agricultural information in Agona West District of Ghana. To close this gap and add to already existing knowledge in the District of study, there is a need for this study to assess whether mobile phone usage have impact on smallholder farmer.

General Objective of the Study

Examine the determinant of farmers use of mobile phone to access agricultural information in Agona East District.

Specific Objectives

1. To identify farmers' the level of awareness and knowledge of mobile phone use in obtaining agriculture information in the district.

2. To examine the benefit farmers derive from using mobile phone to access agricultural information in the district.
3. To compare male and female farmers' extent of use of mobile phone services to access agricultural information.
4. To examine the extent and level of use of mobile phone services for agriculture information.
5. Examine the predictors of mobile phone use for agricultural information.
6. To access the challenges affecting mobile phone ownership and use by farmers in Agona East District.

Research Questions

1. To what extent can awareness and knowledge of mobile phone be used in obtaining agricultural information in the district?
2. Do famers get benefit from using mobile phone to access agricultural information?
3. Do male and female farmers differ in their extent use of mobile phone services to access agricultural information?
4. To what extent and level do smallholder farmers use mobile phone services for agriculture information?
5. What are the predictors of mobile phone use for agricultural information?
6. What challenges does smallholder farmer's face in owning and using mobile phone?

Hypothesis of the Study

The following hypothesis was formulated for the study and was tested at 0.05 alpha level.

1. H_0: There is no significant difference between male and female farmers and their extent use of mobile phone for agriculture information.

   H_1: There is a significant difference between male and female farmers and extent use of mobile phone for agriculture information.

2. H_0: There is no significant relationship between background characteristics of farmers, attributes of the innovation and the extent use of mobile phone services for agriculture information.

   H_1: There is significant relationship between background characteristics of farmers, attributes of the innovation and the extent use of mobile phone services for agriculture information.

Justification of the Study

This study determined the use of mobile phone for agricultural information in Agona East District. It is important to distinguish the type of information relevant to farmers and information that farmers seek often. Hence, understanding farmers' needs can ensure and help in the supply of information services that better serve farmer's needs. Again, by handling information needs, it is essential to create a community that is rich in information delivery which is critical to addressing poverty in our country. According to studies by (Shadrach and Summers, 2002); (Patel, Savani, and Paresh, 2012) posited that information helps to reduce poverty through enhancing opportunities, empowerment and increasing economic and social security. Mason and Lee, (2004) also highlighted that there is a clear connection between information access and poverty reduction.

Again, this study was paramount in the sense that mobile phone usage and its services has increased to the extent that is beyond imagination in recent

years, thus knowledge and understanding of the use of such technology would help to project and come up with schemes for more efficient and effective use of mobile phone in accessing and circulating agricultural information to farmers for their farming activities.

The outcome of the study assisted farmers to practice and adopt the use of mobile phone for agriculture information on their farms to increase their crop production and improve their living condition. The use of mobile phone to receive information on farming practices and other agricultural practices help farmers to have abundant of yield, get income for their upkeep and enough food to feed themselves and the nation.

Again, the study gingers government and stakeholders especially those in the telecommunication networks to provide suitable mobile phone orientation, seminars and workshops for smallholder farmers most especially those in the rural areas who are illiterate. This exercise must be facilitated by well trained and well-educated extension officers who will train the smallholder farmers in the use mobile phones to increase crop production and the livelihood of farmers. Furthermore, government must establish and project agriculture institutions where the ministry of food and agriculture would be the head of the institution established. Non-governmental organizations and foreign aids that have keen interest in mobile phone of smallholder farmers should also provide incentives to farmers to motivate them to effectively use mobile phones for their crop production.

Delimitation of the Study

There are so many stakeholders who are involved in agricultural information delivery activities project which includes telecommunication

companies, input dealers, extension officers, processors, farmers and exporters of agricultural products, however, farmers who cultivate agriculture crops in Agona East District of Ghana were involved in the study.

Limitation of the Study

A structured interview guide was used for this study and the instrument was easily be understandable for respondent to respond to the questions. The instrument was made valid by analyzing items that was responded to by the respondents.

Secondly, the sample was purposive. Respondents were chosen based on mobile phone ownership forgetting farmers who do not have access to mobile phone.

Definition of Terms

The key terms used in the study are defined in this section

Mobile phone: This is a portable device where farmers connect to a telecommunication network in order to send and receive information or other data.

Mobile phone use: The extent to which mobile phone is put into service for a particular purpose.

Agriculture: The practice of farming which includes cultivation of the soil for growing of crops and the rearing of animals by farmers in the district.

Agricultural Activity: The extent to which farming is done to produce the needed crop output.

Type of mobile phone: This refers to feature and smart phones that farmers use.

Mobile phone application: A mobile phone application is a type of software that is designed to run on a mobile device. The applications on the mobile phone helps the user to carry out more specific task that are not directly related to the device itself.

Organization of the Study

The thesis consists of five chapters. Chapter One introduced the statement of problem and described the specific objectives that guided the study as well as justification of the study. Chapter Two is made up of the available related literature relevant to the study. Chapter Three constitute the methodology which describes the procedures followed in carrying out the study. Chapter Four focused on the analysis and presentation of the findings of the study. Finally, Chapter Five discussed the summary, conclusions and recommendation and areas for further studies.

CHAPTER TWO

LITERATURE REVIEW

Introduction

This chapter represents related literatures and theoretical reviews of determinant use of mobile phone for agriculture information. The adoption theory of Rogers was reviewed to inform the study. This chapter has been divided into three sections. The first section looks at the theoretical framework of the study and its components. Section two looks at the brief background and history of mobile phone penetration in the world, state of telecommunication in Ghana, communication infrastructure. The final section looks at other related work in the use of mobile phone for agriculture information and a well-presented conceptual framework.

Theoretical Framework

A lot of theories and models have been propounded and used by lot of researchers to define and explicate the use of information technology. In this context of study, Roger's diffusion of innovation theory and unified theory of acceptance and use of technology were used.

Diffusion of innovation theory

Roger's diffusion of innovation theory is largely used in the study of technology diffusion and adoption. This theory is acknowledged by many researchers as crucial to any study which seeks to bring out the purpose of possible adopters of a given innovation. Roger's diffusion of innovation theory shows reasons and at what grade new thought and technologies diffuse through cultures and individuals at different levels. (Oliveira & Martins, 2011; Alqahatani & Wamba, 2012)

Roger's diffusion of innovation theory integrates the innovation decision process, innovation characteristics, adopter characteristics and opinion leadership (Bates, Manuel, & Oppenheim, 2007). Rogers contended five adopter categories which is defined as the category or classification of individuals within a social system based on innovativeness. The five adopter categories include; innovators, early adopters, early majority, late majority and the laggards.

Innovators: These are group of people whom are willing to experience new ways and ideas of doing things and adopt innovation as quickly as possible.

Early Adopters: These are group of people that are limited with the boundaries of the social system. They put their stamp and tale absolute approval on new idea by adopting it.

Early Majority: These are group of people that adopt the innovation immediately before other group of their peers adopt it. They are deliberate in adopting an innovation. They are not the first nor the last to adopt an innovation.

Late Majority: These group of people wait until almost all their peers adopt the innovation because they are skeptical about the outcome of the innovation.

Laggards: These are group of individuals that have limited resources and lack decision knowledge and innovations. They first want to make sure that an innovation works before they adopt.

These categories manifest itself in a more dissimilar way and it is highly subject to the type of adopter and innovation decision process.

Rogers again provided a basis for logical reasoning of five innovative characteristics that may formulate the decision of people within a cultural context to adopt or refuse an innovation. The five innovation characteristics are;

trialability, complexity, compatibility, observability and relative advantage. Rogers (2003) contended that the rate of adoption of an innovation is the relative speed at which an innovation is adopted by members of a social system. For example, the number of people who adopt an innovation for a time frame can be measured as the rate of adoption of an innovation. The sensed attributes of an innovation is significant predictors of the rate at which an innovation would be adopted.

Complexity: This is defined as the degree to which an innovation is seen as relatively difficult to use and understand.

Trialability: This is defined as a degree to which an innovation may be experimented on a limited basis. With this, new idea can be tried, tested and the installment plan will generally be adopted more rapidly than innovations that are not divisible.

Relative advantage: This is the degree to which an innovation is perceived as being better than the idea it supersedes. Relative advantage is often expressed in economic profitability in status giving or other ways. Thus, the cost and social status motivation aspects of innovation are elements of relative advantage. For example, while innovators, early adopters and early majority are more position motivated in adopting an innovation, the late majority and the laggards perceive status as less significant.

Compatibility: This is defined as the degree to which an innovation is seen as logical with the existing values, experience and needs of potential adopters. For example, if an innovation is compatible with a person's wants and needs, then uncertainty will reduce and the rate of adoption of the innovation will improve.

Observability: This is defined as the degree to which the results of an innovation is visible to others.

Notwithstanding, Roger also outlined the adopter's characteristics under three categories namely; socio-economic, personality values and communication behavior (Bates, Manuel, & Oppenheim, 2007). In this study the researcher stressed on the communication behavior particularly the propensity to search for information.

Diffusion of innovation theory see innovation as communicated through certain channels over time within a certain cultural system (Oliveira & Martins, 2011). According to Roger's (2003) the time prospect is neglected in most research.

Unified theory of acceptance and use of technology

According to Ahmed (2014), unified theory of acceptance and use technology was developed and introduced by Ventatesh, Morris, and Davis (2003) based on eight technology acceptance contesting models. These theories and models are the Social Cognitive Theory, the Innovation Diffusion Theory, Theory of Reasoned Action, Motivational Model, the Theory of Planned Behaviour, the Technology Acceptance Model, a model uniting the Technology Acceptance Model and the Theory of Planed Behaviour and the Model of Personal Computer Utilization. The theory was set up on four theoretical concept constituting determinants of intention to use or usage behaviour which plays a crucial roles as replacement of technology acceptance. These theoretical concepts are:

Performance expectancy: This is the level to which an individual believes that using a system will help him or her to achieve a result in job performance. In

this regard, a farmer would choose mobile phone for their agricultural information if a good result would be achieved.

Effort expectancy: This is the degree at which an innovation is easy to use. An easy use of an innovation is critical in all sphere of activities. Easy to understanding an innovation would motivate an individual to adopt.

Social influence: This is the level to which an individual perceives that prominent and people who are important to other should use a new system.

Facilitating conditions: This is the level to which an individual believes that an organizational and technical infrastructure exist to support use of a system. An add up to these variables, the theory considers also moderating factors which check the relationships between various variables and intention to use a system.

Factors that affects Adoption of Innovations

Communication channel as a factor of innovation of adoption

Rogers (2003) defines communication as a process in which participants create and share information with one another in order to reach a mutual understanding. This communication occurs through channels between sources. Rogers (2003) stated that a source is an individual or an institution that creates a message. A channel is the means by which a message gets from the source to the receiver. Rogers states that diffusion is a specific kind of communication and includes these communication elements: an innovation, two individuals or other units of adoption, and a communication channel. Mobile phone and interpersonal communication are two communication channels.

Communication channels also can be categorized as localities and cosmopolite channels that communicate between an individual of the social system and outside sources. While interpersonal channels can be local or

cosmopolite, almost all mobile phone channels are cosmopolitan. Because of these communication channels' characteristics, mobile phone channels and cosmopolitan channels are more significant at the knowledge stage and locality channels and interpersonal channels are more important at the persuasion stage of the innovation-decision process (Rogers, 2003). The use of mobile phone sits within the core value of communities communicating within and between groups for social or economic interactions. It enhances past experiences of communication by removing the awkwardness associated with other communication methods (Qiang, Kuek, Dymond & Esselaar, 2011). This perceived relative advantage of mobile phone arguably increases rate and possibly the growth in mobile phone ownership amongst community members and farmers in particular.

Time as a factor of innovation of adoption

The individual innovativeness concept is based on who adopts the innovation and when. A bell-shaped curve is mostly used to demonstrate the percentage of individuals that adopt an innovation. The first group of adopters is innovators. These are the risk-takers and they are often the first to develop or accept new ideas before others join or accept it. The second group is known as the early adopters. These people represent opinion leaders. They embrace new ideas before the average person. The third and fourth groups are the early majority and late majority. The innovators and early adopters convince the early majority. The late majority waits to make sure that adoption is in their best interests. The final group is the laggard. These are the people who are highly skeptical and resist adopting until absolutely necessary. In many cases, they never adopt the innovation (Rogers, 2003).

Consequences as a factor of innovation of adoption

The innovation-decision process concept is based on time and has five different stages. The first stage is knowledge. Possible adopters must first learn about the innovation and gain a basic understanding of what it is and how it works. Second stage is "Persuasion" in which potential adopters form a positive and negative impression of the innovation. In the third stage, "Decision," is where the adopters actually decide to adopt the innovation or reject it. Fourth stage, "Implementation," occurs when the innovation is actually used. In the fifth stage, "Confirmation," the adopter seeks information about the innovation and either continues or discontinues the use of the innovation. Understanding the use of mobile phones to aid agricultural development requires an adequate knowledge of the technology and the perceived impacts it has, as well as an assessment of the opportunities and barriers reinforced by the local social structure of the user communities (Avgerou, 2010; Davis, & Asenso-Okyere, 2010).

Factors that Determine the Adoption of Mobile Phone Usage Decisions of Individuals

The decision by an individual to adopt a technology is influenced by factors within socio-economic environment as all well as their own personal attributes. These have been broadly classified as external, social, personal and technical factors in this study.

Government policies

Government participation in the telecommunications sector evolved in a non-linear way (Gómez-Barroso & Feijóo, 2010). The role played by government in telecommunications can be described as promoting the

information society. In sub-Saharan countries, providing innovative methods for access to ICTs in rural areas is within the domain of the government. Nowadays, with the increasing pressure of development on governments, ICTs have been seemed to governments as sound fiscal investments relative to other public incentive alternatives than before where the public sector was not considered an investor in telecommunications (Gallup, 2011; ITU, 2012).

The National Communications Commission recognizes several issues that are harmful to this growth of ICTs, such as poor public power supply, poor security, and high operational costs (Onuzuruike, 2009). But according to Gupta and Sullivan (2010), unreliable electricity and insecurity were found to be the main challenges to operating mobile networks. Notwithstanding, they argued that these challenges were much more prominent in Nigeria as compared to other West African countries with more reliable access to the electricity grid (like Ghana, Cameroon, and Côte d'Ivoire). Gupta and Sullivan (2010) back their argument by calculating the costs of fuel for generators and the cost of running network site in Nigeria. According to them, costs of generators, including a minimum of 20 percent of fuel lost to theft, amounted to 60–90 percent of the costs of running network sites in Nigeria. Base station costs in Nigeria add up to US$ 200,000 – 250,000, 3.5 times higher than in India (US$ 60,000–70,000).

They further argued that some of these limitations are at least being overcome through passive infrastructure sharing. "Passive infrastructure sharing" is the sharing of non-electronic infrastructure, equipment, and services at mobile network base stations, including the site space, buildings, towers, masts, and antennas; power supply, back-up batteries, and generators; security;

and maintenance. Passive infrastructure sharing is distinguished from "active infrastructure sharing," which can involve the shared use of electronic infrastructure such as network components (for example, access node switches), radio transmission equipment, and core network software systems (Ghosh, Aggarwal, & Marwaha, 2009). The works of CIMMYT (1993) and Marra, Pannell and Abadi (2003) revealed that the focus of the adoption literatures has been on the individual farmers (e.g. the attitude or personality of the farmers or their socio-economic characteristics, such as wealth, landholding or education) and the characteristics of the technologies, rather than the context in which technology adoption and diffusion takes place. Therefore, to see the result of mobile phone use in extension delivery, government needs to provide the enable environment for farmers. Such environment is reliable electricity, affordable price of mobile phone, and valuable price of agricultural products on the market.

Major agricultural enterprise of farmers

According to Tologbonse, Fashola and Obadiah (2008), most of the farmers seek information on crop production. They assume that because most farmers are mainly crop farmers, they are probably interested in information that would lead to increased productivity. Folitse's (2013) study in Ghana shows that almost all farmers who listen (90.4%) and who do not listen (96.5%) to radio were involved in crop production and animal production.

Farm size operated by farmer

Research revealed that farmers who cultivate farm size ranging from six to twenty acres are assumed to be better off in production than the small-scale farmers in the use new of technology. Also, they are willing to try or take advantage of new technology even if they fail because they know this will not

affect their income greatly as compared to a small-scale farmer whose income is low (Williams & Agbo, 2013). According to the MoFA (2005), majority of the farmers in Ghana are engaged in subsistence farming using traditional methods and low technologies which do not allow them to cultivate huge acres of land. Therefore, about 31% of the farm holding is less than 1.6 acre, whereas only 18% are more than 4.0ha per farmer in Ghana. Mittal and Tripathi (2009) stated that farm size affects economic benefits of farmers from mobile phone use. They emphasized that larger-scale farmers are able to get higher benefits from mobile phone use as they are able to access resources concerned with input availability and disease control better. Besides, they are also able to get technical or professional help immediately in case of plant disease. Likewise, farmers with large farms showed to have been privileged to benefit from the information they get on market prices.

They are able to overcome any possible constraints on production or market access with greater facility than small land size farmers. Yet, the small-scale farmers gained more knowledge through mobile phones compared with larger scale farmers (Mittal & Tripathi, 2009). Williams and Agbo (2013) evaluated the use of ICT in agricultural technology delivery to farmers in Ebonyi state, Nigeria. They found that farm size was positively and significantly related to the dependent variable at 1% level of significance. They concluded that the higher the farm size of the farmers, the more they utilize ICTs as a source of agricultural technology delivery. Similar result was shown in Falola, Adewumi and Olaniyi's (2013) survey which found that the coefficient of the values of farm size was positive and statistically significant, indicating that the more the farmer increase area of land cultivated and the seeds/seedlings used,

the more the quantity of output obtained. Therefore, they concluded that since farm size had the largest coefficient, this could be that the largest impact on output would be experienced if additional land is put into use.

Membership of famers' cooperative

The formation of membership or cooperative group is expected to influence the use of mobile phones service for agricultural activities by farmers which can serve as a source of gathering or passing information and sharing for farming experiences. Ammani, Sani, Kura and Hussaini (2011) conducted a study on agricultural extension services in irrigation schemes under RBDAs' control in Nigeria. The case of Kano River irrigation project. The findings showed that more than 65% of the farmer's interview did not belong to any farmer association or cooperative society. In contrast, Falola, Adewumi and Olaniyi (2013) found membership to positively and significantly relates to use of mobile phone. They therefore concluded that being a member of association enables the farmers to have access to agricultural information in time.

Household size of farmers

Ogbeide and Ele (2015) argued that farmers with children are able to acquire knowledge on how to use the mobile phone. That is the children teach their parents, particularly the less educated ones, how to make and receive calls, store and retrieve messages, send and receive SMS and MMS. Labonne and Chase (2009) study the impact of mobile phones on the welfare of farmers in the Philippines. The study explored the welfare effect of mobile phones by looking at the consumption patterns of farmers with mobile phones. Their findings showed that mobile phone has a great positive effect on the growth rate of per capital consumption of households.

Financial capital

Richer farmers or those with off-farm income may be more willing to bear the financial risk in case the technology does not perform well (Ogbeide & Ele, 2015; Marra, Pannell & Adbadi, 2003). DiMaggio and Cohen (2004) explained the positive correlation between the level of income and timing of adoption of new technology. They found that availability of a technology infrastructure shapes inequality by place of location (urban verses rural) that makes income more important. Similarly, Kalba (2008) argues that adoption of certain technology attributes or alternatives (eg. fixed versus. mobile connection and postpaid versus. pre-paid services) depends on the level of household income over time. In addition, the rate of income depends on the type of occupation, and therefore, it is an important factor for the urgency and relevance of adopting a technology at a given time and within a specific cultural framework Kalba (2008). On the other hand, Poulton, Kydd and Dorward (2006) stated that limited access to credit may hamper smallholder farmers' level of technology adoption as money lenders may not be willing to tolerate the high-risk transaction costs of small disbursements. Also, the seasonality of agriculture and change in climate can hamper regular repayments. At times, access to credit may also be linked to the use of particular inputs, thus limiting technology choices. However, Poulton, Kydd and Dorward (2006) suggested that mobile banking can enable technology adoption by offering transmission services to pay for agricultural technologies or inputs or to repay loans as a way forward in improving farmer's access to finance.

