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The Role and Effectiveness of Mobile Phone Technology in Agricultural Extension Services Delivery in the Northern Region, Ghana

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The Role and Effectiveness of Mobile Phone Technology in Agricultural Extension Services Delivery in the Northern Region, Ghana

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ABSTRACT

The use of ICTs has now become the springboard for agricultural development in many countries, meanwhile Ghana's agricultural sector has not been able to fully utilize this potential. Current ratio of agricultural extension agents (AEAs) to small scale farmers stands at an average of 1:3000 (Peasant Farmers Association of Ghana and SEND-Ghana, 2016). This make extension services delivery very critical. However, MoFA in their current effort to help mitigate the problem, established the E-extension unit under the extension directorate to use innovative ICT based approaches which provide advice to farmers on-line, and the promotion of mobile phones and community radio stations. An interview was conducted to seek the views of farmers in the Tolon, Kumbungu and Sagnarigu districts of the northern region, on the effectiveness of mobile-phone technology use in agricultural extension services delivery. The data was analyzed using descriptive statistics, SERVQUAL analytical tool, correlations, regression, and chi square. The research measured the effectiveness of three extension delivery approaches, namely mobile-phone technology, participatory video and direct contacts with extension agents. The research outcome shows that farmers were not satisfied with extension provision in all the extension approaches measured. However mobile phone extension is the most effective in addressing extension quality gaps followed by participatory video, then direct contacts with agriculture extension agents. The number of people who use mobile-phone technology to access agricultural extension information among the farmers in the area was small representing 35.8% of respondents. 50.9% of the sample population received agricultural extension information through direct contact with agricultural extension agents. Only 13.3% of farmers received agricultural extension information through participatory video. Icek Ajzen's Theory of Planned Behavior was used to assess the intentions of farmers to use of mobile-phone technology. The outcome revealed that three predictor variables (Subjective Norms, Attitude toward the act, and control factors) were statistically significant at varying degrees in predicting farmers' intent to use mobile-phone technology for accessing agricultural extension information. Of the three, attitude was found to be the strongest predictor of Intention to use mobile-phone technology, meaning farmers are willing to use mobile phone for accessing agricultural extension information. Subjective norm was significant in predicting farmers' intention to use mobile-phone, meaning opinion leaders, agricultural extension agents, NGOs and religious leaders have strong influence on farmers' choice of mobile-phone technology for accessing

agricultural extension information. Perceived behavioural control factors showed negative influence towards mobile-phone technology because farmers revealed reasons that will stop them or decrease their intention towards the use of mobile-phone extension provision. The reasons are: If farmers find it difficult to interpret and understand extension messages; if farmers do not receive extension messages on time; and if extension messages are not about farmers' cultivating crops, they will not use mobile phone extension provision. The study also revealed that readiness to use mobile-phone technology was dependent on gender, age and educational level of farmers. Male farmers have strong intention towards the use of mobile phone extension provision than female farmers. Young and the adult farmers have strong intentions towards mobile-phone extension provision than the aged. Also educated farmers have greater intention towards mobile phone than farmers with no education. From the findings of the research, mobile phone has enormous potential for addressing agricultural extension provision gaps. Since mobile phone can be used to access store and disseminate knowledge and information to farmers without barriers such as distance and time, there is the need for MoFA and relevant agricultural extension stakeholders to harness these advantages to the benefit of farmers. With farmers expressing strong intention to use mobile phone for receiving agricultural extension information, government and development partners should use extension agents and community opinion leaders to lead an advocacy to smart phone use by farmers because of its enhanced features such as video and voice recording, train farmers on how to use smart phones and encourage them to patronize mobile phone extension services. DAES E-extension Unit should be focused on creating voice extension messages that carries agricultural knowledge and information in local dialects, and advice every extension agent to create a social group over mobile-phone for farmers under their operational areas/zones. Extension agents should use this social group platform to disseminate knowledge and information to their farmers. The unemployed graduate youth who will be recruited as extension agents by government under the planting for food and Jobs programme should be trained by MoFA and provided with mobile phones or tablet computers loaded with extension information. These extension agents must be allowed to operate on door-to-door basis providing extension services such as advisory support on general farm knowledge and practice using video demonstrations recorded on tablets, providing market-specific information on cost of agricultural commodities and transport services, and providing information on weekly weather forecast