Types of mobile phones used

The services and features offered by mobile phones like calling or receiving, texting, and using of calculator and alarm are to some extend similar but slightly different. There are two types of mobile phones, namely the feature and smart phones. Tschersich (2010) classified mobile devices by three main characteristics: ubiquity (owner can use the device anywhere), reachability (permanent availability of the device and owner) and localization (e.g. GPS). Only feature and Smartphone can perform these critical and can be defined as mobile device.

1. A feature mobile phone is considered to first to, first of all, be a phone, but lacks the advanced operating systems found in smart phones. The software inside a feature mobile phone is limited, but functional. In way of features, conventional phones usually offer a basic camera, simple video capturing, wireless Bluetooth capability and text messaging, address books, calendars, alarm clocks and other basic tools for productivity. These mobile phones may have games, Internet access and with more advanced features including a QWERTY keyboard, and memory cards.
2. A smart phone is basically a small computer. Smart phones have advanced operating systems that go beyond than making phone calls. A Smartphone features Wi-Fi connectivity, fast wireless speeds for data streaming and Web browsing, clear cameras and much more. The ability to run apps allows smart phones to handle email, social networking and office task such as editing documents and creating spreadsheets (Roberts & McIntosh, 2012). In 2012, surveys conducted by Department of

Primary Industries (DPI) and other industry organizations in Australia revealed that around half of the grain producers and advisers own smart phones over feature phones (Lorimer, 2012).

Factors that Affects Mobile Phone Usage

Age as a factor in mobile phone use

Research places the usual age of the African farmers above fifty years and Ghana is no exemption. The age of an adopter plays an significant role in influencing mobile phone usage. According to Okello, Kirui, Njirani and Gitonga (2012), Williams and Agrbo (2013) and Munya (2001) young people contribute in technology regardless of their locality and that young people have a positive correlation with the use of the mobile phone. Therefore, it is expected that young farmers will be prone to use this technology for most of the day-to-day transactions. Age and mobile phone have a relationship through the adaptable nature of young people in technologies. Studies indicated that in terms of technological packages, social and economic considerations, young farmers adopt faster (Okello, Kirui, Njirani & Gitonga, 2012; Williams & Agrbo, 2013; & Munya, 2001). Porcari (2010) argued that young people are far more known with social networking and other recent advances in technologies use than with the older ones because new communication technologies in many cases are strange to the older generation. Therefore, there is a major need for a cultural change so that they can take advantage of these tools to enhance their networking, advocacy and other opportunities to have impact in the farming system. Richardson, Ramirez, and Haq (2000) study Grameen Telecom's Village Phone Programme in Bangladesh. The study found that “higher expenditures for better service are more likely to come from younger phone

users aged 20 to 30, an age group that would more likely be receptive to a wider range of phone services, including card phones". Similarly, Jain and Hundal's (2007) study among the rural people of India showed that the majority of the users (62 %) of mobile phones were within the age group of 20 to 40. Musa (2011) studied the challenges of using information and communication technologies to disseminate agricultural information to farmers in Sudan. In his finding, 26.7 percent of the respondents were between the ages of 20-35 years, 34.2 percent were between 36-50 years, 31.7 percent were between 51-65 years and 7.5 percent were between 66-80 years. He found that majority (61%) of the farmers were 50 years and below, and therefore concluded that they are capable of getting agricultural information much faster than the elderly farmers.

Sex as a factor in mobile phone use

With regards to sex, FAO (2009) and MOFA (2010) studies revealed that extension delivery in Ghana is a male dominated occupation. For instance Kaske, Kayanda and Sife, (2018) found that majority 95% of respondents were males partly due to the small number of female headed household.

According to FAO (2009), male have better social capital which has a direct link with exchange of information and learning as the result they in the majority. MOFA (2010) indicated that despite the fact that women farmers constitute the larger agricultural labour forces in Ghana and the women in Eastern Region are no exception and produce roughly 70 percent of the food crops, they are least served by agriculture information. World Bank (2007) reported that women are disadvantaged in agriculture activities because of limited access to resources decision-making power, education, agricultural information and agricultural inputs and credits.

Education as a factor in mobile phone use

In Ghana, roughly 71.5 percent of the populations are literate (Ghana Statistics Survey, 2010). According to Yasmeen, Abbasin and Hussain (2011), education positively related to the product that boosts up farmer's income. Similarly, Schiffman and Kanuk (2004) argued that education and income are closely related; the more educated a person is, the greater is the likelihood of a high income. Also, DiMaggio and Cohen (2004) stated that educated people are better able to learn and use new technology more and thus they are more likely to be innovative. Jain and Hundal's (2007) study on rural India showed that a majority of the mobile adopters have education level below metric 10th class, so the diffusion of new technology was relatively slow. CIMMYT (1993) and (Okello-Obura, Minishi-Majanja, Cloete, & Ikoja-Odongo, 2009) argued that literacy level of the farmers is important to the use of mobile phones for information access and can also impact their level of difficulty in navigating through the phone menus frequently written in English. Therefore, the literacy level of farmers affects mobile phone use differently and can influence the level of adoption across the various under developed communities.

Marital status as a factor in mobile phone use

Mammo (2013) examines how the use of ICT in farming affected the interest of youth in agriculture. The study interviewed farmers between 24 and 38 years old and discovered a difference in attitude towards ICTs and agriculture among single farmers and farmers who were married and with children. The study indicated that single farmers originally examine ICTs as a gateway to better jobs and employment outside farming, whilst young farmers with families, without any delay, focus on using ICTs to improve productivity

and profitability. Yakubu, Abubakar, Atala, Muhammed and Abdullahi (2013) study the effects of socio-economic factors on ICTs adoption among extension workers in the north-west zone of Nigeria. The study showed that majority of the extension agents (89.8%) were married, with only 10.2% being single.

Years of experience as a factor in mobile phone use

Ibrahim, Adejoh and Edoka (2009) argued that experience is a manner in which one garbles new technology such as mobile phone and use faster in extension delivery. McCall, Dunn and Rosenquist, (2004) defines working experience as knowledge gained over time. Moreover, Sardeshmukh (2008) explained that individuals are shaped by every experience in life, our past and present experiences always affect the development and shape of knowledge, skills, attitudes, ambitions, beliefs and behaviours. In addition, McFarland, and Hamilton (2006) found relationship between work experience and job performance to be influenced by two variables: length of experience and job complexity. Hence, experience is a central force to influence on performance and behaviour.

Other factors that influence adoption of Mobile Phone Technology

Mobile wireless technology is becoming progressively more usual among workers and consumers. Primarily, the initial use of mobile wireless technology was to enable voice communications, however, new methods of services and benefits are gaining thrust and use. On the consumer level, individuals are using mobile wireless technology as a vehicle for network surfing, text messaging, and many m-commerce activities. While institutions, on the other hand are capitalizing and building upon the ease of use, proficiency, and cost effectiveness of mobile wireless technology by providing their staffs

with greater movement, flexibility, and communications options. As the acceptance and use of mobile wireless technology remain to grow and become a ubiquitous part of society, it is important to identify the key factors that affect their adoption and use.

Perceived ease of use and perceived usefulness

Technology acceptance model suggests that individuals' acceptance and usage of a technology are determined by two key beliefs, Perceived Usefulness and Perceived Ease of Use. Perceived Usefulness refers to the level to which an individual believes that using a certain technology will improve his job performance. Perceived ease of use on the other hand refers to the level to which an individual believes that using a technology will be free from effort (Davis 1989). The relationship between perceived ease of use and perceived usefulness and their effects on a user's behavior have been examined and supported extensively in the information technology literature. The results show perceived ease of use having a direct effect on perceived usefulness and having a positive relationship with a user's behavioral intention, both directly and indirectly via its impact on perceived usefulness (Davis et al. 1989). Research demonstrates the direct effect between perceived ease of use and perceived usefulness as being more relevant and the indirect effect via perceived usefulness as being less important (Szajna 1994). Results provide evidence of a positive relationship between perceived usefulness and a user's behavioral intention over and above attitude (Davis et al. 1989). Moreover, a significant body of technology acceptance model research has shown that perceived usefulness is a strong determinant of user acceptance and usage behavior (Agarwal and Prasad 1999). A significant body of literature has included technology acceptance model only

as the theoretical model. For example, Kwon and Chdambaram (2000) modified technology acceptance model to examine the extent of cellular phone adoption. They suggested that user acceptance of cellular phones was influenced directly and/or indirectly by individual characteristics, perceived ease of use, perceived usefulness, social pressure, and apprehensiveness. Lu et al. (2003) extended technology acceptance model by studying mobile wireless internet acceptance. They suggested that individual differences, technological complexity, facilitating conditions, social influences, and wireless trust environment have a positive effect on both long-term and near-term usefulness and ease of use leading to a positive influence on a user's attitude and intention to use wireless internet via mobile technology (WIMT). Liang et al. (2003) modified technology acceptance model to study actual usage in a healthcare setting. They included variables such as personal innovativeness and compatibility to technology acceptance model. Finally, Mao et al. (2005) used technology acceptance model to develop a research model to test advanced mobile phone services' (e.g. mobile Internet access, e-mail, and payments) adoption and acceptance. In addition to perceived ease of use and perceived usefulness, they found support for variables measuring Efficacy and Personal Innovativeness.

Job relevance

Job Relevance is defined as individuals' perception regarding the extent to which a technology is applicable to their job (Venkatesh and Davis 2000). Depending on the nature of one's job and job-related tasks, an individual may possess different attitudes and behaviors toward a technology due to the distinct knowledge they develop through work related experiences. Elaboration Likelihood Model (ELM) suggests that external information is a primary driver

of attitude change, and in turn, influences behavior. Therefore, as individuals expand their work related experiences, they are introduced to new information that causes intention toward the mobile wireless technology in question.

Perceived ubiquity and perceived reachability

Perceived ubiquity and perceived reachability are relatively new concepts in information technology literature, but are becoming more common in research dealing with m-commerce and wireless technology. Perceived ubiquity refers to an individual's perception regarding the extent to which mobile wireless technology provides personalized and uninterrupted connection and communications between the individual and other entities and networks. Perceived reachability refers to an individual's perception regarding the level to which an individual can reach other individuals anytime-and anywhere via mobile wireless technology. Reachability assumes that users and technology have the capability of being connected and reached by other entities. Ubiquity represents a definitive form of spatial, temporal, and contextual mobility (Junglas and Watson 2003).

Sarker and Wells (2003) claimed that the most touted advantage of mobile wireless technology might be the ability to enable anytime, anywhere communication, collaboration, and commerce. In addition, Looney et al. (2004) claimed that the capability of communicating from virtually anywhere at any time offers extraordinary levels of flexibility and convenience, which can affect behavioral intention. Dholakia et al. (2004) found geographical flexibility, referring to anytime-and anywhere capability, to be one of the factors influencing the diffusion of mobile wireles technology. Similarly, they argue

mobile wireless technologys' reachability and ubiquity provide users freedom in time and location that influences their behavioral intentions.

Brief History on how Mobile Phone Penetrated in the World

Mobile phones have great potential to transfer information in a speed of light regardless of distance. According to Garreau (2008), mobile phone is the faster global diffusion of any technology in human history- faster even than the polio vaccine. Studies show that mobile phones being a component of ICT, are now accessible to 90% of the population around in developing countries (de Silva & Ratnadiwakara, 2008; Houghton, 2009; Labonne & Chase, 2009; Rafael, 2003) came up with some facts for its fast penetration. First, it is a potential tool to provide more information to everybody, even to the uneducated since it is very easy to use. Second, it is cheaper to acquire and use compared with other ICTs such as computers or internet. Third, it overcomes geographic barriers as it allows any information to disseminate as fast as the speed of light across space. Mobile phone, according to Aker (2011) and Bhavnani, Chiu, Janakiram and Silarsky (2008), being a cheap and widely-used information and communication technology, has a great potential to solve the problem on costly and lack of accessible information access.

There are 6.8 billion mobile – cellular subscriptions worldwide (ITU, 2013). One of the great importance is the fact that the mobile revolution in agriculture is not driven by mobile phones alone, other devices such as smart phones and tablets have already begun to have an impact as information delivery channels. In 2013, there were almost as many mobile – cellular subscriptions of by people in the world, with more than half in the Asia – Pacific region (3.5 billion out of 6.8 billion total subscriptions) (ITU, 2014). According to ITU

(2014), although mobile phones have not yet reached total geographical coverage, it expects complete mobile coverage of all rural areas around the world by 2015 or even earlier.

State of Telecommunication in Ghana

Ghana experienced mobile telecommunications in the early 1992. Prior to that, only fixed-line services were available in the country. Ghana's mobile voice subscription increased from 30, 360,771 by 0.89% in 2014 to the end of January 2015 at 30, 629,604. (NCA, 2015). ITU (2012) reported that mobile cellular telephone subscriptions at the end of 2012 in Ghana was 25,618, 427. Mobile cellular subscriptions per 100 inhabitants for the same period was 100.28%, fixed (wired) broadband subscriptions for 2012 was 64, 436, fixed (wired) broadband subscriptions per 100 inhabitants was 0.25% as compared to 0.00 in 2001. Fixed telephone subscriptions in Ghana increased from 212,548 in 2000 to 284,981 in 2012. Ghana Telecom had exclusive monopoly over telecommunication services. The policy reforms that started in the telecommunication sector created a competitive environment that enabled mobile telecom network providers and other wireless service providers to operate. Originally, mobile entry was allowed without charge and with minimum regulation. This improvement makes provision for mobile telecommunication services in the country to bring about a revolution in the telecommunication sector (NCA, 2013).

In 1992, the first commercial mobile telecommunication network in Ghana was Millicom Ghana called mobitel. The company started operation using analogue network the first-generation mobile system. The network covered few selected areas to be precise in the urban areas thus Accra and

selected regional capitals. Due to frequency limitations, a small group of people had access to the network. While in 1993, Celtel also started operation using analogue AMPS (Advanced Mobile Phone Service) system and could serve only small number of people, specifically in Accra and its surroundings. Within the same year (1993), the country had 170 mobile subscribers. In 2003, Celtel was changed to Kasapa to give it a local identity, and has since then pursued a distinct strategy aimed at low-income subscribers.

After a few years later, the analogue networks were followed by digital networks, the global system for mobile communication (GSM), which happened to provide services in 1996. The first company to operate digital network was Scancom Ghana limited. Scancom Ghana commenced operation in 1996 using GSM 900 technology with the brand name Spacefon. The GSM technology enabled Scancom to capture relatively larger share of the market. It then became the market leader with increasing number of subscribers. In 2005, the company was taken over by Investcom LLC and was renamed Areeba. Mobile Telecommunication Network group (MTN) acquired Investcom (Areeba) in 2006 and was renamed MTN Ghana in 2007 (NCA, 2013).

However, the booming introduction of digital network by Scancom force other companies to migrate from analogue to digital networks. In 2000, Millicom Ghana switched from analogue to digital under the name Buzz. The company name was again changed to TIGO in March 2006 to conform to a global branding strategy (Overa, 2006). Celtel went digital in 2005 and it happens to be the only mobile service provider using the CDMA (Code Division Multiple Access) standard. In 2000, Ghana Telecom launched Onetouch that was to provide mobile services. The company was able to capture 60,000

subscribers within the first year of operation. The status of Onetouch, however, changed due to the acquisition of 70 percent shares of Ghana Telecom by Vodafone International in 2008. As a result, Ghana Telecom and Onetouch became Vodafone. In 2008, Zain entered the mobile industry as the fifth mobile market in Ghana (Overa, 2006). Quite recently, another mobile network having to be the six operators GLO, a Nigerian-based mobile network provider, made her way into the telecom market. GLO, prior to its launch, was seen as the industry game-changer with high public goodwill. Since then, expansion in mobile telecommunication networks in the country has created a competitive environment for the industry.

Competition in the industry has led to reduction in prices of mobile telecom services. This has made it possible for a wide range of people to become mobile phone subscribers. For example, both old and young, rich and poor, now depend on mobile services for communication. The benefits being enjoyed by subscribers originating from competition in the mobile industry in the country support the finding provided by a great deal of research that competition in telecommunication improves performance over monopoly (Wallsten, 2001, & Sey, 2008).

Ghana's mobile telecom industry is highly oligopolistic. The industry is made up of six main operators currently providing mobile telecom services to a wide range of subscribers. There is high competition for customers in the industry. Network providers adopt various strategies to have competitive advantage in the market. They are expanding their networks to improve service quality so as to attract more subscribers. Since firm's survival and growth are driven by customer loyalty and retentions which in turn are driven by customer

satisfaction and value, delivering quality service has been important goal and pursuit for each of the six expanding mobile telecom networks. According to National Communication Authority (2013), mobile telecom service providers have universal access obligations which consist of paying 1 percent of their net revenue into a universal access fund, ensuring that their subscribers can make emergency calls, and expanding network coverage to all regions of Ghana. The network coverage obligation has made providers to extend coverage to the remote villages. Nevertheless, it is important to understand that network coverage is concentrated in the south which is a relatively more-developed part of the country. Mobile coverage is extensive in the southern and eastern Ghana (Greater Accra, Volta, Oti, Central, Western, Western – North, Eastern, Ashanti, Bono, Ahafo, and Bono-East) and limited in the northern Ghana (Northern, Savanna, North-East, Upper East and Upper West). Airtel/Tigo and GLO have limited coverage but they are expanding rapidly. Vodafone and MTN have made significant progress in network coverage. They are roughly in all the regions of the country (NCA, 2013).

Communication Infrastructure

Several studies argued on factors that influence the choice of subscription to a network. These factors include the qualities of the mobile network and the characteristics of the mobile subscribers, choice subscribing, customer care, discount, promotion and special offers on calls (Birke & Swann, 2006; Corrocher & Zirulia, 2008). Furthermore, Kim and Kwon (2003) stated that in terms of qualities consumers consider network size before subscribing to a mobile network. That is the larger mobile networks have advantage over smaller networks in acquiring subscribers because of intra-network-call

discounts and quality-signaling effect. They also argued that mobile network with larger subscriber base attracts more subscribers because with increasing number of users subscribing to a network becomes more attractive to other people to subscribe to the same network. Corrocher and Zirulia (2008) found similar result to Kim and Kwon (2003) and Birke and Swann (2006) findings that the larger the customers base of mobile network, the greater the benefits from adoption. The benefits in terms of calls discount to the same network. Generally, calls that terminate within the same network are relatively cheaper than calls terminating in another network. Thus, customers are likely to pay less for mobile service when the network size is large. Corrocher and Zirulia (2008) further stated that network effects affect the choice of mobile operator. Network effects in communication are common trend where consumers mostly reason the model of adoption by agents in their social neighborhood. These agents include family, friends and other social groups. Birke and Swann (2006) also stated that social network (friends, family and partners), income and characteristics of the individual mobile subscriber influence the choice of mobile operator. They believe that mobile users in other to avoid high expenditure on phone calls, they try to convinced their friends and family to subscribe to the same network. According to Verkasalo (2008), a person has to examine the advantages and disadvantages of service before adopting or not. The advantages could be constant contact with family member or friends without any interruption of network. So, when the benefit associated with using the service is greater or more than the presumed cost, then the individual will use the service. He further argued that needs are inherent in the person and they tend to direct all behaviour. One way of satisfying these needs is to obtain a

good or service thus, becoming a consumer and in the case of mobile phone services farmer, becoming a subscriber or user of the services.

Source of Agricultural Information

Morrow, Kelly and Kirley (2004) stated that in rural development, information which helps farmers to take decision and appropriate action for farming and marketing is an important resource. They indicated that depending upon the kind of information different people use different sources for seeking information. Demiryurek, Erdem, Ceyhan, Atasever and Mayis (2008) also argued that agricultural information disseminated by AEA affects agricultural production in many ways. Firstly, it can help out the farmers to make informed decisions about land, labour, capital, management, and livestock. Secondly, agricultural production can be improved through useful, relevant, and reliable information. Studies by Mtega (2012), Lwoga, Stilwell and Ngulube (2011), OkelloObura, Minishi-Majanja, Cloete, and Ikoja-Odongo (2009) investigated the sources of information used by rural communities in accessing agricultural information. This source includes radio, co-farmers, cooperative, extension services and newspapers. Moreover, Nazim (2000), and Farooque (2004) stated that different target groups have different information needs; thus, needing different information services. Therefore, information providers should assess and recognize their target groups and work out the best means to disseminate meaningful information for sustainable development to such groups. According to Harande (2009), the major concerns in the agricultural technology transfer process is what technologies are appropriate and available, and how these technologies can be delivered among farmers like oral/verbal means, printed literature and electronic media. In addition, (Harande, 2009) emphasized that in

the age of information and technology, delivering of information becomes much easier and nevertheless more complex; thus, it must be transferred to the farmers in the way through the use of approach, which is appropriate, and best supports farmers. According to Rana (2002) the sources of information is divided into two main categories, interpersonal and impersonal sources. Face-to-face exchanges of information between individual respondents constitute interpersonal methods, whereas exchanges by mobile phone are known as impersonal methods enabling one or a few persons to reach many addressees at a time. Butt (2002) found that most of the respondents (61.60%) obtain information from extension organizations and about half (51.20%) from fellow farmers, followed by print media (46.00%) and research organizations (36.00%) in a study of television viewing habits among farmers in Pakistan. Furthermore, in Tanzania, a study on maize adoption by Kalba (2008) found extension services as one of the major factors that positively influence the adoption of new technology. Similarly, Tologbonse, Fashela and Obadiah's (2008) study reveals farmers (72%) seek information from extension agents and friends/fellow farmers (26.7%).

The Concept of Mobile Phone and their Level of Usage.

According to Aoki and Downes (2003), the invention of mobile phone was essentially made for business use by adult. This is not very different to the fixed telephones in the 20th century where telephone engineers explained that the telephone was made for the business world and not for social conversation (Campbell, 2005). Mobile phones have over the years developed and has been acquired by more users at the global level (Srivastava, 2005). According to Javid, Malik, & Gujjar (2011) the invention of mobile phone has fundamentally

helped our society for easy accessibility, safety and security co-ordination of social and business activities. Mobile phone has now become part of our culture in very part of the world. The craze of mobile phone started after 1980's but has now touched the level of esteem. Initially, it was just for a status symbol but now it has become a direful need of the day and it the reach of everyone (Cho, 2014).

The level of mobile phone usage varies from community to community and this is influenced by factors such as age, gender, education level, marital status, farm size, farming experience and among others. Al-Khatib & Sabbah, (2008) argues that daily text messages among American teens has shot up from 38% to 54% as teenagers in America who use mobile phones to text their friends and loved ones every day. A study conducted by Kenichi, (2004) reveal that 40% of the population in Japan enjoys access to the internet via mobile phones. Sife, Kiondo, & Lyimo-Macha (2010) reveal the importance of mobile phones in sending and receiving money among rural farmers in Tanzania as their study shows that 50% of their respondent used mobile phone for financial transaction. The study further reveals that 58.9% of the respondents used mobile phone for selling and marketing their agricultural products. Also, a related study by Njelekela & Sanga (2015) argues that mobile phones usage in rural Tanzania is mainly for agricultural activities specifically for communication between farmers and extension officers.

Mobile Phone and Agricultural Production

Climate change, disease and pest are prone and characterized to agricultural production. It is for this purpose that there is the need to lay emphasis on agricultural production (Aker & Mbiti, 2010). Smallholder farmers

can differentiate making profit or losses when they have access to weather information or market prices of goods. Smallholder farmers can use mobile phone to access information on potential threats that permits them to make modification early enough when threat is detected in the purpose of their agricultural activities. Again, access to agricultural technologies have been found to significantly limit the cost of accessing information on technology for smallholder farmers and thereby have an impact on their production (Aker, 2011). Developed countries have high level of use of inputs in agriculture among their smallholder farmers but relatively low to developing countries (Wiggins & Brook, 2010). High transaction cost such as time, money and distance has been associated as the major cause of acquiring inputs. A study by Bayes (2001) in Bangladesh noted that access to agricultural inputs such as seeds, fertilizer and technology can be facilitated using mobile phones by smallholder farmers. Bayes in his study compared two villages where one village has access to mobile network coverage and the other village without mobile network coverage. Bayes found in the study that, farmers in the village with mobile network coverage had improved their use of seeds and fertilizer as against the village without mobile coverage. To Bayes, the mobile phone helped smallholder farmers to communicate among themselves on the availability of agricultural inputs in advance manner thereby minimizing some challenges that already existed. Bayes argued that, due to access to information on mobile phone, smallholder farmers and buyers were able to have open notion of the agricultural inputs available in the area thereby avoiding unanticipated circumstances.

Furthermore, Aker (2011) stated that mobile phone has the inherent capacity for stimulating smallholder farmer's adoption to innovative technology for agricultural production such as fertilizer and better seeds to increase agricultural production. For example, smallholder farmer can easily call extension officers and input dealers to determine the availability of agricultural inputs before they visit to purchase such input. This obviously reduce cost and accident associated with travelling. Again, telecommunication companies and extension officers can facilitate access to technical agricultural information either by voice calling or texting (SMS) thereby doing away with the need for travelling. A study by Aker (2010) noted that the use of mobile phone by smallholder farmers in Niger has alleviated low-cost of access to information through texting equivalence to the initial means which involves travelling long distance to visit extension staff. Aker argued that this could empower smallholder farmers who are vulnerable to be in total control of their farming activities. This argument has been supported by Jensen (2010) who opinioned that the mobile phone can link smallholder farmers to extension officers and telecommunication centers, thereby minimizing the need for farmers to travel long distance for information.

Further studies by De-Silva & Ratnadiwakara (2008) in Sri-Lanka noted that the use of mobile phones by smallholder farmers to access information for their agricultural activities has led to a significant drop of 33% in information search cost. A build up study by Xiaolan & Shaheen (2012) in India also noted that the advent use of mobile phone has increased the quality and velocity of extension distribution of inputs and other agricultural information to smallholder farmers.

Mobile Phone Technology and Agricultural Usage

The central to adoption, use and benefit of mobile phone technology application in agriculture by smallholder farmers is always attributed to the diffusion of innovation theory (Martin & Abbott, 2011). Robinson (2009) noted that when an innovation is initiated into the environment, it provides three worthful suspicion into the procedure of social change. Such suspicion includes what distinguish attribute makes an innovation to circulate, understanding the needs of different users and roles played by equal network in enhancing the spread of the innovation. According to Avgerou (2010), understanding the use of mobile phone to help agricultural development call for passable knowledge of the technology and the sensed impacts it has and look at the opportunities and challenges reinforced by the local social structure of the user communities. Martin & Abbott, (2011) and Aminuzzaman, Baldersheim, & Jamil (2003) argued that mobile adoption by smallholder farmers connote on the perceptual experience that it is better than most other communication technologies because it is easy to handle, improves social status of the user and provides economic advantages. This perceived relative advantage of mobile phone debatably increases the magnitude and the growth of mobile ownership amongst smallholder farmers.

A relative study by Alhassan & Kwakwa (2012) noted that smallholder farmers in Northern part of Ghana used mobile phone to communicate with family and friends. This support the point made by Goodman (2005), in his study in South Africa and Tanzania found out that mobile phones were mostly used to strengthen relations. According to Scott, Batchelor, Jonathan, & Jorgensen (2004), as one talk and keep in connection with family and friends, it

strengthens social capital. The study also showed that few smallholder farmers used their mobile phone to interact and fix up with agricultural input, sellers and extension officers when they need to purchase seeds, weedicides and pesticides from governmental and non-governmental organizations and local dealers. (Alhassan & Kwakwa, 2012)

Extent of Use of Mobile Phone in Accessing Agricultural Information

Kwakwa (2012) found that roughly 97% of traders do voice calling more than sending text messages. Video calling, internet and email accessing was less used by the respondents. He argued that making voice calls does not require any complex procedure. All that one needs to do is to enter the number and then press the send button and as such those with low level of education can easily learn and use. It is therefore user friendly to those who are illiterate. Moreover, he argued that sending of text messages, video calling, internet and email accessing was probably a challenge because it is not user friendly to illiterate and so they will find it uncomfortable to use as compared to calling. Asharf, Akhtar, Sarwar and Ashraf (2005) argued that lesser extent of SMS usages by farmers was due to higher rate of illiteracy. They also argued that the challenges mobile phone users face is because the SMS carries only a limited amount of information and requires a basic level of literacy.

Falola and Adewumi and Olaniyi (2012) conducted a study on constraints to use of mobile phone for agricultural production in Nigeria. The rate at which mobile telecommunications facilities are used for agricultural production was measured on five-point likert scale where an average of 1, 2, 3, 4, and 5 represents where the facility is used seldomly, occasionally, monthly, weekly, and daily. The findings revealed that the respondents used calling four

to five times weekly, while taking pictures for documentary activities was the least. Crandall's (2011) study on use of mobile phone by Kenyan Farmers revealed that calling using mobile phone was popular than sending SMS. He argued that most farmers regardless of age, sex, or location, tend to prefer making calls to using SMS and other mobile applications.

Perceived Benefits of Using Mobile Phones to Access Agricultural information

Researchers survey on ways in which technology best suit the rural dwellers for social and information deliver. Mobile phone best suited for the rural people including the farmers. Okello, Kirui, Njirani & Gitonga, (2012). They argued that interactions with mobile phones are cost effective ways for farmers to stay connected with other stakeholders and also provide them with a sense of security and social status. Agriculture as a means of earning income involves a lot of interactions. It can be in terms of hiring labour, gathering market and price intelligence, procurement of farm inputs, in search of technical assistance from the extension or expert agents or acquiring weather information (Okello et al., 2012). However, the location of the parties in the interaction, travel distances, ineffective and costly transportation, all burdens the ability of the farmers to improve productivity and improve the family and community well-being (Okello et al., 2012; Overa, 2006). Key to these interactions is the need for them to be done in a manner that is timely, effective and efficient. Farmers must adopt a means by which they are able to gain access to obtained information and inputs at the appropriate time in a gainful manner. Mobile phones have proved to have numerous benefits such as operation benefits, information quality, quality and timely delivery benefits, relational benefits and

strategies benefits. Operational Benefits are associated with reduction in risk and cost of services delivered. According to Overa (2006), Abraham (2006) and Jensen (2010), mobile phones add security to the traders as they are able to report or ask help during risky situations such as road accidents, robberies, car breakdown, or police harassment. Mobile phone can help reduce cost. For example, a farmer travelling more than twenty kilometers just to access agriculture information from extension agent on an upcoming training can just call using his or her mobile phone to contact the extension agent and he will save himself from motor bike accident and also reduce his travelling cost.

Increase in income-mobile phone is likely to translate in increase in profitability of farmers that may lead to more intensive farming (Muto & Yamano, 2009; Jensen, 2010). It could then result in increase in production per hectare or cultivation of non-agricultural land or idle lands. This would then result in other multiplicity effects and benefits to consumers because of reduced gains from arbitrage among producers and production of more goods that are more highly valued on the margin (Jensen, 2010). According to Overa (2006), mobile phone can improve quality information and timely delivery of service by facilitating delivery of agricultural inputs such as fertilizers and seeds. In terms of delivery-vehicle breakdown, another truck can complete the delivery of the broken vehicle just with a call and prevent the rotting of goods especially, perishable goods.

A relational benefit is associated with improvement of communication and relationship among actors. Mobile helps to improve communication networks between farmers and extension agents and reduce cost of travelling. Aker (2008), Jensen (2007) and Overa's (2006). They argued that just as more

often and open communication can result in better relationship because of better trust and rapport, mobile phone use is also important in reporting dishonest behaviour of intermediaries, trade partners, drivers, or customers. More so, because of mobile phones, the behaviour of dishonest trade participants is easily known by others because of faster information channels. And thus, this saves other potential farmers and trading partners from dealing with them and being cheated as Overa (2006) found in his study that mobile phone makes reputation building extend to more people in just a short time.

Again, the findings from Ratnadiwakara, De-Silva, & Soysa, (2008) shows that mobile phone use have assisted small scale farmers to minimize transaction costs in through the stage of agriculture production from the planting stage to the last stage of marketing point of the farm produce. Studies by Boadi, Boateng, Hinson, & Opoku, (2007) (Ofosu-Asare, 2011) and Salia, Nsowah-Nuamah, & Steel, (2011), opined that, farmers profited from the use of mobile phone by receiving better market information of which farmers were able to make informed decisions, get increased income, have enhanced marketing activities enjoy reduction in transportation cost, have enhanced marketing activities.

Role of Mobile Phones in Agricultural Information Delivery

Mobile phones can be used in every aspect of extension approaches from the farm gate to the market, just to mention few mobile phones can be used in improving market efficiency, improving access to information, reducing search costs, and farmer welfare improvement (Okello et.al., 2012; Qiang,Kuek, Dymond & Esselaar, 2011).

Market Information

The most common agricultural projects related to mobile phones in developing countries today are related to providing better market information to farmers. Mobile phones have now mostly replaced the role of message boards and radio of traditional information systems (Aker & Mbiti, 2010). One example is in West Africa where a private sector innovator called TradeNet is using cellular networks to provide up-to-date market information to farmers via SMS. Similarly, in Niger, Senegal, and Ghana, farmers just type in a text code and then immediately receive price information about goods (Aker & Mbiti, 2010).

The role of mobile phones was first highlighted by Jensen (2010) in promoting development in terms of providing market information. Jensen listed some benefits farmers get through mobile phones use. First, it improves their income through better output price by reducing search cost that somewhat increases competition among buyers. Second, it could increase arbitrage. Third, it could provide direct price information in alternative markets which could force traders, even in a smaller market, to give a competitive price. Jensen supported his claims by the findings of his study, which was conducted in Kerala, India (Jensen, 2007). Jensen for five years tracked the prices of sardine and discovered that fishermen, when provided with information and communication technology like mobile phones, contact a number of landing points to canvass prices. They then decide where to sell their product based on that price information along with transportation costs. This strategy dramatically decreased the price instability and variation of fish that lead to well-being improvement of both fishermen and consumers. The average price

paid to sellers increased their net profit by 8 percent while consumer prices also declined by 4 percent. Thus, it resulted in a consumer surplus of 6 percent. Apart from that, his data also showed that these fishermen were able to increase arbitrage and were also able to eliminate wastage. The use of mobile phones leads to more efficient marketing systems that allowed them to search for information on where to sell their catch. This thus prevented fishermen from throwing away their catch as they used to do when they find no trader upon landing in the shore (Jensen, 2010). Abraham (2006) and Labonne and Chase (2009) also found positive and similar results as Jensen.

The study of Aker (2008), on the other hand, focused on the effects of mobile phones on traders, instead of farmers, in the grain market in Niger. Nevertheless, just as the other researchers, she found positive results as well. Her results showed that mobile phone service reduce grain price dispersion by at least 6.4 percent with higher effects on market pairs that are farther apart or linked by poor quality roads. The effect also gets higher as the travel time between these markets increases. This 6.4 percent dispersion she found, however, is smaller than that of Jensen (2007), but she explained this difference is due to the perish ability of the goods and the lower search costs. She further explained that with mobile telephony, grain traders were able to adjust their search and marketing behaviour that led to cheaper search costs compared to their non-mobile phone user counterparts. They were able to search and sell in more markets because they have more market contacts (Aker, 2008). Moreover, Aker's study showed that mobile phone use reduced intra-annual price variation by 10 to 16 percent, which translates into increased trader and consumer welfare. While the consumers' intra annual price risk decreased, increased sales

price through spatial arbitrage opportunities increased traders' welfare. This resulted in a net effect of 29 percent increase in average daily profits.

Muto and Yamano (2009) also proved the importance of price information through mobile phones in increasing the income of farmers in Uganda. Both the effect of mobile phone use on banana and maize prices were observed using panel dataset on farm households from 2003 to 2005. Their findings suggest that improved access to price information reduce marketing costs and increase farm-gate prices; thereby, increasing production efficiency. They also found out that perish ability of goods, as discussed by Jensen (2007) and Aker (2008), is one factor that affects the price increase brought about by mobile telephony. Farm-gate prices of bananas increased as compared to maize because the latter is easier to transport and does not require immediate transfer and careful handling.

In contrast, however, a study by Futch and McIntosh (2009) did not find any price impact brought by mobile phones in Rwanda. Futch and McIntosh (2009) studied a village phone program which, according to their study, was not new to the farmers study, thereby, arguing that farmers already have access to market information through the existing mobile phone information service. Thus, the new program that they studied did not result in higher price for farmers' output but rather just reduced the rate of information service by providing competition to the earlier mobile phone service.

Transportation Cost

Transportation is one of the problems that hinder agricultural productivity. Overa (2006) defined transportation cost in two terms: Transporting people in order to exchange information and transporting of goods

from the producer to the consumers. Agricultural market participants spend money for transportation cost to personally transact their business with other market participants. They have to go through this because, one, landlines are not very common and hard to acquire and two, other communication avenues such as letters are slow (Overa, 2006). So, before the advent of mobile phones, transportation was an inevitable part of transacting with input suppliers or output buyers, when checking market prices of goods, or when searching for farming knowledge. However, that was years ago Rafael, (2003).

A study conducted by Aker and Mbiti (2010) in Nigeria revealed that 89 percent of grain traders used to visit weekly markets and thus, spend money for transportation that increases as distance and length of poor roads increase. But since the advent of mobile phone, the costs of transportation have reduced by 50 percent. Even though they also have to spend for calling and texting, these are relatively much cheaper compared with transportation cost and the other costs incurred when travelling such as lunch and snack (Aker & Mbiti, 2010). Moreover, the cost of texting and calling in developing countries are very cheap. In fact, in Ghana, presently, a person can subscribe to one day or months of unlimited texting and calling promotion. For example, Vodafone, TIGO and MTN have a programme that allows their subscribers to get five or any amount bonus you recharge. Moreover, the bonus can be used to call and text either the same network or others network. Overa (2006) also carried out a study in Ghana on traders and found that mobile phones eliminate distance barriers as its use reduces transportation and transaction costs. Hence, he concluded that less transportation due to mobile phone use could result in higher profits for the traders and the producers.

Bhavnani et al. (2008) researched on the role of mobile phones in sustainable rural poverty reduction and disclosed that mobile phone use results in reduction of buyers' transportation cost and among others. This is because mobile phones allow efficient communication between buyers and sellers without travelling. They also found that the reduction in transportation cost also leads to lower expenditure and as a result, increased surplus for the sellers. Just as Overa (2006), they argued that mobile phone is more beneficial for those who have to travel long distances just to check demand or negotiate prices. With mobile phones, they can have a deal without travelling, and in some cases, even without the middle man.