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LIST OF ACRONYMS

AEAs	Agricultural Extension Agents
CEAs	Community Extensions Agents
DAES	Department of Agriculture Extension Services
DIRTS	Disseminating Innovative Resources and Technologies to Smallholders
FBOs	Farmer Based Organizations
FASDEP	Food and Agriculture Sector Development Policy
GAEA	General Agricultural Extension Approach
GDP	Gross Domestic Product
ICT	Information and Communication Technology
IPA	Innovation for Poverty Action
ISSER	Institute of Statistical, Social and Economic Research
KACE	Kenyan Agriculture Commodity Exchange
METASIP	Medium-Term Agriculture Sector Investment Plan
MDG	Millennium Development Goal
MoFA	Ministry of Food and Agriculture
NCA	National Communication Authority
NGOs	Non-governmental organizations
PBC	Perceived Behavioural Control
SERVQUAL	Service Quality
SPSS	Statistical Package for Social Sciences
SDGs	Sustainable Development Goals
T&V	Training and Visit
TPB	Theory of Planned Behavior
UNDP	United Nations Development Project
WSIS	World Summit on the Information Society
YEA	Youth Employment Agency

CHAPTER ONE

INTRODUCTION

1.1 Background

Agriculture is the backbone of the Ghanaian economy and underpins its socio-economic development. Consequently, it is a sector with great potential for influencing growth and employment and eradicating poverty. In 2015, the sector contributed 20.2% to the Gross Domestic Product (GDP) of the country and employed 56% of the population [Institute of Statistical, Social and Economic Research (ISSER), 2016]. The agricultural sector's contribution to the country's economy is as a result of multiple factors which include the vast abundance of fertile lands, abundant farming population, generally conducive and predictable climatic conditions, relatively favourable market conditions and some government support to the sector.

However, the above-mentioned contributions of agriculture are being threatened in so many ways. The available fertile lands are being subjected to degradation due to over cultivation, bad farming practices and limited fertility replenishment. The fertile land is diminishing due to take-overs by ongoing commercial and residential developments. The weather pattern is changing with the occurrence of extreme climate events such as floods and drought. The weather is increasingly becoming difficult to predict thus affecting farmers' ability to plan their farming operations. In addition, water scarcity has become a major issue due to the shortening of the rainy season due to weather changes. (Moore et al., 2015). All these changes have culminated in low farm yields and addressing these challenges require some national level interventions.

Based on the foregoing, the government of Ghana, as part of its investments in the sector, has funded the agricultural training institutions, provided accessible roads for easy transportation of agricultural commodities, instituted input subsidies, offered credit facilities for farmers and rallied development partners to deliver effective development aid to the sector. MOFA, the lead agency responsible for the development of policies and programmes for the agricultural sector facilitated the preparation of the Food and Agriculture Sector Development Policy (FASDEP II) and the Medium-Term Agriculture Sector Investment Plan (METASIP), 2011-2015 as the overarching sector policy and investment frameworks. These frameworks provide the long-term objectives of

government in relation to the development of the agriculture sector and are also aimed at ensuring that the sector's stakeholders are best positioned to take advantage of the emerging opportunities to improve food security, livelihoods and employment. The METASIP (2011–2015) which indicated government's planned investments to remove the numerous constraints affecting the agricultural sector and thereby attain agricultural development as spelt out in the FASDEP II had as its targets, an agricultural GDP growth of at least 6% annually, halving poverty by 2015 in consonance with MDG 1 (MOFA, 2010). This was to be based on government expenditure allocation of at least 10% of the total budget to the agricultural sector.

It is important to critically highlight the fact that both FASDEP II and METASIP policy documents acknowledge the fundamental need to promote the growth and development of the agricultural sector through the provision of cost efficient and effective extension service via a decentralized system, through partnership between the government and the private sector. This is because extension provides technical guidance and direction for farmers and other actors along the agricultural value chain to achieve higher productivity, higher outputs at relatively lower costs, higher quality products to ensure household and national food security as well as higher incomes for the farmers and other value chain actors. Agricultural extension ensures the transfer of improved agricultural technologies and information at the farm levels (Hasan et al., 2013). The development and dissemination of the right information at the appropriate time among farmers is therefore key to providing change in agriculture (Asiedu-Darko, 2013).