In contrast, Minten and Kyle (1999), whose study was mainly about the effect of mobile phone use on transportation costs within poor quality roads, found more specific benefits. They explained that lower transportation cost increases the availability and reduces the prices of goods and thus, should also benefit the general consumers. Higher availability, especially of perishable food stuffs, is achieved by balancing supply and demand through careful coordination by phone. This resulted in reduced spoilage of food which happens when there is over supply and a more reliable stream of goods in the market. Reduced prices, on the other hand, should be a result of the savings on transportation cost. Though Overa (2006) also observed the benefit of higher product availability in his study, he did not observe reduced prices. He said that this was because majority of the traders during his research still did not have mobile phones. Thus, the market price was still dictated by this majority. In the end, the savings on travel cost mainly resulted in higher income and improved competitive position for the traders using mobile phones.

De Silva and Ratnadiwara (2008) showed that mobile phone result in timely market information, especially on perishable goods. With that, it significantly reduced the expenditure of Sri Lankan farmers on transaction and travel cost which constitute 11 percent of the total farming cost, from deciding what to grow until the time of selling.

Challenges of Mobile Phone Usage in Agriculture

Rural communities and for that matter smallholder farmers are faced with numerous challenges when it comes to the use of mobile phones for agricultural activities. The main challenges that smallholder farmers face is language barrier and illiteracy according to a study by Masuki, Kamugisha, Mowo, & Adera (2010). A relative study in Ghana by Frempong, Essegbey, & Tetteh (2007) and in Kenya by Ashraf, Gine, & Karlan (2005) shows that lesser extent of Short Message Services (SMS) by farmers was due to smallholder farmers inability to have formal education. In Kenya, it was revealed that only 9% of the respondents know how to send an SMS for agricultural activities. (Ashraf, Gine, & Karlan, 2005) whiles in Ghana it was 21%. (Frempong, Essegbey, & Tetteh,2007). In addition to the high illiteracy rate of smallholder farmers, Rashid & Elder (2009) reported that, other factors such as display of SMS words were very small and for that matter not clear for smallholder farmers to see. This explains the inability of smallholder farmers to adopt mobile phone for farming activities. Poor signal of network on the part of the network service providers is also seen as a challenge. Masuki, Kamugisha, Mowo, & Adera (2010) reported undependable network as one of the major challenges that heavily hinders the use of mobile phone hence its impact on agricultural activities.

Despite the potential benefits offered with the use of mobile phones in agricultural information delivery, it has its own challenges. Jafkin (2003) indicated that income, educational background, social and cultural barriers, and the possibility of a person having the basic skills can shape the use of mobile. He argued that the use of mobile phone for development can be constrained in two major areas: connectivity and content. Concerning connectivity, penetration rates may overstate true access to mobile phones. An in- depth household surveys data from developing countries show significant differences between rural and urban access. For example, in Brazil the rural penetration rate is 53.2 percent, whereas the urban rate is 83.3 percent, in Bolivia, the figures are 18.7 percent and 77.6 percent, respectively, India, 51.2 percent and 76 percent, Malawi, 32.3 percent and 72.7 percent and Ghana, 29.6 percent and 63.5 percent. Clearly, access to mobile phones varies considerably between countries, and wide gaps in rural connectivity still exist in many developing countries. International Food Policy Research institute (IFPRI) (2002). Kwakwa (2012) outlines some constraints faced by mobile phone user in agriculture. These constraints include poor reception, coverage, and cost of using phone, customer services and phone functionality. Whereas, (Richardson, Ramirez & Haq, 2000) argued that lack of available and accessible communication infrastructure in many rural communities, cost of technologies, lack of favorable policy and lack of stakeholder's support in mobile phone planning process as a constraint. Moreover, Tologbonse, Fashola and Obadiah (2008) found lack of funds to obtain information (54.3%) and language barrier (50.5%) as major constraints in Nigeria.

Burrell (2010) affirm that efficient usage of mobile phones heavily depends on the availability of electricity. As it was also orated by Beimans, Swaak, Hettinga, & Schuurman, (2005), receipt and use of mobile phones, like any further technological devices, are improved wherever facilitating conditions such as internet browsing, electricity and financial challenges in acquiring mobile phones are provided. Also, the findings of Ahmed & Laurent, (2009) that illiteracy can prevent many rural farmers from taking advantage on majority of the features on the mobile phone due to their level of illiteracy and thus not familiar with the keys on the mobile phone.

Conceptual Framework

Like any other ICTs, mobile phone application includes in scope interactive process, meaning for effective mobile phone application and different people including farmers need to be involved. The most vital part of adopting an innovation such as mobile phone technology application for agricultural information depends on the ability to change an existing way of doing things in a better and more effective way. The finest outcome is to provide improved quality of market, better income for farmers and a change and better community life.

The conceptual framework illustrates the determinant use of mobile phone for agricultural activities is influence by the following components:

(i) farmers decision to choose mobile phone such as job relevance, perceived ease of use, perceived usefulness, perceived ubiquity and perceived reachability.

(ii) Other factors that influence farmers to choose mobile phone for their farming activities include age, sex, marital status and educational level and farm experience.

(iii) mobile phone challenges such as poor network service, not familiar with the keys, difficulty in texting, language barrier, financial constraints, high-cost tariff, electricity for charging phones and high cost of mobile phone.

(iv) Extent of mobile phone us such as short message service (SMS), voice call and browser, social media, internet

(v) Awareness and knowledge of mobile phone include check market prices, weather information, agricultural inputs and access to extension service.

(vi) Benefit of using mobile phone include, connected to market, travel cost, access to agricultural inputs.

The mobile phone application use by farmers is well known worthy of imitation case of technology enabling button-up empowerment through information access driven by agricultural and end user innovation (GSMA, 2013). In this study, the major mobile phone functional applications used are the short message services (SMS), voice call and internet browsing, social media. The use of these applications could be influenced by some factors such as job relevance, perceived ease of use, perceived usefulness, perceived ubiquity, perceived reachability and specific knowledge of the technology available to the consumer thus smallholder farmers.

Perceived Usefulness refers to the level to which an individual believes that using a certain technology will improve his job performance. Perceived

ease of use on the other hand refers to the level to which an individual believes that using a technology will be free from effort (Davis 1989). Moreover, a significant body of technology acceptance model research has shown that perceived usefulness is a strong determinant of user acceptance and usage behavior (Agarwal and Prasad 1999). A significant body of literature has included technology acceptance model only as the theoretical model. For example, Kwon and Chdambaram (2000) modified technology acceptance model to examine the extent of cellular phone adoption.

Job relevance is defined as individuals' perception regarding the extent to which a technology is applicable to their job (Venkatesh and Davis 2000). Depending on the nature of one's job and job-related tasks, an individual may possess different attitudes and behaviors toward a technology due to the distinct knowledge they develop through work related experiences. Elaboration Likelihood Model (ELM) suggests that external information is a primary driver of attitude change, and in turn, influences behavior. Therefore, as individuals expand their work-related experiences, they are introduced to new information that causes intention toward the mobile wireless technology in question.

Reachability assumes that users and technology have the capability of being connected and reached by other entities. Ubiquity represents a definitive form of spatial, temporal, and contextual mobility (Junglas and Watson 2003). In addition, Looney et al. (2004) claimed that the capability of communicating from virtually anywhere at any time offers extraordinary levels of flexibility and convenience, which can affect behavioral intention. Dholakia et al. (2004) found geographical flexibility, referring to anytime-and anywhere capability, to be one of the factors influencing the diffusion of mobile wireless technology.

Similarly, they argue mobile wireless technologys' reachability and ubiquity provide users freedom in time and location that influences their behavioral intentions.

The farmers frequently would need to initiate communication but are mostly catch up in the middle of the communication chain changing the information they source into their agricultural activities such as pre and post planting, marketing, harvesting and post harvesting. In this regard, their level of awareness and knowledge of using mobile phone such checking market prices, weather, technical knowledge, availability of agricultural inputs, extension services, improved seeds, stock and machineries information must be acquired as soon as possible, easily and in a cheap manner (Szilagyi & Herdon, 2006). Obviously when this information is obtained, there is no need for farmers to travel long distance, spend money to seek for information for their farming activities which clearly benefit the farmers. With the help of information farmers access on the use of mobile phone, farmers can plant seeds at the right time, get weather warning before unforeseen circumstance occurs and will be able to communicate to extension officers for any agricultural challenges observed on the farm for quick intervention. Furthermore, when information is sourced on market at the appropriate time, it helps farmers to determine a better cropping pattern, estimate input price, plan what to sell and at what price (Qiang, Kuch, Dymond, & Esselaar, 2011).

The result of getting better information for agricultural activities is outmost and quality yield of crops. In this situation, smallholder farmer can take advantage of the best market price leading to increased income and livelihood, better social and community life. (Odhiambo, 2014); (Ansari & Pandey,

2013).In as much as better information improves smallholder farmers livelihood and income, a lot of challenges is also faced with the advent use of mobile technology. The network, language barrier especially when the smallholder farmer is illiterate, financial constraint and complicated applications on mobile phones are some of the challenge's smallholder farmer's encounter. It has been reported by Masuki et al., (2010) reveal that lesser extent of short message service (SMS) usage is due to higher rate of illiteracy.

Finally, literature has revealed that, socio-economic factors such as sex, farm experience, age, educational level and other variables can influence farmers decision to choose mobile phone for agricultural information. e. According to Okello, Kirui, Njirani and Gitonga (2012), Williams and Agrbo (2013) and Munya (2001) young people engage in technology faster than the older no matter where they find themselves. Young people have a positive correlation in the use of the mobile phone. Porcari (2010) contended that young people are more used social networking and other recent technologies use than with the older ones. Schiffman and Kanuk (2004) claimed that education and income are closely related; the more educated a person is, the greater is the likelihood of a high income. Also, DiMaggio and Cohen (2004) stated that literate people are better able to adopt, learn and use new technology more and hence more likely to be inventive and innovative. DiMaggio and Cohen (2004) explained the positive correlation between the level of income and timing of adoption of new technology.

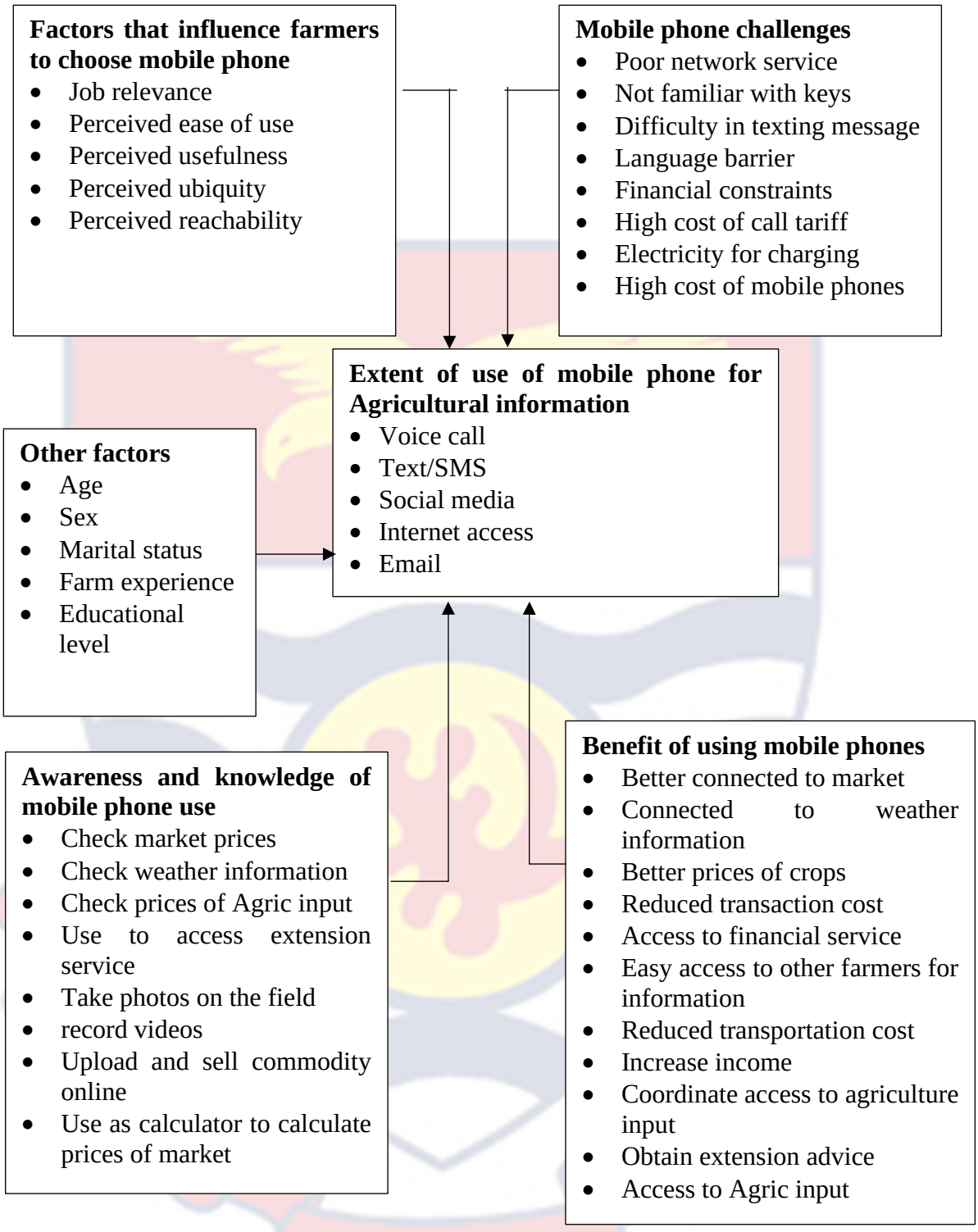

Figure: 1 Framework of Determinant of Farmers' Use of Mobile Phone to Access Agricultural Information in Agona East District, Central Region

Source: Author's Construct

CHAPTER THREE

RESEARCH METHODOLOGY

Introduction

This chapter describes the research methodology that will be utilized for this study. It gives a systematic procedure followed to achieve the objectives of the study. Research methodology is the collective term used to describe the scientific approach to conducting research. This chapter presents the research methodology, research design as well as the sampling approach. It also presents the data collection techniques, the analysis technique and also represent the steps taken by the researcher to ensure validity and reliability of the study.

Study Area

The study was carried out in the Agona East District in the Central Region of Ghana. The district was formed out of the Agona District now the Agona West Municipality in 2008. Agona East is one of the twenty Districts in the Central Region of Ghana. The district is situated in the eastern part of Central Region. Agona East has one constituency and five area councils. These councils are Nsaba, Asafo, Mankrong, Duakwa and Kwanyako.

Agona East District is situated within latitudes 50 30″and 50 50″N and longitudes 00 35″ and 0 0 55″W. It is bounded to the south by the Agona West Municipality and the Gomoa East District Assembly, to the north by the Birim South District and to the northeast by the West Akim District, both in the eastern region. The eastern part of the district is bounded by the Awutu Senya District and to the West by Asikuma-Odoben-Brakwa and Ajumako-Enyan Essiam Districts. Generally, the District lies in the wet semi-equatorial climatic zone. It has two main crop growing seasons; a bio-modal pattern of rainfall with the

maximum occurring in May/June and the minor occurring in September/ October. The annual rainfall figure lies within the range of 1000 mm – 1400 mm. The dry season starts in December and ends in March with the highest mean monthly temperature of 33.8oC occurring between March and April and the lowest of about 29.4oC in August. The district capital is Agona Nsaba, which is approximately 35 kilometres North of Winneba and 20 kilometres from Agona Swedru.

Figure 1: Map of Study Area

Source: Agona East District Assembly

Households in Agriculture

According to Population and Housing Census (2010) reveal that information on households who engages in agricultural activities in the district is 69.95%. Also, the proportion of households who engage in farming activities in the district is 76.3%. This shows that the people in the rural communities engage more in agriculture than those in the urban communities.

Ownership of Mobile Phone

According to Population and Housing Census (2010), a population of twelve years and older own mobile phones and those who use internet facility is 2.6% in Agona- East District. Out of a population of 56,845 persons in the district who are twelve years and older representing 36.8% own mobile phone. It also reveals that ownership of mobile phone is higher among males than females.

Research Design

Research design is the comprehensive plan that a researcher employs as a guide while shaping his/her research study. In research design, a researcher is able to provide wide-ranging measures on how the study is to be conducted. (Schindler, 2018). Research design can also be overall idea and strategy that notifies the vital decisions that are approved in research. There are different types of research designs that a researcher can choose from. These include, an exploratory, descriptive explanatory, case study, cross sectional studies, longitudinal or time series research designs and many more. These types of research design are informed by the overall objective of the research (Bryman & Bell, 2015). For the purpose of this study, a descriptive correlational survey research design was adopted. Descriptive survey was used to describe the

distribution, characteristics and attitude of farmers by observing and collecting data in the natural and actual way of life setting of farmers during the study (Vanderstoep & Johnston, 2009). The survey design will be helpful in the sense that it will compare the effect, challenges, objectives, influence and perceptions about the agricultural activities of farmers in the district (Bennett, 1979). Survey design can adjust readily and not complicated to use. It is also less expensive in terms of the number of persons included in the study.

Population of the Study

According to Schindler (2018) population is the overall assembly of elements about which a researcher needs to make inferences. Population is a bigger gathering of all subjects from which a sample is drawn. Target population in statistics is the precise population around which an information is desired.

The population of the study were farmers who had registered their names with the agriculture directorate in the Agona East District of Ghana.

Sample Size and Sampling Procedure

Sampling technique or procedure refers to the situation and procedures that are used to select the sample size. A sample is a sub group of the larger population (Saunders & Lewis, 2019). Sampling techniques has been divided into two broad parts. They are the probability sampling technique and non-probability sampling techniques respectively. Non-probability sampling includes, snow ball sampling, self-selection sampling, purposive sampling convenience sampling and quota sampling. Probability sampling on the other hand includes cluster sampling, systematic random sampling, stratified random sampling and simple random sampling respectively. (Bryman & Bell, 2015).

A sample size is a determinate portion of statistical population whose properties are studied to gain information about the entire population. A sample size is also the number of elements which can be accessible by the people in the study (Bryman & Bell, 2015). A sample size can be used in the situation when the population in consideration is too huge or when there are limitations of time and resources (Schindler, 2018).

For this study, a list of all registered farmers in all the 14 communities numbering 339 in the district was compiled into a sample frame to select farmers. The 14 communities in the district were; Gyasi, Kwanyako, Mankrong, Duakwa, Mensakrom, Asafo, Nsaba, Fante Bawjiase, Duotu, Kwesitwekwa, Ninta, Anomabo, Topre and Jacob respectively.

Firstly, proportionate random sampling method was used to select 181 farmers from the 339 registered farmers based on Krejcie & Morgan (1970) table for determining sample size for a given population. The stratum was based on the 14 communities from the district. The Table 1 provides the list of the population and number of respondents that can be selected from the population as the appropriate sample to be used for the study. For a population of three hundred and thirty-nine (339) respondents, the corresponding sample size was one hundred and eighty- one (181) and thus was rounded to one hundred and eighty-two (182) respectively.

Secondly, the population was stratified into communities. Proportional random sampling technique was used to separately select sample of respondents from each of the selected communities based on their population. According to Best & Kahn (1998), unbiased nature of simple random sample guarantees that every member has the equal chance of being selected in a given population.

Table 1: Population and Sample Size Selected for the Study

Name of Community	Number of Registered Farmers	Sample Size of Framers
Gyasi	5	3
Kwanyako	23	12
Mankrong	18	10
Duakwa	48	26
Mensakrom	23	12
Asafo	85	45
Nsaba	24	13
Fante Bawjiase	7	4
Duotu	29	15
Kwesitwekwa	18	10
Ninta	26	14
Anomabo	5	3
Topre	23	12
Jacob	5	3
Total	339	182

Source: Field Survey, Cudjoe (2021)

Instrumentation

A structured and validated interview schedule was developed as the instrument for the study. The face validity was ensured by the researcher and the content validity was checked by the supervisor and lecturers in the University of Cape Coast, Department of Agricultural Economics and Extension. The questions on the instrument were made up of open and close

ended questions. The interview schedule consisted of six parts. Part one measured the background, farm and phone related characteristics of respondents.