However, over-reliance on old approaches to agricultural extension and the neglect of the use of farmers' tacit knowledge, researchers' and extension workers' explicit knowledge in agricultural extension practice has long been identified as an impediment to increased agricultural productivity (Yadav et al., 2015). In addition, not much wide use has been made of available modern communication technologies to facilitate extension services delivery to the vast numbers of smallholder farmers spread throughout the country. This is although the role of ICTs to provide needed data and information to stimulate agriculture, enhance food security and support rural livelihoods is increasingly recognized and was officially endorsed at the World Summit on the Information Society [WSIS] 2003-2005 (InforBridge, 2017). In this sense, the rapid growth of information and communication technologies (ICT) in African countries offers unique opportunities to transfer knowledge and information by means of private and public information electronic

systems. Information and communication technology (ICT) has therefore generated a lot of hope to disseminate updated agricultural information to the farming community, overcoming the barriers of distance, socio-economic status, and gender differences just to mention a few (Palaiah et al., 2016).The strategic application of ICT to the agricultural industry, the largest economic sector in most African countries, thus offers the best opportunity for economic growth and poverty alleviation on the continent (Zyl et al., 2012).

There are increasing examples of the use of ICT in agricultural extension on the African continent. The countries with the highest use of ICTs in agriculture in Africa are Kenya, Mozambique, Uganda and Ghana (UNDP Ethiopia, 2012). The Kenyan Agriculture Commodity Exchange (KACE) for instance, uses ICT to collect, update, analyse and provide reliable and timely marketing information and intelligence on a wide range of crop and livestock commodities, targeting actors in commodity value chains, with attention to smallholder farmers and small-scale agribusinesses (UNDP Ethiopia, 2012). The provision of the marketing information and intelligence is done through Internet, National Radio, and Rural FM Radios and mobile phones. The mobile phones deliver SMS (UNDP, Ethiopia 2012). Through an IT system using mobile phones, agricultural insurance products were also provided to smallholder farmers. The Mozambique Agricultural Marketing Service collects and disseminates nation-wide and provincial data on market prices, product processing and availability through a variety of media including email, internet, national and rural radios, television and newspapers and text messages. The text messages are delivered through mobile phones (UNDP Ethiopia, 2012). In Uganda, in the 'Rubaya' sub-county in Kabale district, village information centres were established and farmers given mobile phones to communicate with extension officers to receive information from the village information centres. The usage of mobile phone was found to benefit farmers in areas such as productivity, market access, natural resource management and knowledge base (Masuki and Tukahiwa, 2013). In Ethiopia, the Improving Productivity and Market Success (IPMS) project developed various ICT and non-ICT tools and established the Ethiopian agriculture portal-www.eap.gov.et, (Mekennon et al., 2012). In Ghana, Esoko, a local company, implemented the Cocoa Link Programme, a pilot programme that provides cocoa farmers with useful information about improving farming practices, farm safety, crop disease prevention, postharvest production, and crop marketing. In this program farmers receive information and specific answers to questions at no charge through voice and SMS messages in their local language or English (Sakyi-Dawson and Nudanu, 2013).

The adoption of mobile phones especially by the rural farming populations is delivering good benefits regarding the weather, market and other related issues (Aker and Mbiti, 2010). Among the many benefits engendered by the use of mobile phones is the opportunity provided to the farmers to communicate and develop commercial relationships with market players such as traders and aggregators and also with customers which enables them to sell their produce at good prices. This is because the direct connection with buyers helps them to eliminate middlemen who often cream off a large percentage of profits by buying produce at lower prices form the farmers. Other related benefits from the use of ICTs include opportunities to enhance interactions among groups of farmers when they meet to discuss and choose appropriate variety of seeds, fertilizers, pesticides and a range of other agricultural inputs and how they must apply the appropriate technical packages. Considering the above, it can be stated that the use of mobile phones leads to savings in time and efforts of farmers to access improved agricultural technologies, better marketing of produce and improved incomes for farmers.

It is very important to note that other complementary ICT media such as radio, and television (Zakar & Zakar, 2009) have been used in the provision of agricultural extension broadening the appeal of ICT to enhance social and business interactions.

Despite the many benefits that have been observed to attend the use of mobile phones, there are several challenges in the nature of policy, operational and technical and social issues that confront the widespread adoption and use of mobile phones in agricultural extension. On the policy level, in addition to the fact that in some instances, there are no explicit statements regarding government's recognition and acceptance, often there are no substantial investments to promote this technology in extension delivery. Technically and operationally, there are issues with quality, cost of service provision by the private telecommunications businesses/networks and how they will facilitate the delivery of suitable agricultural data and information using appropriate IT media (SMS, voice and video) to meet the needs of different target groups of farmers. Socially, most developing countries have low literacy levels; an important factor that affects the knowledge and skills levels required to use modern technology. In economic terms, the relatively high cost of mobile phones, their high maintenance and recharging costs are all challenges identified as affecting the adoption and use of mobile phones in agricultural extension.