The second part of the structured interview schedule measured farmers level of awareness and knowledge of mobile phone use in obtaining agricultural information. A five-point Likert- type scale to rate the level of awareness and knowledge was developed. The respondents were asked to indicate; 1 = Strongly Disagree (SD), 2 = Disagree (D), 3 = Moderate (M), 4 = Agree (A), 5 = Strongly agree (SA).

Part three of the structured interview schedule measured the perceived benefits smallholder's farmers derive from using mobile phone to access agriculture information. A five-point Likert – type scale was developed to measure the respondent's view on the benefits of using mobile phone. The respondents were asked to indicate; 1 = Very Low Benefit (VLB), 2 = Low Benefit (LB), 3 = Moderate Benefit (MB), 4 = High Benefit (HB), 5 = Very High Benefit (VHB).

Part four of the structured interview schedule compared male and female extent use of mobile phone services to access agricultural information using a five-point Likert – type scale; 1 = Very Low (VL), 2 = Low (L), 3 = Moderate (M), 4 = High (H), 5 = Very High (VH) on the extent use of mobile phone services by farmers.

Part five of the structured interview schedule measured the attributes of mobile phone technology that influence farmers to choose mobile phone to access agricultural information. Again, the respondents were asked to indicate; 1 = Very Low (VL), 2 = Low (L), 3 = Moderate (M), 4 = High (H), 5 = Very

High (VH) on factors that influence farmers to choose mobile phone for agriculture information.

The final part of the structured interview schedule measured the challenges that affect mobile phone ownership and usage by farmers. A five-point Likert- type scale was developed to measure the respondents view on the challenges that affect mobile phone ownership and use by farmers using; 1= Strongly Disagree (SD), 2 = Disagree (D), 3 = Moderate (M), 4 = Agree (A), 5 = Strongly agree (SA) on the challenges that affect mobile phone ownership and use by farmers. According to Simon and Goes, (2013), Likert – type scale items of five or more categories can be used as interval procedures in social science research, hence the need for five point Likert- type scale was employed as interval scale for the study.

Pre-testing

The instrument was pre-tested on thirty selected smallholder farmers from Agona West Municipal. This ensured that respondent selected had the same characteristics as the respondents of the study. The aim of pre-testing is to discover ambiguities, insufficiencies and weakness in the instrument for corrections and modifications to improve the internal consistency of the instrument. (Alumode, 2011); (Vanderstoep and Johnston, 2009)

An instrument is said to be reliable when its Cronbach alpha value is 0.7 or more (Pallant, 2005). Since the Cronbach alpha values were more than 0.7, the instrument was considered to be reliable.

Table 2: Reliability and Co-efficient of the Instrument

Subscale	Number of Items	Alpha
Awareness	9	0.701
Knowledge	9	0.736
Benefit	14	0.712
Level of use	12	0.708
Perceived Ubiquity	3	0.715
Perceived Reachability	4	0.719
Job Relevance	2	0.839
Perceived Ease of use	4	0.772
Perceived Usefulness	4	0.750
Behavioral Intension	2	0.957
Challenges	6	0.727

Source: Field Survey, Cudjoe (2021)

Data Collection

To facilitate data collection, a letter from the Department of Agricultural Economics and Extension of the University of Cape Coast was obtained and sent to the District Directorate of the Ministry of Agriculture in Agona East District. Explanation was made to highlight the nature of the research to authorities of the ministry and seek for support for data collection. Field data collection was carried out by the researcher and other four trained assistants. The four enumerators were trained to help the researcher administer the instrument. The training involved explaining the meaning and interpretation of each of the items on the interview schedule. This was to equip them with the requisite skills needed to solicit information from the beneficiaries. The training

was also meant to help the enumerators acquaint themselves with objectives of the study and the content of the interview schedule. After the training, the researcher went to the field with the enumerators for data collection. Before the instrument was administered the purpose of the study was explained to respondents and respondents were assured of confidentiality. The validated and pretested instrument was administered in the local dialect of randomly selected respondents and their responses were recorded on the interview schedule. The data collection lasted for four weeks. The long period resulted from the unavailability of respondents in the study communities. The period was a farming period and the respondents were always on their farms. With the help of opinion leaders in the study communities, the researcher was able to schedule convenient time with respondents. Specifically, late evenings on week days and Sundays after church service were scheduled with the respondents.

Data Analysis

Data analysis is the method of methodically applying statistical and/or rational techniques to define and illustrate and assess data. It has two components, descriptive and inferential. For the purpose of this study, data was analyzed using descriptive. The descriptive statistics contained measures of central tendency (mean, standard deviation) and frequencies and percentages were used to summarize the data allowing the researcher to meaningfully describe distribution of measurements. (Cooper & Schindler, 2014).

The data collected was ordered and cleaned. The data was coded into the Statistical Package for Social Sciences version 25.0. Template was created based on the instruments. Descriptive such as frequencies, percentages, means

and standard deviation was run to check errors in data entry. The following statistics based on the objectives were generated.

Objective one considered farmers' level of awareness and knowledge of mobile phone use in obtaining agriculture information. In this objective, frequencies, percentages, means and standard deviation were generated to describe the variables.

Objective two of the study identified the perceived benefit smallholder's farmers derive from the using mobile phone. Again, frequencies, means, percentages and standard deviation were used to analyze the objective.

Objective three of the study compared male and female extent use of mobile phone services to access agricultural information. In this objective, Independent Sample t- test was used to analyze the data.

Objective four of the study measured attributes of mobile phone technology that influence farmers to choose mobile phone for agricultural information. To address this objective, frequencies, percentages and standard deviation were used.

Objective five of the study identified the predictors of farmers' extent use of mobile phone services for agricultural information from background characteristics of farmers and the attributes of the innovation. In this objective, multiple linear regression was used.

Objective six of the study also determined the challenges affecting mobile phone ownership and use by the smallholder farmers. Again, frequencies, percentages, means and standard deviations were generated to determine the various variables in the study.

CHAPTER FOUR

RESULTS AND DISCUSSION

Introduction

Agriculture is considered as the main driving force in Ghana's economy providing livelihoods for many people and generating one fifth of the national GDP. Despite this, the sector is facing numerous challenges including non-adoption of agricultural technology at the farm level, due to farmers' lack of access to the latest information. In this context, the current study focusses on determining factors that influence the use of the mobile phone in accessing agricultural information among the farmers of the of Agona-East District, Central region of Ghana. As a result, this chapter presents the findings, which are based on the data gathered. The chapter begins with the description of respondents followed by the presentation, interpretation and discussion processes. Discussion of the findings is supported by literature, as discussed in the previous chapters, as well as from theoretical frameworks. The chapter concludes with the summary.

Respondents' Demographic Information

Although the demographic information of respondents was not specified in the study's objectives, it was vital to collect this information since it allowed the investigator to have a better knowledge of the target population's background characteristics. This section therefore presents, interprets, and discusses the breakdown of the descriptive data of the surveyed respondents' demographics information.

Sex of the Respondents

Farmers in the agriculture has been shown to be varied across gender, with male farmers usually dominating compared to their counterparts' female farmers. Also, findings have revealed that usage of mobile phones to access agricultural information is influenced by gender of farmers. Table 3 shows the gender distribution of the participants in the study. Out of the 182 farmers, more than two thirds were males, accounting for (83.5%), which is high indicative of male dominance of household in the study area. while the remaining respondents (16.5%) were females. This explains that majority of the farmers from Agona-East District that participated in this study were male farmers. according to the statistics. Further, the findings revealed that men, on average, dominate farming activities in Ghana's and these findings are consistent with previous studies who stated that when it comes to agricultural in Ghana, men are in the forefront.

Table 3: Sex of Farmers

Sex	Frequency	Percentage
Male	152	83.5
Female	30	16.5
Total	182	100.0

Source: Cudjoe, 2020 n = 182

MOFA (2010) showed that in as much that women in agriculture constitute the greater agricultural force in Ghana, of which women in Agona East District are no exemption, as they cultivate about 65% of the food crops, they are least taught the use of mobile phone for their agriculture. Women are disadvantaged in the use of mobile phone due to inadequate access to agriculture

inputs and credits, agriculture information, education, and access to resources-decision making power. (World Bank, 2007)

Age of the Respondents

Studies show that in terms of technological innovations, social and economic reflections, young farmers adopt agriculture fastest. (Okello J. , Kirui, Njirani, & Gitonga, 2012; Williams & Agbo, 2013; Munya, 2001). Age of a farmer is a growing concern in agriculture because farmer's age is a significant element in determining his or her ability to work.

Table 4: Farmers' Age Groups

Age Categories (Years)	Frequency	Percentage
Less than 20	4	2.20
20 – 29	24	13.20
30 – 39	32	17.60
40 – 49	36	19.80
50 - 59	46	25.30
60 – 69	27	14.80
70 and above	13	7.10
Total	182	100.00

Source: Cudjoe, 2020, n = 182. Mean = 46.81years, S.D = 15.29years, Min. = 18years, Max. = 89years

The mean age is 46.81 years with majority (77.5%) of the farmers were between 30 to 69 years of age Table 4. However, (13%) constitute the ages between 20 to 29 years whiles the few (2%) were between the ages less than 20 years. This result confirms the studies of (Atidjah,2004; Buadi,2008 &

MOFA,2011) which revealed that averagely most Ghanaian farmers in our various communities falls between the ages of 30 to 50 years.

Marital Status of the Respondents

With regards to the marital status of the farmers, the results in Table 4 indicates that out of the 182 farmers that were surveyed in the Agona-East District in the Central region of Ghana, about 70% were married. From this, majority of farmers in the district that participated in this study were married and the implication of the findings is that marriage is socially acknowledged as a requirement that drives agriculture productivity.

Table 5: Marital status of the farmers

Marital status	Frequency	Percentage
Married	128	70.30
Not Married	54	29.70
Total	182	100.00

Source: Cudjoe, 2020 n = 182

Farmer's Years of Experience

In agriculture, experience is the foundation for progress and success, and a lack of experience is likely to result in low production and income for farmers. Farmer's years of personal experience or prior understanding of agricultural practice might be a valuable source of information. Table 6 therefore presents the results of the farmers years of experience. As shown in Table 6, the results shows that experience varies among the respondents.

Majority (84%) of farmers had farmed between 1 to 30 years Table (6). The mean farming experience 20.1 years indicates that the farmers were experienced. Close to one- fifth (16%) had farmed between 21 and 30 years.

The result agrees to the findings of (Buadi, 2008) in a comparable study found that farmers in the area are experienced. The mean years of farming experience of 20.1 years contrasts the findings of MoFA (2011) which in a national study revealed that the mean years of farming experience of 88 farmers studied is 11 years. It is expected that with considerable number of years of farming experience the farmers in the study area should easily adopt new technologies and training information from development agencies and MoFA extension agents (Bosompem, 2006).

Table 6: Years of Farming Experience

Years of farming experience	Frequency	Percentage
1 – 10	62	34.1
11 – 20	54	29.7
30 and above	37	20.30
21 – 30	29	15.90
Total	182	100.00

Source: Cudjoe, 2020, n = 182. Mean = 20.19years, S.D = 14.15years, Min. = 1year, Max. = 75years.

Ibrahim, Adejoh, and Edoka, (2009) had argued that the more experienced farmers are, the more they are exposed to sources and channels of information. Ibrahim, Adejoh and Edoka (2009) added that experience is essential to garble and use new technology such as mobile phone for agriculture activities.

Respondents' Farm Size

Agricultural output is strongly connected with farm size. Thus, farm size plays a critical role in agricultural sustainability. Also, the likelihood of farmers

using modern technologies such as mobile phones increase with increasing farm size (Mittal & Mehar, 2016). According to Mittal et al. (2010), farms with larger farm sizes, better exploit the use of information and communications technologies than small-scale farmers. Based on these observations, the researcher included farmers farm size in this study and the results are presented in Table 7. As shown in table 6, about (76%) of farmers' farm size fall within the range of 1 to5 acres, whiles the remaining (24%) cultivate 6 to 20 acres. The findings show that every farmer in the survey had attained some level of farm size with the majority farm sizes within 1-5 acres.

Table 7: Farm size Cultivated by Farmers

Farm Size (Acres)	Frequency	Percentage
1 – 5	138	75.8
6 – 10	32	17.6
11 – 15	6	3.3
16 – 20	5	2.7
Above 20	1	.5
Total	182	100.0

Source: Cudjoe, 2020, n = 182. Mean = 4acres, S.D = 4.15acres, Min. = 1acre, Max. = 30acres.

According to Williams and Agbo (2013) and Falola, Adewumi, and Olaniyi (2013), farmers with huge farm size are expected to use ICTs in agricultural technology delivery. They also emphasize that larger-scale farmers are able to get higher benefits from the use of mobile phone as they are able to access resources that has to do with input accessibility and other agricultural materials. Farmers with huge farm size are also privy to get technical or expert

assistance immediately in case of farming activities. They are also fortunate to benefit from the information they get on prices of commodities in the market and are able to overcome any likely limitations on production or access to market.

Respondents' Educational Level

Results in Table 8 illustrates that few of the respondent (8.8%) had no education at all. However, an overwhelming (91.1%) respondents have had some form of education. These include JSS/JHS (61%), Primary (14.8%), SHS/SSS (8.2%) and Tertiary (7.1%). This is to say that every farmer in the study had at least some level of education, with the majority having attained JSS/JHS educational level.

Education level definitely has effect on use of mobile phone and since majority of respondents in the study area have some level of educational qualification, it is anticipated that farmers in the study area should be able to use mobile phone to expand their agriculture and livelihood. The result conforms with Ghana Statistics Service (2010) report that about two-thirds (63.6%) of the population aged 15 and older in Agona East are literate.

Table 8: Level of Education of Farmers

Level of Education	Frequency	Percentage
None	16	8.80
Primary	27	14.80
JSS/JHS	111	61.00
SSS/SHS	15	8.20
Tertiary	13	7.10
Total	182	100.00

Source: Cudjoe, 2020, n = 182.

Farmers' Membership in Farm-Based Organizations

An expected increase in agriculture requires increase in agricultural productivity. However, it is worth noting that agricultural productivity sometimes much depends on the farmer's membership of farm-based organizations. This is based on the premise that FBOs give delivery of extensions services and empower FBO members to influence policies that affect their livelihoods. Therefore, the respondents were asked to indicate as to whether they belong to farm based organizations and the results are presented in Table 9, majority (72%) of farmers in the Agona-East District do not belong to any farmer-based organization, whiles only (28%) are members in farmer-based organization.

Table 9: Members in Farmer Based Organizations

Membership in FBOs	Frequency	Percentage
No	131	72.00
Yes	51	28.00
Total	182	100.00

Source: Cudjoe, 2020, n = 182.

Falola, Adewumi and Olaniyi (2013) in their study found similar results that majority of farmers were engaged in farming association. Furthermore, Pascua (2009) contended that farmer's contribution in farming association can excite information exchange among themselves.

Respondents' Farming Scale

Table 10 represent about (59.9%) of the respondents were reported to be subsistence farmers, whiles the remaining (40.1%) were commercial farmers.

This is to say that majority of the farmers that were surveyed from Agona East Districts are into subsistence farming scale.

Table 10: Farming Scale

Farming Scale	Frequency	Percentage
Subsistence	109	59.90
Commercial	73	40.10
Total	182	100.00

Source: Cudjoe, 2020, n = 182.

Respondents' Crop Cultivation

Table 11 represents crop cultivated by farmers surveyed in the Agona East District. As shown in the table majority of farmers cultivate cassava, followed by cocoa, maize, maize and plantain respectively.

Table 11: Crops Cultivated by farmers in the study area

Crops	Frequency*	Percentage
Cassava	138	75.80
Cocoa	126	69.20
Maize	102	56.00
Plantain	84	46.20
Tomatoes	33	18.10
Pepper	32	17.60
Okra	32	17.60
Coconut	30	16.50
Oil palm	26	14.30
Cucumber	26	14.30
Garden eggs	25	13.70
Cocoyam	21	11.50
Cabbage	19	10.40
Yam	17	9.30
Citrus	10	5.50
Onions	5	2.70
Carrot	4	2.20
Rice	4	2.20
Sweet potato	3	1.60
Sugar cane	3	1.60

Source: Cudjoe, 2020, n = 182. *Multiple responses

Usage of Mobile Phone

Mobile has proven to be an effective communication tool that has not only revolutionized the working styles of many industries, but has also produced new professional dimensions in a variety of industries, including agriculture (Omwansa, Waema, Chen & Sullivan, 2013; Asongu & Boateng, 2018). In the agriculture sector, usage of mobile phone for smooth information exchange is critical for the successful adoption of farm innovation needed for agricultural development. However, many farmers in developing countries do suffer from a huge communication asymmetry between the latest agricultural knowledge and farmers due to a lack of resources and infrastructure including mobile phone (Baloch & Thapa, 2014). Therefore, Table 12 presents results on farmers usage of mobile phone among farmers. According to the survey, (100%) of the respondents own a mobile phone. All the farmers in Agona East District indicated mobile phone ownership.

Table 12: Use of Mobile Phone

Use of Mobile phone	Frequency	Percentage
Yes	182	100.00
No	0	0.0
Total	182	100.00

Source: Cudjoe, 2020, n = 182.

According to Okello, Kirui, Njirani and Gitonga (2012), ownership and possession of mobile phones generates the readiness to discover the product and its functions. Again, it increases the preparedness and capability of an individual to use the mobile phone in so many situations. Moreover, the ownership and use of mobile phones for farming increases the respondent's knowledge and signify

high social status in the farming community. It is therefore projected that farmers in the study area will adequately use mobile phone t help them in their farming activities.

Number of Mobile Phone Farmers Use

Farmers, particularly those who are somewhat more fortunate use mobile phones to acquire timely information. However, it is worth mentioning that with the number of mobile phone use by farmers can enable them to access information services. This is underpinned by the fact that it is a good moment to assess their impact on the agriculture industry. Table 13 revealed that (98%) of the respondent use only one mobile phone. Whiles only (2%) use two mobile phones.

Table 13: Number of Mobile phones used

Number of Mobile phones used	Frequency	Percentage
One	179	98.40
Two	3	1.60
Total	182	100.00

Source: Cudjoe, 2020, n = 182.

Number of Mobile Sim Cards used by Farmers

Table 14 shows that majority of respondents (82%) use only one sim, (15%) use two sim cards, while only (3%) of farmers reported to be using three sim cards. According to Okello, Kirui, Njirani and Gitonga (2012), possession of mobile phones brands the willingness to discover the product and its functionalities. Again, it increases the willingness and ability of a person to use them in diverse situations. Furthermore, the ownership or use of mobile phones

increases the respondent' product knowledge and symbolize high social status in the farming community.

Table 14: Number of Sim cards used

Number of Mobile Sim Used	Frequency	Percentage
One	149	81.90
Two	28	15.40
Three	5	2.70
Total	182	100.00

Source: Cudjoe, 2020, n = 182.

Mobile Phone Types used by Farmers

Complexity, compatibility, or the degree to which an invention fits inside the socio-cultural context and the perceived difficulty of use, are directly connected to the adoption and use (Rogers, 2003). Mobile phone use pattern shows the farmers' behaviors regarding the various type of communication. In this regard, mobile phone use among farmers was assessed by documenting the type of mobile phone with respect to feature and smart phone. The findings presented in Table 15 revealed that nearly (78%) of respondents use feature phone, whiles the rest (22%) of the farmers were reportedly using smart phones. Therefore, majority of the farmers in Agona-East District use feature phones. The more percentage of the farmers using the feature phones suggests that the applications of feature phone are not that complex as the smartphone as stated by Rogers (2003) that adoption will take place when an innovation is not too complex to use.