Following the growing trend in the use of ICT in agriculture globally, the Ministry of Food and Agriculture (MoFA) in Ghana has commenced the implementation of an E-Agriculture program whiles several agricultural value chain projects are also mainstreaming the use of mobile phone technology in agricultural extension. The current state of these interventions is that the E-Agriculture intervention is yet to fully take off and the adoption of mobile phone technology have been largely pilots in limited geographical areas of the country. Considering the potential developmental benefits that accrue from the adoption and use of this technology in agriculture and the several challenges that many countries have experienced, there is a major need for evidence to understand the dynamics of the use this technology in Ghana.

The current research will therefore be of great use to policy makers, development partners, service providers and smallholder farmers in the rural communities who are deploying and using mobile technology since it will reveal gaps and shortcomings that exist in mobile phone use in agricultural extension delivery. Especially for extension service providers, the evidence gathered will assist them to design interventions to address the gaps in order to make extension service delivery effective to the full benefit of rural smallholder farmers.

1.2 Problem Statement

The country's population growth rate is fast increasing and so there is the urgent need to find sustainable ways of developing the agriculture sector to produce commodities to satisfy the increasing demands of the population. One way of doing so is to improve extension service delivery to enhance the transfer of knowledge and information to farmers and other actors along the value chain to raise productivity and incomes from agriculture.

It is noted that traditional forms of extension have had challenges such as low AEA to farmer ratio, inadequate funding to demonstrate new technological packages to deal with changing environmental conditions, and inability to incorporate business and value chain approaches to connect farmers to evolving market conditions. This situation has largely arisen due to fiscal challenges facing government.

The ineffectiveness and inefficiencies of the traditional forms of extension services have led several countries including Ghana to adopt ICT to improve extension delivery to

enhance agricultural productivity and income generation for smallholder farmers to reduce the incidence of poverty. This development has become imperative to ensure that agriculture contributes effectively to socio- economic development.

Globally, ICTs are known to critically facilitate rapid, efficient, and cost-effective management and transmission of knowledge (UNDP, 2012). ICT tools such as mobile phones, tablets and computers can capture, store and ensure dissemination of knowledge and information to larger populations of farmers in real time when it is needed. Due to these advantages, the telecommunications networks together with development organisations have been deploying various ICTs in agricultural extension service delivery across the country. This laudable effort has been on-going for several years now. A progressive development taking place in the telecommunication space is the investments being made by smallholder famers to purchase mobile phones in order to benefit both from services offered by the telecoms and the agricultural extension services providers. With the passage of time, efficiency and impact issues are being raised concerning the delivery of these ICT based agriculture extension services. For instance, Sekye-Dawson and Nudanu (2013) enquire as to whether Ghana has been able to fully utililise its ICT potentials in agricultural extension delivery. It is based on such concerns that this research has been conducted to examine these issues in detail.

1.4 General Research Objective

The goal of this research was to assess the effectiveness of mobile phone technology on agricultural extension services delivery in Northern Ghana with a view to make recommendations that will inform policy.

1.3 Specific Research Objectives

The following objectives were stated to guide the research.

1. To assess farmers' attitude and behaviour towards the use of mobile phone technology in agricultural extension.
2. To examine the influence of demographic variables (gender, age, education) on farmers' intention to use mobile phone in accessing extension information.
3. To identify the other modes of knowledge transfer among the actors in agricultural extension services delivery.

4. To assess the effectiveness of mobile phone technology on agricultural extension services delivery.

5. What policy measures can be taken to improve the adoption, delivery and impact of mobile phone technologies in agricultural extension services delivery?

1.4 Significance of the Study

The use of ICT tools such as the mobile phones in agriculture generally continues to have great transformative impact in several countries. The social and economic changes that have occurred from using these technologies have brought about attitudinal changes in the farming population especially in the youth. For instance, the youth are able to rapidly search and discover other modern technologies that they can use in their farming operations and this development is engendering their interest in agriculture. Hitherto, the search for such information took a lot of time, effort and therefore was expensive. Considering these potential benefits, it is critical to examine the extent of use of mobile phone technology in agricultural extension, the factors that influence the perceptions of people on the use of such technologies and the current gaps in the provision of such ICT services by MoFA and the service providers in Ghana. Unearthing such evidence will go a long way to improve the delivery of agricultural extension using ICT.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter presents a literature review of the various concepts contained in the conceptual framework used in the methodology in chapter three. These concepts explain the issues affect the uptake and use of mobile phone and its effectiveness for extension work in Ghana. This chapter also reviews literature on the various types of extension delivery approaches used in Ghana.