Table 15: Type of Mobile Phone used

Type of Mobile phone used	Frequency	Percentage
Feature Phone	141	77.50
Smart Phone	41	22.50
Total	182	100.00

Source: Cudjoe, 2020, n = 182.

In addition, other studies Kaliba, Verkuijl, and Mwangi, 2000,and Qiang, Kuek, Dymond, and Esselaar (2011) opined that smaller holder farmers try to adopt modest technologies first before furthering on to more complex ones. Therefore, cheaper technologies may be adopted first before the more expensive ones. Diffusion and innovation theory states that an innovation will be first adopted by a few number of individuals and if the innovation offers a relative advantage, large number of individuals will adopt resulting in a more critical group of people (Rogers, 2003).

Number of Years that Farmers had used Mobile Phone.

Majority of the respondents (84.6%) had been using mobile phone for 1 to 15 years. However, few of the respondents representing (15.3%) had used mobile phone from 16 to 25 years. The minimum, maximum and mean years that the farmers have been using mobile phone were one year, 30 years and 4.48 years respectively.

Table 16: Number of Years Mobile Phone Usage

Number of Years Used Phone (Years)	Frequency	Percentage
6 – 10	73	40.10
11 – 15	53	29.10
1 – 5	28	15.40
16 – 20	19	10.40
21 – 25	9	4.90
Total	182	100.00

Source: Cudjoe, 2020, n = 182. Mean = 4.48years, S.D = 4.15years, Min. = 1year, Max. = 30years.

The result presented in Table 16 also revealed that mobile phone technology is not new to in Agona East of Ghana as they have used it for a long time. According to Rogers (2003), at the beginning of the adoption, the adoption rate will be low but as times goes back, it will increase and then start to fall, at which we can say adoption has taken place. For example, approximately from 21-25 years, the rate of adoption was low and this is what Rogers classify as innovators, while from 6 to 10 years, the rate of adoption to mobile phone increases as Roger called them early adopters. Lastly, from 16 to 20 years, the rate of adoption began to fall as he called them the early majority or the late majority as shown on Table 16. Therefore, from the finding, it indicates that the use of mobile phone is adopted and is used by the respondents for agriculture information in the study area.

Mobile Network Connectivity in Community

Telecommunication, especially mobile phones have the potential to provide solution to the existing information asymmetry in various lagging sectors like agriculture. Mobile phone has always played a key role in agriculture, enhance farmers get access to information regarding their agriculture practices. However, farmers in developing countries often face the challenges for using mobile phones due to no reception, poor sound or breaking up of sound and calls ending unexpectedly. Table 17 shows the findings of access to network connectivity in communities surveyed in this study. The findings from the study revealed that, all the respondent (100%) surveyed reported to have access to network connectivity without challenge of “no reception”.

Table 17: Access to Network connectivity in community

Network connectivity	Frequency	Percentage
Yes	182	100.00
No	0	0.0
Total	182	100.00

Source: Cudjoe, 2020, n =182.

According to Corrocher and Zirulia (2008), factors that influence the choice of subscription to a network include the qualities of the mobile network and the characteristics of the mobile subscribers; the network quality obtains from the range of mobile telecommunication services influence costumer decision making power

Types of Mobile Networks Farmers Use

In order, to identify the various types of mobile networks been subscribed to the surveyed communities, the respondents were asked to indicate the type of mobile network and the results are displayed. Table 17, majority of the farmers, (97.30%) reported subscribed to MTN, (11.0%) subscribed to Vodafone, (7.10%) have subscribed to Airtel/Tigo, whiles only (1%) of the respondent have subscribed to Glo. This is to say that MTN is the commonest mobile network that have been subscribed by farmers in the Agona-East District.

Table 18: Type of Mobile Network subscribed

Mobile Network	Frequency*	Percentage
MTN	177	97.30
Vodafone	20	11.00
Airtel/Tigo	13	7.10
Glo	1	0.50

Source: Cudjoe, 2020, n = 182. *Multiple responses

This result agrees with the finding of National Communication Authority (2014) that the leading telecommunication network in Ghana is MTN, followed by Vodafone and Glo is the telecommunication institution that is least subscribed to by Ghanaians. The study also conforms to the findings of Birke and Swann (2006), which concluded that the characteristics of the individual mobile subscriptions, social network (friends, family and partner) and income influence the choice of mobile users. Moreover, many are subscribing to MTN, because according to Kim and Kwon (2003), in order to avoid high expenditure on phone calls, mobile users try to convince friends and family to subscribe to the same network. Kim and Kwon (2003) argued that consumers consider network size before subscribing to a mobile network. Generally, the larger the mobile networks, the more advantage it has over smaller networks due to intra-network call discounts and quality signalling effect. Furthermore, mobile network with larger subscriber base attracts more subscribers and it becomes more attractive to others.

Reasons Considered in the Selection of a Network

In order to discover the reasons for selecting a network, the respondents were asked to give reason(s) for using or subscribing to a particular network. The results in Table 19 showed that most common explanation was that they have wide coverage network services and conditions. Thus, to take advantage of service promotions and network coverage, the majority of respondents (85.70%) enrolled to the selected network. The second was reason was good reception accounting for (73.10%) respondents considered this as a key factor in selecting a network. Also, (27.5%) considered affordability in subscribing to

a network, because they believe that calling a number on the same network is less expensive than calling a number on a different network.

Table 19: Reasons for choosing Network

Reasons for choosing Network	Frequency*	Percentage
They have wide coverage	156	85.70
They have good reception	133	73.10
Call tariff is affordable	50	27.50
Promotion from network operators	45	24.70
Good data service	33	18.10
They send agriculture message through (SMS, E-mail and internet)	10	5.50

Source: Cudjoe, 2020, n = 182. *Multiple responses

According to Corrocher and Zirulia (2008), factors that influence the choice of subscription to a network include the qualities of the mobile network and the characteristics of the mobile subscribers; the network quality obtains from the range of mobile telecommunication services influence costumer decision making power.

Quality of Network Reception

The farmers in the surveyed District perceived the quality of network reception in the various communities of Vodafone (Mean= 3.65, SD= 0.67); Airtel/Tigo (Mean= 3.50, SD= 1.24); and MTN (Mean= 3.39, SD= 1.06) to be good.

Table 20: Table Quality of Network Reception in Community

Mobile Network	n	Mini.	Max.	Mean	S.D
Vodafone	20	2	5	3.65	0.67
Airtel/Tigo	12	1	5	3.50	1.24
MTN	180	1	5	3.3944	1.06
Composite mean					

Source: Cudjoe, 2020, n = 182. Means were calculated with a scale of 1 = Very Bad, 2 = Bad, 3 = Average, 4 = Good, 5 = Very Good

Farmers with E-mail Account

The findings presented in Table 21, shows that majority of the farmers (90.10%) do not have e-mail account. This is could by the fact that most of these farmers are not highly educated, hence do not know the purpose of owning e-mail account.

Table 21: Numbers of Farmers with E-mail account

E-mail account	Frequency	Percentage
No	164	90.10
Yes	18	9.90
Total	182	100.00

Source: Cudjoe, 2020, n = 182.

Farmers who Received Agricultural Information via E-mail

An important objective that the study seeks to achieve is to determine whether the use of mobile phone enhances farmers' access agricultural information. As a result, the respondents were asked whether they received agricultural information from using mobile phone through e-mail account. Among the 18 farmers that reported having e-mail account, only six (33%) indicated that they received agricultural information via e-mail, while the rest (66.70%) do not receive agricultural information via e-mail account. This show that most of the farmers do not access agricultural information via e-mail.

Table 22: Numbers of Farmers Received Agricultural Information via E-mail

Receive Agric info via email	Frequency	Percentage
No	12	66.70
Yes	6	33.30
Total	18	100.00

Source: Cudjoe, 2020, n = 18.

Type of Agricultural Information Received via E-mail

Farmers' access to information and knowledge are the driving forces behind agricultural sector development. Agricultural information, for example, is viewed as critical resources and needed in efforts to reform the agricultural sector. (Ndimbwa, Mwantimwa & Ndumbaro, 2021). It is also worth noting that farmers tend to benefit from access to and use of agricultural information and knowledge, which appears to impact change and enable them to plan and make educated decisions about their farming activities. As Das, Basu and Goswami (2016) noted, it also implies that having the correct information and knowledge, as well as timely access to it, allows smallholder farmers to make the best decisions.

Thus, the type of agricultural information and the appropriate channel used to deliver the agricultural information and knowledge are among the important ingredients in agricultural development. In this regard, the researcher investigated the type of agricultural information received via E-mail in this study and the results are presented in Table 23. As shown, out of the total of 6 famers that were reported to get access to agricultural information in Agona East District, all the 6 (100%) reported to received information on crop disease management and workshop/training via email. Also, 5 (83.30%) received market information via email, 4 (66.70%) farmers received weather information via email.

In addition, only 3 farmers agreed to receive information on variety of new crops, 2 get access to agricultural information on recommended fertilizer application and pest management respectively through email channel. While, only one farmer reported to receive agricultural advice from the extension

officers through the use of email. These findings therefore corroborate with previous studies like Kalema (2017); Mittal and Mehar (2012) that found that farmers received agricultural information on what seeds to plant, how to manage pests and illnesses, how much food commodity to sell and where to sell it, and where to receive credit or a loan.

Table 23: Type of Agricultural information received via E-mail

Type of Information	Frequency*
Disease management on crops	6
Workshop/Training information	6
Market information	5
Weather information	4
Variety of new crops	3
Recommended fertilizer application	2
Pest management	2
Extension Advice	1

Source: Cudjoe, 2020, n = 6. *Multiple responses

Numbers of Farmers who use Social Media

The issues and opportunities that come with a quickly changing agricultural landscape are also evolving. As such, farmers must have access to agricultural knowledge in order to improve their ability to sustain and increase farm output. With the introduction of the internet and web-based services, any amateur can learn farming skills and become self-sufficient in the field. Social media has therefore, been considered as modern archive or medium for information whereby people can obtain information. Various social media platforms play a key role in disseminating agricultural information that can assists farmers in solving problems and influencing their choices. Social media is a mechanism for group members to explore and recognize mistakes in thinking.

According to Conley and Udry (2010), farmers who lack the resources to obtain agricultural information from formal sources can rely on social media to get access to agricultural information from their informal social network and share agricultural knowledge through social contacts. Hence, social media is convenient to those who need information instantly or do not have easy access to information to exchange knowledge. Based on these observations, the researcher in this study sought to explore the number of farmers that use social media to access agricultural information. The results displayed in Table 24 indicates that majority (80.20%) of farmers do not use social media, whiles (19.80%) farmers were found to be currently using social media.

Table 24: Numbers of Farmers who use Social Media

Use Social Media	Frequency	Percentage
No	146	80.20
Yes	36	19.80
Total	182	100.00

Source: Cudjoe, 2020, n = 182.

Types of Social Media Platform Used by Farmers

Agricultural extension organization that has the ability to incorporate contemporary scientific findings and other relevant knowledge in an attempt to tackle unique agricultural challenges has been critical recent around the world. This has renewed the current global interest to make sure that more and more farmers are actively engaging in social media platforms, for both personal and business reasons. This is underpinned by the fact that social media use was also seen to have an enhancing ability of farmers get access to agricultural information and knowledge that intend boost household outcome variables (farm output, welfare, and wealth) of smallholder farmers.

As mentioned in Table 24, only (19.80%) farmers reported to be currently using social media. In this this section of the study, the researcher sought to know the type of social media platforms (WhasApp, YouTube, Facebook, etc.) used by farmers so as to enable to deliver useful content at the right moment. The results presented in table 25 indicates that the various social media platforms used by farmers are WhasApp, Facebook, Youtube, Twitter, and Instagram. Among these social media platforms, majority 35 of farmers were found to using WhatsApp. This is followed by 31 of farmers using Facebook, Youtube were 12. Again 8 farmers reported using Twitter, while 6 farmers were found to be using Instagram. The findings of the study are similar to those of Meredith and Agrimedia (2015), study and Future survey in 2016, which found that WhatsApp and Facebook are the most popular social media network among farmers, followed by YouTube, Twitter, LinkedIn, Pinterest, and Instagram.

Table 25: Social Media Platforms used by Farmers

Social Media platforms	Frequency*	Percentage
WhatsApp	35	97.20
Facebook	31	86.10
Youtube	12	33.30
Twitter	8	22.20
Instagram	6	16.70

Source: Cudjoe, 2020, n = 36. *Multiple responses

Social Media Platforms Farmers access agricultural information

Farmers' usage of social media platforms has the potentials to promote knowledge sharing and communication while also complementing traditional techniques. After establishing this fact, it is necessary to determine how successful each of the various social media is in terms of providing farmers'

access to agricultural information. It is very vital to figure out how effective social media platforms are communicating with farmers. This would be also be beneficial to organizations and other stakeholders interested in learning more about the effectiveness of social media as a tool for sharing and communicating agricultural information to farmers.

Also, respondents in this study were asked which social media tools they utilized to get agricultural information the most. This would give an idea of the specific social media channels farmers utilize to find agricultural information. Table 25 below, presents the results. As indicated in Table 26, 13 (36.10 out of the 36 farmers were found to get access to agricultural information through WhatsApp and Facebook respectively. YouTube and Twitter are the least used as indicated by only 2 (5.60%) of respondents respectively. The findings clearly illustrate the major platforms in use by farmers to source for agricultural information which conforms to the findings of Kuria (2014) who established that majority of farmers in Kenya, use WhatsApp and Facebook as their main social media platform when looking for agricultural information, followed by YouTube and Twitter respectively.

Table 26: Social Media Platforms Farmers access Agricultural Information

Social Media platforms	Frequency*	Percentage
WhatsApp	13	36.10
Facebook	13	36.10
YouTube	2	5.60
Twitter	2	5.60

Source: Cudjoe, 2020, n = 36. *Multiple responses

Statistical Analysis of Research Questions

This section presents the data analysis on the research questions are set out to achieved in this study (farmer's use of mobile phone for agriculture

information in Agona East District). Since the researcher wanted to make in-depth assessment on farmer's use of mobile phone for agriculture information in Agona East District, the research questions were sub-divided into six (6) questions. These include:

(1) To what extent can awareness and knowledge of mobile phone be used in obtaining agricultural information in the district?

(2) Do famers get benefit from using mobile phone to access agricultural information?

(3) Can male and female be compared in the extent use of mobile phone services to access agricultural information?

(4) To what extent and level do smallholder farmers use mobile phone services for agriculture information?

(5) What are the predictors between the background characteristics of farmers, attributes of the innovation and the extent use of mobile phone services for agricultural information?

(6) What challenges does farmers' face in owning and using mobile phone?

The data was analyzed with SPSS software, which is a statistical package for social sciences. Mean (M) and standard deviation (SD) were calculated using the software. According to Ofori and Dampson (2012) and Vetter (2017), descriptive survey design statistics is a sort of analysis in which numerical values regarding respondents are computed. According to Ofori and Dampson (2012), mean (M) can be defined as the average of a group of numbers, while standard deviation (SD), represents or measures the variability of a group score. The questionnaire used in the study was five-point Likert scale type. The researcher adopted Ofori and Dampson (2012), way of interpreting

five-point Likert-type scale where 1.00-1.99 denote very low response, 2.00-2.99 low response, 3.00-3.99 moderate response and 4.00-4.99 represent high response.

Research Question 1: To what extent can awareness and knowledge of mobile phone be used in obtaining agricultural information in the district?

In many developing nations, the recent expansion of mobile telephone and mobile-based information services presents prospects to reduce costly and imprecise information transmission in the agriculture sector and maintain market efficiency. However, farmers' level awareness on mobile phone adoption, uses, and perceived impact are critical to successfully using mobile phones to access agricultural information. Despite the fact that global assessments of farmers' awareness and capability in the use of mobile phone for agricultural information have been explored, such assessments obscure important geo-spatial differences among local farmers.

Assessing the level of farmers' awareness on the use of mobile phone to access information is critical for the creation of national agricultural policies and programs targeted at enhancing farmers' awareness and usage of mobile phones for agricultural information. As such, this section was directly related to research question one (To what extent can awareness on mobile phone be use to obtain agricultural information by smallholder farmers in Agona East District?). At this section the researcher provided series of statements for respondents to agree or disagree on the level of their awareness on mobile phone be use to obtain agricultural information increase.

Table 27 displays the finding from the respondents on the level of farmers' awareness of mobile phone use to obtain agricultural information**.** The

overall mean of means scores for Table 27 was (M=2.58, SD=1.90) prove that famers' level of awareness on the use of mobile phone to access agricultural information in Agona East district was approximately low. However, the responses on each of the various item varies. For example, on the response item "I am aware that mobile phone can be used to check weather information" recorded a mean of 3.35 (SD=1.33) which was within the moderate score range. In the same, on the response item "I am aware that mobile phone can be used as calculator to calculate prices of commodities at the market", recorded a mean of 3.30 (SD=1.12) which was also within the moderate score range.

On the other hand, on the response item "I am aware that mobile phone can be used to access extension services" displayed a mean of 2.74 (SD=1.07) which was approximately within the low level of awareness. For the statement "I am aware that mobile phone can be used to check market prices" the study found a mean of 2.47 (SD=1.02) within the low level of farmers' awareness. In addition, the item response on "I am aware that mobile phone can be used to check where agriculture inputs are (availability)" indicated a mean of 2.43 (SD=1.04) which is within the low response range. Moreover, the respondents' response on the item "I am aware that mobile phone can be used to take and record videos (disease, pest and experiment) on the field" recorded a mean of 2.12 (SD=1.10) and this fall within the low response range. Therefore, the level of awareness on mobile phone be use to obtain agricultural information by smallholder farmers in Agona East District is low.

The findings of the study confirm to the study by Chisama (2016) who established that only one in five farmers were aware of mobile use to access agricultural information. Also, Anjum (2015) found that farmers are still

reluctant to use the mobile phone to do agriculture banking transaction due to illiteracy. According to Anjum (2015) although mobile weather forecasting applications are available but farmers were found to still depends on indigenous knowledge weather forecast system which is based on myths and religious beliefs, observing the patterns of plants/flowers/trees and positions of the sun/moon/stars. Also, farmers are still used to get agriculture market information from others, radio, TV and newspapers.

Table 27: Level of Farmers Awareness of Mobile Phone use to obtain Agricultural information

Statements	Mean	S.D
I am aware that mobile phone can be used to check weather information	3.35	1.33
I am aware that mobile phone can be used as calculator to calculate prices of commodities at the market	3.30	1.12
I am aware that mobile phone can be used to access extension services	2.74	1.07
I am aware that mobile phone can be used to check market prices	2.47	1.02
I am aware that mobile phone can be used to check where agriculture inputs are (availability)	2.43	1.04
I am aware that mobile phone can be used to check the prices of agriculture inputs	2.41	1.04
I am aware that mobile phone can be used to take photos on the field	2.27	1.09
I am aware that mobile phone can be used to take and record videos (disease, pest and experiment) on the field	2.12	1.10
I am aware that mobile phone can be used to upload and sell commodity online	2.10	1.02
Composite mean	2.58	1.90

Source: Cudjoe, 2020, n = 182. Means were calculated with a scale of 1 = Strongly disagree, 2 = Disagree, 3 = Moderate, 4 = Agree, 5 = Strongly Agree

Mobile phone technology has spread fast throughout the world, even in developing nations, as an affordable ICT tool for accessing agriculture market information and knowledge, as well as increasing agriculture company

productivity, particularly in developing countries. The recent expansion of mobile telephone and mobile-based information services in many developing countries, offers prospects to increase access to complete information dissemination in the agriculture sector and maintain market efficiency. However, understanding the farmers' knowledge of mobile phone usage, and perceived impacts is critical in order to successfully use mobile phones for the optimal growth of agricultural markets.