2.2 Agricultural Extension and the Development of the Agricultural Sector

Agricultural extension is generally defined as the delivery of information to farmers (Aker, 2011). Numerous research works have identified agricultural extension as a potential propeller of agricultural growth and economic development in developing countries (ibid). In Ghana, agricultural extension provision is dominated by the public sector with few of the services provided by private agencies (MoFA, 2012).

Although over 90% of the country food production comes from smallholder farmers, this category of farmers is found to lack the appropriate skills and knowledge required to increase farm productivity. One of the underlying causes of farmers' lack of skills and knowledge is that, the extension approaches used by the public sector agricultural extension officers are ineffective, thus failed to meet farmers' needs (Kwadzo, 2014).

Governments and international organizations have attempted to overcome some of the perceived failures related to agriculture via agricultural extension services in Ghana. ICT was later recognized by the government of Ghana as the appropriate means of ending the extension services provision problems (MoFA, 2014). The evidence of government recognition and effort was the establishment of the E-extension unit of MoFA with the purpose of providing extension services using ICTs such as mobile phone and radio.

2.3 Different Agricultural Extension Approaches in Ghana

Extension approaches are the means through which agricultural information reaches farmers. Bolinger et al. (1994) explained that an agricultural extension approach consists of a series of procedures for planning, organizing and managing the extension institution

as well as implementing practical extension work by staff with technical and methodical qualification. Agricultural extension services play a pivotal role in ensuring that the farmers have access to improved and proven technologies and that their concerns and needs are properly addressed by relevant service providers (DAES, 2012). Different agricultural extension approaches have been implemented in Ghana since colonial era till date. Some of the approaches that were implemented included the unified extension system [modified Training and Visits (T&V)]; pluralistic extension with NGOs and private companies as part of the national extension system; decentralized extension approach with the use of farmer field schools and E-extension approach. Out of these, the three main approaches employed by the public sector (MOFA), include the general agricultural extension approach, Training and Visit (T&V) System, and the decentralized extension system (Kwadzo 2014).

The general public agricultural extension approach is the traditional extension system practiced by central government and which employs agricultural extension agents who are deployed to communities to introduce agricultural innovations to local farmers. The modified T&V system known as the unified extension system was the extension approach that replaced the General Agricultural Extension Approach. The T&V System was adopted in Ghana in 1992 and was designed to address some weaknesses associated with the general agricultural extension Approach (Amezah and Hesse, 2004). The T&V System assumes that extension workers were not properly trained and, because of this there was a lack of extension staff supervision and regular visitation of farmers. The T&V System prescribed a fixed number of visits to farmers, regular supervision, and in-service training of extension field staff. The T&V System was also found to be characterized by a top-down approach (ibid). The decentralized extension system was adopted and implemented in 1997 to address the problems associated with the previous extension approaches (Kwadzo, 2014). The decentralized extension system assumes that farmers' challenges could be understood and solved better at a local level. With the decentralized extension system, the power and decision to plan and implement extension programs have been transferred from the national and regional levels to the district level. The main objectives of this approach are to promote responsibilities, participation, and program ownership at the district level. However, the decentralized extension system does not place emphasis on decision making by key stakeholders, the farmers (Kwadzo, 2014).

The E-extension system recently implemented by MoFA and private extension organisations is the most current extension approach. With the E-extension approach, extension service providers use ICT tools such as mobile phones, computers, radios, projectors and LCD/LED screens as their platform for disseminating information to farmers. These innovative ICT based approaches provide advice to farmers on-line, and promote the use of mobile phones and community radio stations. Several private organisations have adopted the application of ICTs in extension provision. Esoko, a technology-based organization provides agricultural production and marketing information to farmers and traders (David-West, 2010). In 2013, Innovation for poverty action (IPA) launched the Disseminating Innovative Resources and Technologies to Smallholders (DIRTS) project in Northern Region through which Community Extensions Agents (CEAs) are trained on how to receive and understand messages on agricultural production using mobile phones (Karlan et al., 2014).

2.4 Participatory Video Access and use in Extension Delivery

Participatory video is just one among the ICT tools that are used for disseminating agricultural Information. Participatory video is an audio-visual tool and its use started in the late 1960s by Donald Snowden who was the then Head of the Extension Department at Memorial University of Newfoundland (Fancy, 2015). Participatory video first began in Fogo Island, where poverty was at its peak, with not much communication between the communities that occupied the Island. Snowden and other scientists decided that for the Islanders at Fogo Island to survive, there is the need to form co-operatives that will be used to bring people together so that they can share their problems and protect their cultures. Snowden and his colleagues through the consultation of the communities, therefore, introduced the use of film so that people can tell their stories and also share their problems with others. This approach was also to enable people to jointly develop solutions to the shared problems. Since then the use of participatory video expanded to various regions and now it has been applied in various projects around the globe (Fancy, 2015). Participatory videos cannot do all the job of extension. They cannot offer personal advice and support, or answer questions immediately. Participatory video serves better when used for spreading awareness of new ideas and creating interest in farming innovations. It has the advantage of multiplying the impact of extension activities, making people to share their experiences with other individuals and communities, reinforcing or repeating information and advice.