This section therefore investigated the extent knowledge on mobile phone by farmers can be used to access agricultural information and the result is presented in Table 28. Table 28 shows that the overall mean of means score was (M=2.14, SD=0.86) which gives the general picture that respondents have low knowledge on mobile phone when it comes to it usage to obtain agricultural information. On the first statement "I know that mobile phone can be used as calculator to calculate prices of commodities at the market", the results indicated a mean value of 3.18, (SD=1.24) which fall within moderate range, indicating that in general farmers in Agona East have average knowledge that mobile phone can be used to calculate prices of commodities at market.

For the response item "I know that mobile phone can be used to access extension services" the result indicated a mean of 2.49 (SD=1.11) which fall within the low range. Also, the results envisaged that "I know that mobile phone can be used to check weather information" has a mean of 2.14 (SD=1.16) which is also on the low response range. Still on the extent of farmers' knowledge on mobile phone use to obtain agricultural information, the statement "I know that mobile phone can be used to check where agriculture inputs are (availability)" recorded a mean of 1.95 (SD=0.90) which revealed that it is within the very low

response range. In the same, the study indicated that "I know that mobile phone can be used to take and record videos (disease, pest and experiment) on the field" recorded mean of 1.95 (SD=0.95) within very low range. It is therefore revealed that farmers in Agona East district know that mobile phone can be used as calculator to calculate prices of commodities at the market. However, their knowledge on mobile phone use that can be used to obtained agricultural information is very low.

Table 28: Knowledge of the use of Mobile Phone to obtain Agricultural Information

Statements	Mean	S.D
I know that mobile phone can be used as calculator to calculate prices of commodities at the market	3.18	1.24
I know that mobile phone can be used to access extension services	2.49	1.11
I know that mobile phone can be used to check weather information	2.14	1.16
I know that mobile phone can be used to check where agriculture inputs are (availability)	1.95	0.90
I know that mobile phone can be used to check market prices	1.95	0.93
I know that mobile phone can be used to check the prices of agriculture inputs	1.93	0.91
I know that mobile phone can be used to take and record videos (disease, pest and experiment) on the field	1.91	0.95
I know that mobile phone can be used to take photos on the field	1.91	0.96
I know that mobile phone can be used to upload and sell commodity online	1.83	0.93
Composite mean	2.14	0.86

Source: Cudjoe, 2020, n = 182. Means were calculated with a scale of 1 = Very Low, 2 = Low, 3 = Moderate, 4 = High, 5 = Very High

Research Question 2: Do famers get benefit from using mobile phone to access agricultural information?

The rapid rise of mobile telephone and the advent of mobile-enabled information services offer opportunities to increase information distribution in

the knowledge-intensive agriculture industry while also assisting in the reduction of information asymmetry among farmers. It also contributes to closing the gap between agricultural input availability and delivery and agricultural infrastructure, at least in part. This section of the study delved deeper into the subject and presents evidence to demonstrate how mobile phones and mobile have benefited small scale farmers in Agona East district.

Table 29 demonstrate the results on the perceived benefits of mobile phone to smallholder farmers. The overall mean of (M=3.16, SD=0.73**)** indicated that majority of the respondents agreed to the fact that they have benefited from the use of mobile phone. The response on the first statement "Facilitate access to financial services (Mobile money transaction)" recorded a mean of 3.81 (SD=1.03) which approximately fall within the high range. On the statement "Reduce travel cost", the study recorded a mean of 3.76 (SD=1.08) indicating a high response range. In addition, the farmers indicated that mobile phone has benefited them in terms of "Easy to connect to other farmers for more information about farming" (M=3.65, SD=1.02). On the other hand, the item "Get connected to weather information" recorded mean of 2.30 (SD=1.28) which fall within low range.

This suggest that there are opportunities to target policy interventions at increasing phone use for agricultural activities in ways that facilitate access to timely, actionable information to support farmer decision making. This confirms to the findings of Okello, Kirui, Njirani and Gitonga, (2012) that interactions with mobile phones are cost effective ways for farmers to stay connected with other stakeholders and also provide them with a sense of security and social status. According to Okello et al. (2012), farmers benefit

from mobile phone in terms of hiring labour, getting market and price intelligence, procurement of farm inputs, in search of technical assistance from the extension or expert agents or acquiring weather information. Further, a recent study by Quandt et al. (2020) established that many farmers report that mobile phone use increases their agricultural profits and decreases the costs and time investments of farming.

Again, the findings from Ratnadiwakara, De-Silva, & Soysa, (2008) shows that mobile phone use have assisted small scale farmers to minimize transaction costs in through the stage of agriculture production from the planting stage to the last stage of marketing point of the farm produce. Studies by Boadi, Boateng, Hinson, & Opoku, (2007) (Ofosu-Asare, 2011) and Salia, Nsowah-Nuamah, & Steel, (2011), opined that, farmers profited from the use of mobile phone by receiving better market information of which farmers were able to make informed decisions, get increased income, have enhanced marketing activities enjoy reduction in transportation cost, have enhanced marketing activities.

Table 29: Perceived benefits of Mobile Phone to Smallholder farmers

Statements	Mean	S.D
Facilitate access to financial services (Mobile money transaction)	3.81	1.03
Reduce travel cost	3.76	1.08
Get better connected to market	3.71	0.99
Easy to connect to other farmers for more information about farming	3.65	1.02
Easy access to other value chain actors	3.59	0.99
Reduced transaction cost	3.40	1.01
Obtain extension advice	3.10	0.96
Get better prices of crops	2.96	1.03
Increase income	2.95	0.97
Coordinate access to agriculture input	2.91	0.94
Access to agriculture inputs information	2.79	1.05
Access to agronomic information	2.69	1.06
Increase yield of crops	2.59	0.89
Get connected to weather information	2.30	1.28
Composite mean	3.16	0.73

Source: Cudjoe, 2020, n = 182. Means were calculated with a scale of 1 = Very Low benefit, 2 = Low benefit, 3 = Moderate benefit, 4 = High benefit, 5 = Very High benefit

Research Question 3: Can male and female be compared to the extent use of mobile phone services to access agricultural information?

The results presented in Table 30 show that there is a difference in the extent to which male and female farmers use mobile phones. The P-value of 0.03 is less than 0.05, indicating that the difference in mobile phone use between male and female farmers is statistically significant.

Table 30: Independent Sample t- test between male and female farmers extent use of mobile phone services.

Sex	n	X	SD	Mean Difference	t- ratio	Sig.	Std. Error Diff
Male	152	2.84	0.69	0.67	5.05	0.03	0.13
Female	30	2.18	0.47	0.67	6.46		0.10

Source: Cudjoe, 2020 **p< 0.03** n =182

Means were calculated with a scale of 1 = Very Low, 2 = Low, 3 = Moderate, 4 = High, 5 = Very High

According to the study's findings, male farmers use mobile phones for agricultural purposes moderately, whereas female farmers use mobile phones lowly at a 5% statistical significance level. Thus, there is a significant difference in mobile phone use between male and female small-scale farmers.

Research Question 4: To what extent and level do smallholder farmers use mobile phone services for agriculture information?

Mobile phone usage is becoming increasingly important for farmers' commercial development in agriculture in developing countries. Recently, mobile phone usage has been deemed critical in boosting farmers' access to better agricultural market conditions. Farming communities value mobile phones as a simple, quick, and handy means to communicate and receive immediate solutions to their problems. Farmers, in particular, now have the ability to obtain information on marketing and weather via their cell phones. They can communicate directly with market personnel and provide their produce at reasonable prices thanks to this vital technology. In this study, the results displayed in Table 31 captures the extent and level farmers use mobile phone services for agricultural information.

As indicated, the study recorded an overall mean of (M=2.74, SD=0.70) which explains that farmers in Agona East district use of mobile phone for agricultural information is low. However, the findings vary among the item statements response. For instance, the statement "Facilitate access to financial services (Mobile money transaction)" recorded a mean of 3.81 (SD=1.03) which is approximately high. Also, the mean score for the item statement "Reduce travel cost" was 3.76 (SD=1.08) approximately within the high range. In the same, the statement "Get better connected to market" recorded mean of 3.71 (SD=0.99) on the average. Additionally, addressing research question 4, respondents were asked how mobile phones make them "Easy to connect to other farmers for more information about farming were affecting their own agricultural productivity" and the mean valued was 3.65 (SD=1.02).

Although, mobile phone is increasing among farmers but still there is gap available among farmers in terms of use for agriculture information. For example, as shown in Table 31, on results on the item statement "Access to agronomic information" recorded a mean of 2.60 (SD=1.06). Moreover, the item statement "Access to agriculture inputs information" received a mean of 2.79 (SD=1.05). These finding are similar to that of Razaque and Sallah (2013) who revealed that farmers lack access to agricultural information that would allow them to boost their output and income. According to the findings of Razaque and Sallah (2013), farmers are increasingly using mobile phones, yet there is still a disconnect when it comes to mobile phone usage and access to agricultural information. There is therefore the need to improve use of mobile phone to access agricultural information.

Table 31: Extent of Mobile Phone Use for Agriculture Information

Statements	Mean	S.D
Facilitate access to financial services (Mobile money transaction)	3.81	1.03
Reduce travel cost	3.76	1.08
Get better connected to market	3.71	0.99
Easy to connect to other farmers for more information about farming	3.65	1.02
Easy access to other value chain actors	3.59	0.99
Reduced transaction cost	3.40	1.01
Obtain extension advice	3.10	0.96
Get better prices of crops	2.96	1.03
Increase income	2.95	0.97
Coordinate access to agriculture input	2.91	0.94
Access to agriculture inputs information	2.79	1.05
Access to agronomic information	2.69	1.06
Composite mean	2.74	0.70

Source: Cudjoe, 2020, n = 182. Means were calculated with a scale of 1 = Very Low, 2 = Low, 3 = Moderate, 4 = High, 5 = Very High

Research Question 5: Predictors of mobile phone use for agricultural information.

The study sought to determine what factors influence mobile phone use among small-scale farmers in the Agon-East district. The F-statistic of 38.88, which is statistically significant at 1%, and the highest VIF of 3.99 indicate that the regression model for modelling the relationship between mobile phone

usage and farmer background characteristics was fit, and there was no issue of multicollinearity, respectively. Also, the R Square of 0.81 indicates the independent variables together explain 81% of the variance in the dependent variable (extent of use of mobile phones). According to the study's findings, five factors statistically significantly influence farmers' use of mobile phones: awareness of mobile phones, knowledge of mobile phone use, benefits of using mobile phones, farmers' educational level, and type of mobile phone used. The study found that small-scale farmers' awareness of mobile phone usage increases mobile phone usage by 15% at a statistical significance level of 5%. Similarly, increasing small-scale farmers' knowledge of mobile phone use increases their use by 15%. This is statistically significant at 5%. Furthermore, at a significance level of 1%, the study discovered that small-scale farmers' perception of the benefits of mobile phones contributes to a 46% increase in mobile phone use. Furthermore, highly formally educated farmers were found to use mobile phones 11% more frequently. The P-Value of 0.01 is less than 0.05, indicating that higher education statistically significantly increases mobile phone usage. Finally, it was revealed that farmers who own analogue phones use mobile phones 26% less than those who own smartphones. This relationship is statistically significant at 1% (Table 32).

Table 32: Predictors of mobile phone use for agricultural information.

Independent variables	The extent of use of mobile phones among small-scale farmers					
	Unstandardised beta	Standard error	Standardized Coefficient beta	t	Sig.	VIF
(Constant)	1.32	0.354		3.73	0.00	
Awareness	0.119	0.050	0.15*	2.38	0.02	3.55
Knowledge	0.123	0.056	0.15*	2.19	0.03	3.99
Benefit	0.440	0.045	0.46**	9.75	0.00	1.90
Perceived ubiquity	0.031	0.044	0.03	0.71	0.48	1.72
Perceived reachability	-0.020	0.054	-0.02	-0.37	0.71	2.50
Job relevance	0.039	0.044	0.05	0.88	0.38	2.31
Perceived ease of use	0.037	0.055	0.04	0.68	0.49	3.34
Perceived usefulness	-0.003	0.053	-0.00	-0.05	0.96	2.79
Behavioural Intention	-0.049	0.036	-0.07	-1.37	0.17	2.03
Age	-0.001	0.003	-.019	-0.30	0.76	3.26
Sex	0.074	0.076	.039	0.97	0.33	1.39
Marital Status	-0.069	0.057	-.045	-1.19	0.23	1.21
Years of farming experience	0.001	0.003	.021	0.38	0.70	2.54
What is your total farm size	0.011	0.007	0.07	1.72	0.09	1.34
Highest educational level	0.084	0.034	0.11*	2.48	0.01	1.72
Scale of farming	-0.040	0.055	-0.03	-0.73	0.47	1.26
Type of mobile phone used	-0.444	0.078	-0.26**	-5.66	0.00	1.88
Number of years of using mobile phone	-0.005	0.005	-0.04	-1.05	0.29	1.21
F statistic	38.88**					
R Squared	0.81					
Adjusted R Squared	0.79					

**P<0.01; *P<0.05 Source: Cudjoe (2020).

Farmers' use of mobile phones is regarded as critical for agricultural development and has received scholarly attention. Previously, studies have shown that farmers' use of mobile phones increases their income and farm productivity (Ogunniyi & Ojebuyi, 2016). Recent research has also linked mobile phone use to increased agricultural productivity. Quandt et al. (2020) found that Tanzanian smallholder farmers who used mobile phones for agricultural purposes increased their maize yield. According to Adenubi et al. (2021), the use of mobile phones increases agricultural productivity in Sub-Saharan Africa.

This study's findings are consistent with those of Hoang and Drysdale (2021), who found that farmers with higher formal education used mobile phones to help with livestock and poultry marketing in Vietnam. The findings also support the findings of Asravor et al. (2022), who revealed that higher formal educational levels of farmers influence the intensity of mobile phone use. This is because formal education increases farmers' access to information via information communication technologies such as mobile phones, as well as their ability to search for and process information (Abdul-Salam & Phimister, 2017). This means that highly educated farmers can easily access and communicate information useful for improving agricultural production via mobile phone.

The study's findings also show that farmers' use of mobile phones is significantly influenced by their awareness of mobile phone use. Technology awareness is essential for technology adoption. It exposes farmers to the attributes of the technology, which aids farmers' adoption decisions (Acheampong et al., 2018). Acheampong et al. (2018) observed a link between

sweet potato variety awareness and adoption. Yigezu et al. (2018) noted that farmers' awareness and exposure to zero tillage technologies influenced adoption. The findings of this study confirm a positive relationship between farmer awareness and the use of technology, particularly mobile phones. As a result, there should be increased awareness of the benefits and necessity of mobile phones among farmers to increase agricultural productivity.

The research additionally found a positive correlation between knowledge and mobile phone use among smallholder farmers. This conforms to Chuang et al. (2020) who found a positive relationship between knowledge and technology adoption, implying that the more farmers are knowledgeable about agricultural technology, the more likely they are to adopt the technology. The findings of this study, therefore, imply that the more knowledgeable smallholder farmers are about mobile phones, the more likely they are to use mobile phones. This calls for extension knowledge on mobile phone use to farmers via extension agents to improve farmers' use of mobile phones to improve agricultural productivity.

The (expected) benefits of technology have been found to positively influence technology adoption. For example, Akudugu et al. (2012) noted that the expected benefits of technologies influence technology adoption in Ghana. The study's findings support previous research by revealing that the perceived benefits of mobile phones positively influence small-scale farmers' use of mobile phones in the study area.

Research Question 6: What challenges do smallholder farmers face in owning and using mobile phone?

The incorporation of ICTs as tools have increased agriculture production and sustainability by changing traditional agricultural processes. In recent years, there has been a rapid increase in mobile phone subscriptions all over the world, making one of the fastest growing ICTs tools use globally. In the developing countries, mobile phone plays a critical role in promoting access to agriculture information. Today, farmers can text (SMS) to communicate with friends and relatives, as well as negotiate the price of their crops in order to buy and sell. Also, mobile phones have opened up a new avenue for agricultural development and provides farmers with the most up-to-date information on agricultural challenges.

Further, residents of rural areas have seen a significant reduction in the cost of information and communication thanks to mobile phones. Nevertheless, farmers especially in the rural areas frequently struggle to own and use mobile phones to access agricultural information. For example, they confront difficulties using cell phones to trade and sell their products at markets that are typically far away from their farms. Furthermore, because their location lacks mobile phone service, farmers are unable to acquire agricultural information or proper prices for their products, forcing them to sell at a loss. Farmers who seek to sell their produce on the market are affected by these challenges.

In this regard, the researcher investigates into the challenges affecting the use of Mobile Phone for Agricultural information in Agona East district in Ghana and the results are presented in Table 33. The composite means score (M=2.57, SD=0.72**)** in Table 30 shows that there are challenges affecting the

use of mobile phone for Agricultural information. The responses on the item "High cost of call tariff" recorded a mean of 3.05 (SD=0.99) which explains that respondents believed that high cost of call tariff moderately affect their use of mobile phone for agricultural information. For the item "Difficulty in texting message" the mean score was 2.88 (SD=1.22), while the statement "Unable to read messages/ language barrier" produce a mean of 2.84 (SD=1.11).

Moreover, farmers need information on pest control methods. Access to timely and relevant information in pest control will contribute significantly to agricultural developments in developing countries. However, farmers are unable to read messages due to language barrier as well as face financial constraint in buying credit card. The findings therefore conform with Reeka (2018) who established that, farmers confront a lot of hurdles when it comes to using mobile phones to check market pricing. These hurdles include, among others, system operators' delays in updating their data base or market prices, language barriers, high expenses associated with utilizing the system, technical issues such as network failures, and the system's unfriendly attitude to rural farmers.

Additionally, According to the findings of Mbagwu, Benson and Onuoha (2017), challenges to meeting rural farmers' information needs through mobile-based services include a lack of network through which mobile-based services can be provided and accessed, a lack of interest in using agricultural information among rural farmers, insufficient knowledge among rural farmers, insufficient knowledge of rural farmers' agricultural information needs, a lack of ICT literacy, and the lack of an information-providing agency in rural areas.

Burrell (2010) affirm that efficient usage of mobile phones heavily depends on the availability of electricity. As it was also orated by Beimans, Swaak, Hettinga, & Schuurman, (2005), receipt and use of mobile phones, like any further technological devices, are improved wherever facilitating conditions such as internet browsing, electricity and financial challenges in acquiring mobile phones are provided. Also, the findings of Ahmed & Laurent, (2009) that illiteracy can prevent many rural farmers from taking advantage on majority of the features on the mobile phone due to their level of illiteracy and thus not familiar with the keys on the mobile phone.

Table 33: Challenges affecting the use of Mobile Phone for Agricultural information

Statements	Mean	S.D
High cost of call tariff	3.05	0.99
Difficulty in texting message	2.88	1.22
Unable to read messages/ language barrier	2.84	1.21
Not familiar with the keys	2.78	1.11
Financial constraint in buying credit card	2.73	0.98
Poor network service	2.40	1.10
High cost of mobile phone	2.36	1.12
Electricity for charging phone	1.54	0.64
Composite mean	2.57	0.72

Source: Cudjoe, 2020, n = 182. Means were calculated with a scale of 1 = Strongly disagree, 2 = Disagree, 3 = Moderate, 4 = Agree, 5 = Strongly Agree

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Introduction

This chapter presents the summary of the key findings according to the objectives of the study. The conclusions and recommendations to improve the use of mobile phone to access agricultural information and other relevant findings are presented in this chapter. The chapter ends with suggestions for further studies.

Summary

The speedy growth and easy access of mobile phone in most rural communities and its prospect in contributing to the increase of agricultural technologies to farmers impelled the various sectors of Agriculture especially farmers to possibly use mobile phone technology for agricultural information. However, much is not identified about the use of mobile phone to access agricultural information by farmers in Agona East District of Ghana. This study evaluated the determinant use of mobile phone to access agricultural information in Agona East District of Ghana.

The core objective of the study was to determine farmer's use of mobile phone for agriculture information in Agona East District The study specifically sought to:

1. To identify farmers' the level of awareness and knowledge of mobile phone use in obtaining agriculture information in the district.
2. To identify the benefit farmers get from using mobile phone to access agricultural information in the district.

3. To compare male and female extent use of mobile phone services to access agricultural information.
4. To examine attributes of mobile phone technology that influence farmers to choose mobile phone for agriculture information.
5. Examine the predictors of mobile phone use for agricultural information.
6. To determine the challenges affecting mobile phone ownership and use by farmers in Agona East District.

The study employed a descriptive correlational survey design. A multi-stage sampling technique was used to select 182 respondents from a population of 339 registered farmers from fourteen communities in Agona East District. Percentages, means and standard deviation were used to analyze the data using SPSS version 25.

Summary of Key Findings

Socio-economic and background characteristics of farmers

The majority of farmers that participated in the study were males whiles the rest were females. Majority of farmers were found to range between the ages of 50 to 59 years respectively. They were more married farmers except few who were single. Most had farming experience of 1 to 10 years. Most of the farmers cultivate 1 to 5 acres of land. Majority of respondents in the study area have JSS/JHS as their highest certificate. Respondents in the study area do not join any farmer-based organizations. They engaged more in subsistence farming to commercial farming. Cassava was cultivated most in the study area.

All the participants in the study area use mobile phone and one sim card. Participants use only feature phone and mostly having 6 to 10 years' experience in using mobile phone. Mobile network connectivity was accessible to all

farmers. MTN and Vodafone were extremely subscribed by farmers. The main reason for the selection of a particular network thus MTN was it ability to have a wide coverage. MTN was selected to be good among the other networks.

Farmers in the study area had no email account and do not receive agriculture information via email. Majority of participants in the study do not have social media handles.

The level of awareness on mobile phone use to obtain agricultural information by farmers

In terms of awareness on use of mobile phone to obtain agriculture information in the study area prove that famers' level of awareness was approximately low. However, the responses on each of the various item varies. For example, on the response item "I am aware that mobile phone can be used to check weather information" recorded a mean of 3.35 (SD=1.33) which was within the moderate score range. In the same, on the response item "I am aware that mobile phone can be used as calculator to calculate prices of commodities at the market", recorded a mean of 3.30 (SD=1.12) which was also within the moderate score range.

The level of knowledge on mobile phone use to obtain agricultural information by farmers

The results from this objective shows that the overall mean of score was (M=2.14, SD=0.86) which gives the general picture that respondents have low knowledge on mobile phone when it comes to it usage to obtain agricultural information.

Perceived benefit of using mobile phone for agriculture information

With regards to benefits of using mobile phone, the overall mean of (M=3.16, SD=0.73) indicated that majority of the respondents agreed to the fact that they have benefited from the use of mobile phone. The farmers facilitate access to financial services (Mobile money transaction) and reduce travel cost indicate a high response range. In addition, the farmers indicated that mobile phone has benefited them in terms of easy to connect to other farmers for more information about farming. On the other hand, get connected to weather information fell within the low range.

Can male and female be compared to the extent use of mobile phone services to access agricultural information.

The results presented show that there is a difference in the extent to which male and female farmers use mobile phones. The P-value of 0.03 is less than 0.05, indicating that the difference in mobile phone use between male and female farmers is statistically significant.

The extent and level do farmers use mobile phone services for agriculture information.

As indicated, the study recorded an overall mean of (M=2.74, SD=0.70) which explains that farmers in Agona East district use of mobile phone for agricultural information is low.

The predictors of mobile phone use for agricultural information.

The study sought to determine what factors influence mobile phone use among small-scale farmers in the Agon-East district. The F-statistic of 38.88, which is statistically significant at 1%, and the highest VIF of 3.99 indicate that the regression model for modelling the relationship between mobile phone

usage and farmer background characteristics was fit, and there was no issue of multicollinearity, respectively. Also, the R Square of 0.81 indicates the independent variables together explain 81% of the variance in the dependent variable (extent of use of mobile phones). According to the study's findings, five factors statistically significantly influence farmers' use of mobile phones: awareness of mobile phones, knowledge of mobile phone use, benefits of using mobile phones, farmers' educational level, and type of mobile phone used.

Challenges in owning and using mobile phone for agricultural information

Farmers in the study area perceived high cost of call tariff as their main challenge that affect their use of mobile phone for agricultural information, followed by difficulty in texting message and unable to read messages/ language barrier.

Conclusions

1. Male farmers participated more than females in the study and farmers were adult married farmers, with varied years of farming experience, working on small farm size.
2. Farmers are aware that mobile phones can be used to check weather information, take pictures on the field and use mobile phones are calculators to calculate prices of commodities at the market.
3. Farmer’s knowledge in the use of mobile phone for agriculture information was however very low.
4. All farmers who participated in the study use mobile phone and had mobile network connectivity in their respective communities.
5. Participants in the study area benefitted in using mobile phones. Some of the benefits includes; facilitate access to financial services, reduction in

travel cost, get better connected to market and easy connection to other farmers for more information about farming.

6. Participants frequently use mobile phone for voice call rather than other applications on their mobile phone. Internet, email and social media were less used by farmers for agriculture information.
7. The extent use of mobile phone between male and female farmers is statistically significant.
8. Five factors significantly influence farmers' use of mobile phones. They were awareness of mobile phones, knowledge of mobile phone use, benefits of using mobile phones, farmers' educational level, and type of mobile phone used.
9. The challenges farmers faced in using mobile phone were high cost of call tariff, difficulty in texting message, unable to read message, not familiar with the keys and financial constraints.
10. Electricity was not a challenge in the area of study.

Recommendations

1. The study commends that the agricultural directorate in the district should roll out special arrangement for women in agriculture to encourage them to participate in the use of their mobile phone for cheap agricultural information.
2. Mobile network service providers should offer short codes to farmers to be used as a pedestal for agricultural information delivery. This will aid ease the challenge of access to recharge credit that will lead to frequent use of the mobile phone for agricultural information.

3. The district directorate of agriculture should strengthen extension officers and farmer-based organization in the district with the requisite materials and resources to train farmers on the use of mobile phone for agricultural information.
4. The farmers in the study area are literate and are able to exploit the mobile phone, particularly for voice calls, therefore agricultural messages premeditated by stakeholders in agriculture must be in the form that farmer will appreciate. One clear example is by integrating voice-based agricultural information services into the present SMS-based agricultural information services that's being provided by ESOKO and other actors.
5. The district directorate and NGOs should enroll more young individuals in the extension field. During the enrolment, more females should be recruited in other to fill the gender gap. This will aid to avoid some gender associated social issues associated with mobile phone use for agricultural information.
6. Furthermore, the district directorate of agriculture should link with mobile network service providers to put farmers into training workshop in video calling/conferencing, social media (Facebook, WhatsApp, twitter and telegram), internet, email and new mobile phone applications to improve their skills, and help advance communication channels between farmers, researchers and MOFA.

Suggestions for Further Studies

1. The effect of this study is not convincing since the scope was limited farmers who use mobile phone only. Therefore, it is advised and suggested that another research be carried out to look into other ICT tools.

2. It is also suggested that the study should be repeated in the study area after some time to explore the tendency of success of the objectives of the determinant use of mobile phone for agricultural information.
3. Similar research should be conducted in some other Districts in the Central Region to find out the degree of conformity of findings from other parts of the Region.

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APPENDICES

APPENDIX A: STRUCTURED INTERVIEW SCHEDULE

UNIVERSITY OF CAPE COAST

DETERMINANTS OF USE OF MOBILE PHONE TO ACCESS AGRICULTURAL INFORMATION IN AGONA- EAST DISTRICT

The main aim of this study is to access smallholder farmer's use of mobile phone for agricultural information in Agona- East District. It is anticipated that the results would be use by main stakeholders in the agriculture sector of the district and the country at large to plan training programmes for smallholder farmers and formulate policies to address smallholder farmer's use of mobile phone in Agona – East District. The study is being conducted in partial fulfilment for an award of MPhil. NGO Studies and Community Development at the University of Cape Coast.

The information given would be used for the purpose it is provided only. I therefore appeal to you to be sincere and honest to expressing your opinion and suggestions as much as possible. Your confidentiality is assured.

THANK YOU.

Section A: Demographic Characteristics

1. Name of interviewer: ……..

2. Date of interview: ……...

3. Name of community: …….

4. Respondent's contact number (if any): ……..

5. Age at last birthday (Years)…….

6. Sex A. Male [ ] B. Female [ ]

7. Marital status A. Married [ ] B. Single [ ]

8. How many years have you been farming? …….

9. What is your total farm size? ……..

10. Do you belong to any farming group or association? A. Yes [ ] B. No [ ]

11. Highest educational level completed (*Tick one only*)

A. None [ ] B. Primary [ ] C. JHS [ ] D. Secondary [ ] E. Tertiary [ ]

F. Other (specify). . . . . ..

12. Number of years spent in school ……

13. What is your scale of farming?

A. Subsistence farming [ ] B. Commercial farming [ ]

14. What crops do you cultivate?

Crop	***Yes***	***No***
Tomato		
Pepper		
Onion		
Carrot		
Cucumber		
Cabbage		
Cassava		
Plantain		
Yam		
Maize		
Cocoa		
Okro		

Garden Egg		
Cocoyam		
Palm		
Rice		

15. Do you use mobile phone?

A. Yes [ ] B. No [ ]

16. If yes, how many mobile phones do you have? A. One [ ] B. Two [ ]

C. more than two [ ]

17. What is your reason for using more than one phone?

.....

18. How many SIM cards do you have?.....

19. What type of mobile phone do you use?

A. Smart phone [ ] B. Feature phone [ ]

20. How many years have you been using mobile phone (*In years*)?

……

21. Do you have access to mobile network in your community? A. Yes [ ]

B. No [ ]

22. Indicate the type of mobile network you are subscribe to? (*Tick as many*)

A. MTN [ ] B. Vodafone [ ] C. Tigo / Airtel [ ] D. Glo [ ] E.

Other……

23.Why do you choose the mobile network you tick above? (*multiple response)*

A. They send agricultural message through (SMS, E-mail and Internet) [ ]

B. They have wide coverage [ ]

C. They have good reception [ ]

D. Call tariff is affordable [ ]

E. Promotion from network operators [ ]

F. Good data service [ ]

G. Other (specify) …….

24.What is the quality of the reception in your community? **Rank 1 to 5. 1= Very Bad, 2= Bad, 3= Average, 4= Good, 5= Very Good**

Network	**1= Very Bad**	**2 = Bad**	**3 = Average**	**4 = Good**	**5 = Very Good**
MTN					
VODAFONE					
AIRTEL/TIGO					
GLO					

25. Do you have an E-mail account? A. Yes [ ] B. No [ ]

26. If yes, do you receive agriculture information on your E-mail?

A. Yes [ ] B. No [ ]

27. If your answer to question 26 is Yes, what type of agriculture information do you receive on your E-mail?. (*Tick as many*)

A. Market information [ ] B. Weather information [ ]

C. New variety of Crops [ ] D. Recommended fertilizer application [ ]

E. Disease Management on crops [ ] F. Pest Management [ ]

G. Workshop/Training [ ] H. Extension Advice [ ]

28. Do you have a social media account? Yes [ ] B. No [ ]

29. if Yes, what social media account are you subscribe to on your phone? (*Tick as many*)

A. Facebook [ ] B. What's up [ ] C. Twitter [ ] D. YouTube [ ] E. Instagram [ ] F. Tango [ ] G. LinkedIn [ ]

30. Which of these social media handles to you access agriculture information from your phone? (*Tick as many*)

A. Facebook [ ] B. What's up [ ] C. Twitter [ ] D. YouTube [ ] E. Instagram [ ] F. Tango [ ] G. LinkedIn [ ] H. None[ ]

Objective one: To identify the level of awareness and knowledge of mobile phone use in obtaining agriculture information in the district.

Indicate in one of the boxes a tick (√) to show the extent to which you agree to the statements below using the following guide. **1= Strongly Disagree (SD), 2= Disagree(D), 3= Moderate (M), 4= Agree(A) and 5= Strongly Agree (SA).**

Awareness of the use of mobile phone to obtain agriculture information

S/N	**STATEMEMT**	**SD**	**D**	**M**	**A**	**SA**
a.	I am aware that mobile phone can be used to check market prices.					
b	I am aware that mobile phone can be used to check weather information					
c	I am aware that mobile phone can be used to check the price of agriculture inputs					
d	I am aware that mobile phone can be used to check where agriculture inputs are (Availability)					

e	I am aware that mobile phone can be used to access extension services					
f	I am aware that mobile phone can be used to take photos on the field					
g	I am aware that mobile phone can be used to take and record videos (disease, pest and experiment on the field)					
h	I am aware mobile phone can be used to upload and sell commodity online					
i	I am aware that mobile phone can be used as calculator to calculate price of commodities at the market					

Knowledge of the use of mobile phone to obtain agriculture information

Indicate in one of the boxes a tick (√) to show the extent to which you agree to the statements below using the following guide. **1= Strongly Disagree (SD), 2= Disagree(D), 3= Moderate (M), 4= Agree(A) and 5= Strongly Agree (SA).**

S/N	**STATEMEMT**	**SD**	**D**	**M**	**A**	**SA**
a.	I know how to use mobile phone to check market prices.					
b	I know how to use mobile phone to check weather information					
c	I know how to use mobile phone to check the price of agriculture inputs					

d	I know how to use mobile phone to check where agriculture inputs are (Availability)					
e	I know how to use mobile phone to access extension services					
f	I know to use mobile phone to take photos on the field					
g	I know how to use mobile phone to take and record videos (disease, pest and experiment on the field)					
h	I know how to use mobile phone to upload and sell commodity online					
i	I know to use mobile phone as calculator to calculate price of commodities at the market					

Objective Two: To identify the benefit farmers get from using mobile phone to access agriculture information in the district.

Indicate in one of the boxes a tick (√) to show the extent to which you agree to the statements below using the following guide. **1= Very Low Benefit (VLB), 2= Low Benefit (LB), 3= Moderate Benefit (MB), 4= High Benefit (HB), 5= Very High Benefit (VHB)**

33. What are the perceived benefit smallholder farmers derive from using mobile phone?

S/N	**STATEMEMT**	**VLB**	**LB**	**MB**	**HB**	**VHB**
a.	Get better connected to markets					
b.	Get connected to weather information					

c.	Get better prices of crops					
d.	Increase yield of crops					
e.	Reduced transaction cost					
f.	Facilitate access financial services. Eg mobile money transactions					
g.	Easy to connect to other farmers for more information about farming.					
h.	Easy access to other value chain actors					
i.	Reduced travel cost					
j	Increased income					
k	Coordinate access to agriculture input					
l	Obtain extension advice					
m	Access to agriculture inputs information					
n	Access to agronomic information					

Objective three: To examine the extent and level of use of mobile phone services for agriculture information.

Indicate in one of the boxes a tick (√) to show the extent to which you agree to the statements below using the following guide. **1= Very Low (VL), 2= Low (L), 3= Moderate (M), 4= High, 5= Very High (VH)**

34. What is your level of mobile phone use for agriculture information

S/N	STATEMEMT	VL	L	M	H	VH

a.	Text / SMS					
b.	Voice calling					
c.	Sending money					
d.	Access internet					
e.	Buying internet data					
f.	Extension advice					
g.	Agriculture inputs					
h.	Marketing of commodity					
i.	Receiving money					
j.	Buying credit					
k	Payment of utilities (light, water, DSTV bills)					
l	Upload and sell commodities online					

Objective four: To examine the predictors between background characteristics of farmers, attributes of the innovation and extent use of mobile phone services for agriculture information.

Indicate in one of the boxes a tick (√) to show the extent to which you agree to the statements below using the following guide. **1= Very Low (VL), 2= Low(L), 3= Moderate (M), 4= High(H) and 5= Very High (VH).**

35. What influence you to use mobile phone for agriculture information?

Perceived Ubiquity						
S/N	**STATEMEMT**	**VL**	**L**	**M**	**H**	**VH**

a.	As a farmer, mobile phone provides communication and information accessibility anytime and anywhere.					
b.	As a farmer, mobile phone provides me network accessibility anywhere, anytime.					
c.	As a farmer, I frequently use mobile phone for farming purposes?					
Perceived Reachability						
a.	I feel more connected to people around me because of my use of mobile phone as a farmer.					
b.	People around me think that I should have mobile phone so that they can communicate to me anytime, anywhere.					
c.	People frequently contact/call me on my job because of the use of mobile phone.					
d.	I receive a lot of incoming contacts/calls from other people					
Job Relevance						
a.	As a farmer, my use of mobile phone in farming activity is very high.					
b.	As a farmer, usage of mobile phone is relevant to my farming activities.					
	Perceived Ease of Use					

a.	I find it easy to get mobile phone to do what I want it to do as a farmer.					
b.	I find mobile phone easy to use as a farmer					
c	My interaction with mobile phone is understandable as a farmer.					
d.	Learning to operate mobile phone is easy for me as a farmer					
e	As a farmer, I find mobile phone as flexible to interact with					
Perceived Usefulness						
a.	Using mobile phone as a farmer enables me to accomplish tasks more quickly.					
b.	Using mobile phone as a farmer helps increase my productivity.					
c.	As a farmer, I find mobile phone useful in my farming activities.					
d.	Using mobile phone has improved my farm performance.					
Behavioral Intention						
a.	Assuming I have access to mobile phone, I intend to use it for my farming activities.					
b.	Given that I had access to mobile phone, I predict that I will use it for farming activities.					

Objective five: To determine the challenges affecting mobile phone ownership and use by farmers in the district.

Indicate in one of the boxes a tick (√) to show the extent to which you agree to the statements below using the following guide.

1= Strongly Disagree (SD), 2= Disagree(D), 3= Moderate (M), 4= Agree(A) and 5= Strongly Agree (SA).

36. What challenges affect you in the course of using mobile phone?

S/N	STATEMEMT	SD	D	M	A	SA
a	Poor network service					
b	Not familiar with the keys					
c	Difficulty in texting message					
d	Unable to read message/ language barrier					
e	Financial constraint in buying credit card					
f	High cost of call Tariff					
g	Electricity for charging phones					
h	High cost of mobile phone					

APPENDIX b: TABLE FOR DETERMINING SAMPLE SIZE FROM A GIVEN POPULATION

N	*S*	*N*	*S*	*N*	*S*
10	10	220	140	1200	291
15	14	230	144	1300	297
20	19	240	148	1400	302
25	24	250	152	1500	306
30	28	260	155	1600	310
35	32	270	159	1700	313
40	36	280	162	1800	317
45	40	290	165	1900	320
50	44	300	169	2000	322
55	48	320	175	2200	327
60	52	340	181	2400	331
65	56	360	186	2600	335
70	59	380	191	2800	338
75	63	400	196	3000	341
80	66	420	201	3500	346
85	70	440	205	4000	351
90	73	460	210	4500	354
95	76	480	214	5000	357
100	80	500	217	6000	361
110	86	550	226	7000	364
120	92	600	234	8000	367
130	97	650	242	9000	368
140	103	700	248	10000	370
150	108	750	254	15000	375
160	113	800	260	20000	377
170	118	850	265	30000	379
180	123	900	269	40000	380
190	127	950	274	50000	381
200	132	1000	278	75000	382
210	136	1100	285	1000000	384

Note.—*N* is population size. *S* is sample size.

Source: Krejcie & Morgan, 1970