Extension agents can contribute to the successful participatory video approach by providing materials such as photographs, recorded interviews with farmers, items of information about extension activities or ideas for new extension films to media producers. In the Northern Region of Ghana, IPA used participatory video approach to educate farmers about general farm management practices and compost preparation. Participatory video uses both visual and verbal communication methods and it is regarded as the appropriate extension tool for less developed countries (Fancy, 2015). In Ghana, participatory video was used as a tool to empower innovative farmers to share their innovations with other farmers. Zossou et al., (2009) posits that participatory video is a form of farmer to farmer diffusion since it is the presentation of technical messages from a farmer to another farmer to encourage innovation and trust.

2.5 Use of Direct Contact Approach in Extension Delivery

Direct contacts with extension agents' approach refers to the face-to-face interaction between the farmer and extension agent. The direct contacts with extension officers approach is provided through the traditional training and visit (T&V) method. The T&V System is the extension approach that replaced the General Agricultural Extension Approach. The T&V System was first adopted in Ghana in 1978 and was designed to address some weaknesses associated with the General Agricultural Extension Approach (Ntifo-Siaw and Agunga, 1994 Amezah and Hesse, 2004). This approach was changed through the modified training and visit system and is referred to as the Unified Extension System (UES). With this approach, all technical subjects in extension were coordinated by the most senior technical officer who reported to regional and national directors for extension (Amezah and Hesse, 2002) and was characterized by allocating a whole geographical area to one extension officer. The extension officer provides extension services by making personal visits to farmers. Due to the large extension worker-to-farmer ratio, an extension worker often meets farmers in groups to deliver extension information. The approach was characterized by problems such as unmatched ratio of field staff to farmers; low levels of training, poor reward systems; gender and transfers (ibid).

2.6 Mobile Phone Technology Access and Use in Extension Delivery

A mobile phone is a portable telephone that can make and receive calls with the user moving within a telephone service area. The radio frequency link establishes a connection

to the switching systems of a mobile phone operator, which provides access to the Public Switched Telephone Network (PSTN), (Heeks and Richard, 2008). Most modern mobile telephone services use cellular network architecture. Mobile phones support a variety of other services such as text messaging, MMS, email, internet access, short-range wireless communications (infrared, Bluetooth), business applications, gaming, and digital photography. Mobile phones which offer these and more general computing capabilities are referred to as smartphones. In Ghana, the National Communication Authority's (NCA) report on industry information-telecommunication indicated that, at the end of May 2016, the total number of mobile voice subscribers had increased from 36,395,116 at the end of April 2016 to 36,534,611 as at the end of May, 2016.

According to Masuki et al. (2010), Africa achieved an impressive growth rate of 46.2 percent in mobile subscription between 2001 and 2005. A study by Masuki et al. (2010) revealed that Africans are willing to pay a higher proportion of their income for access to telephone than in developed countries. For over two decades now, mobile telephony has become the predominant mode of communication in Ghana.

Mobile phone technology has diffused rapidly in the rural areas of the developing countries in recent years. It has an advantage over other ICT tools in terms of its appropriateness for the under-developed local conditions (Fu and Akter, 2012). Unlike mobile phones, other ICT tools suffer from the problem of accessibility and high cost to the poor in geographically disadvantaged areas because of lack of enabling environments such as infrastructure and capital. Electricity and network infrastructure are the major problems facing mobile phone use in the rural areas. This makes it difficult for internet enhanced technologies to be used in those areas. However, mobile phone technology has much less requirement for infrastructure and hence its wider use. The information and communication capabilities of the mobile phone can be more valuable to rural populations who are dispersed and isolated from knowledge centres (Sakyi-Dawson and Nudanu, 2013).

Aker (2008) studied the impact of the mobile phone rollout on grain markets in Niger and found out that mobile phone service has reduced grain price dispersion across markets by a minimum of 6.4 percent and reduced intra-annual price variation by 10 percent (Fu and Akter, 2012). Mobile phones, beyond basic connectivity, offer benefits such as mobility and security to users. The Economist (2008) reported that mobile phones

are conduits for accelerated development, particularly in developing and marginalized communities. It added that mobile phones work by overcoming physical infrastructure constraints such as lack of roads, telephone lines, and that mobile phone sub-stations can be powered by generators in places with no electricity. Mobile phones only require basic literacy and are accessible to a large proportion of the population. Also, mobile phones allow for the flow of data to be used in other sectors such as health, education, commerce or governance. Last but not least, with the pre-paid method, the use of mobile phones has become increasingly affordable to the poor and can therefore be used as a means to ensure greater participation of the poor and marginalized in the development process (Sakyi-Dawson and Nudanu, 2013).

Development workers have been able to respond productively to the opportunities presented by mobile phone technology, including those that can improve agricultural productivity and food security. In most developing countries now, mobile phones, projectors, television, and radios are the most common ICT tools used for extension services delivery. Uganda for instance has a rapidly growing ICT market with several internet service providers (ISP), privately owned radio and television stations, several ICT training institutions and many donor-funded ICT initiatives (Masuki and Tukahirwa, 2010). In Ghana, MoFA, Isoko, IPA and other extension development organisations provide extension services through ICT tools such as the mobile phone.

Masuki and Tukahirwa (2010) carried out a research on mobile phones use in agricultural information delivery for rural development in Eastern Africa; particularly in Western Uganda. One of the findings from their research was that the usage of mobile phone was found to benefit farmers in areas such as productivity, market access, natural resource management and in increasing the general knowledge base. In the Northern Region of Ghana, IPA, a development organisation which aims at reducing poverty in rural areas launched an agricultural extension programme to help farmers learn about the benefits of using agricultural inputs effectively. This programme particularly targeted the adoption of inputs like improved seeds which have more complicated planting procedures. As part of the programme, mobile phones were given to Community Extension Agents (CEAs) to access information on Good Agricultural Practices (GAPs), weather and commodity market prices which they in turn were to deliver quickly to farmers via the mobile phones for use. These examples show how mobile phones are increasingly recognized world-wide as a necessary tool for accessing information and knowledge especially in agriculture.

Nkwocha et al. (2009) reported that mobile phone can promote access to and sharing of information in agriculture and other sectors.

2.7 Socio- Economic Factors influencing the Use of ICTs

The socioeconomic characteristics of a population such as gender, age, educational level, income level, marital status, occupation, religion, birth rate, death rate, average size of a family, average age at marriage are generally thought to influence the demand and use of ICTs. Under this section, the study will examine demographic characteristics relevant to the objectives of the research.

2.7.1 Gender and Access to Mobile Phone

The population of Ghana in the 2010 population and housing census was 24,658,823, made up of 12,024,845 (48.8%) males and 12,633,978 (51.2%) females, (GSS, 2013). The use of mobile phones has become a common phenomenon among male and female Ghanaians. This is confirmed by the 2010 Population and Housing Census which gives the total number of people who are twelve years and older as 16,886,306 out of which 8,049,408 (47.7%) owned mobile phones. The percentage of males who owned mobile phones was 53.0% which is higher than that of females which was 42.8% for the same age group. This difference in mobile phone ownership by gender is supported an earlier study done by Castells et al (2004) which found that more men than women own mobile phones in Ghana. According to GSS (2013) persons who are twelve years and older using mobile phones in the Northern Region totaled 341,536 persons made up of 212,773 males and 128,763 females representing 62.3% and 37.7% respectively.

Though the benefits of the use of mobile phones is been universally acknowledged, its access and use has become an issue with gender dimensions. For example, Vota's (2013) notes that, ownership and use of mobile phone is gender neutral. Vota argued that the user interface of mobile phone software is always developed to be as neutral as possible. This position of Vota is a technological one. On the contrary, Zelezny-Green (2013), indicated that the mobile phone is not gender neutral like other technologies. According to Zelezny-Green (2013), in countries such as Iraq and Afghanistan where cultural norms indicate that it is inappropriate for women to interact with men outside their family, the lack of female phone agents for women to interact with concerning access and use of mobile phones constitutes a barrier which affects access and this has to be overcome.

In Ghana, there are no cultural norms that moderates women interaction behaviours with mobile phone agents. In the northern Region of Ghana, both men and women alike can own a mobile phone and use it for their intended purposes. The challenge however maybe with the mobile user interface, a technological issue which affects both genders. GIZ (2013) also takes the position that technologies themselves are seldom gender-neutral and that they may influence gender power relations. Based on this, there must be some consideration of the multiple aspects of mobile phone access and use by the genders in order to achieve an equitable gender-agricultural extension services delivery that empowers women to contribute to agricultural production to their fullest potential.

2.7.2 Age and Access to Mobile Phone

According to the Pew Research Centre (2015), 21% of the Ghanaian population aged between 18 and 34 years and 6% over 35 years own mobile phones. With regard to smartphone ownership, it is observed that people between the ages of 18 to 40 years are more likely to use smart phones than those who are 40 years and older. A study by Marumbwa (2014) indicated older men with extensive experience tend to be driven by habit whilst younger men are motivated more by the pleasurable benefits gained from using a technology. The study also found out that older women are price sensitive and will actually not buy mobile phone without analyzing what they stand to benefit from it. These observations suggest that one cannot just introduce mobile phones in extension delivery without looking at the differences in age and sex of farmers.

2.7.3 Education and Use of Mobile Phone

Education is the backbone of a nation's development. Education instills in individuals the ability to read and write enabling them to acquire knowledge and skills which they can apply to enhance their livelihoods. People with relatively higher educational attainments have the potential to use advanced technologies since instructions on the use of such technologies are often provided in languages they have learnt.

From the foregoing, it can be said that the ability of an individual to use a mobile phone may be influenced by the level of education of that individual. The highly educated are particularly likely to own cell phones and smartphones. Cell phone and particularly

smartphone ownership is also more common among Africans with at least some relative moderate educational level

2.8 Effectiveness of extension approaches Verses SERVQUAL Instrument

Effectiveness is defined by Robert Mitchell Carmichael (2001) as the extent to which planned activities are realized and planned results achieved. Also 'quality' is the degree to which a set of "inherent" characteristics fulfils requirements. Parasuraman et al. (1988) defined perceived quality as "global judgment, or attitude, relating to the superiority of the service".

To appropriately deliver effective services, service providers must constantly demonstrate to customers that their services are customer-focused and that continuous performance improvement is being delivered. Given the financial and resource constraints under which service organisations must operate, it is essential that customer expectations are properly understood and measured and that, from the customers' perspective, any gaps in service quality are identified. This information then assists a manager in identifying cost-effective ways of closing service quality gaps and of prioritizing which gaps to focus on given scarce resources. In the context of this research, farmers are the perceived customers of mobile phone service providers.

The SERVQUAL tool have been used to measure service quality (Parasuraman et al., 1988) and many researchers have used it severally. Brysland and Curry (2001) measured service quality in a university health clinic, and Agus and Kandampully (2007) used the same methodology in an exploratory study of service quality in the Malaysian public service sector. There is also evidence of a research paper using the SERVQUAL instrument to measure quality of service in the agricultural sector. James et al (2012) assessed farmers' satisfaction with agronomic services received in Kumasi metropolis in Ghana using the SERVQUAL methodology.

Parasuraman et al. (1988) stated that "service quality perceptions result from a comparison of consumer expectations with actual service performance, and quality evaluations are not made solely on the outcome of service; they also involve evaluations of the process of service delivery". Bitner (2000) implied that customer expectations are beliefs regarding a service and serve as standards against which service performance is judged.

A process is effective if its outcomes match the stated goals. Effectiveness is therefore similar to 'quality'. As service quality rises, pleasure with the service and intent to use the service equally rises. The SERVQUAL methodology's applicability in the field of agriculture can be justified in a sense that extension delivery can be perceived as a service and the farmer perceived as the customer. If farmers are happy after patronage of product/service, it means they are satisfied with the product/service. If farmers are not happy with the product/service, it means they are unsatisfied with the product/service they patronized. This assertion serves as the basis for selecting the SERVQUAL instrument as a tool to measure effectiveness of agricultural extension delivery services.

One of the aims of this research involves the use of SERVQUAL instrument to ascertain farmers' expectations and perceptions of agricultural extension services offered under mobile phone technology. How the SERVQUAL methodology is used to measure the effectiveness of mobile phone technology in agricultural extension is discussed in chapter three.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

This chapter describes the theoretical and conceptual frameworks employed in the study. The type of data, the study area, the sampling technique and sampling procedures are also described in this chapter. A description of methods of data collection and data analysis is presented in the chapter.

3.2 Theoretical Framework: Theory of Planned Behaviour as a Measuring Tool for Attitude of Farmers Towards Mobile Phone Technology

The theory of planned behaviour proposed by Icek Ajzen in 1985 is found to be well supported by empirical evidence (Maio et al., 2007). The theory was developed from the Theory of Reasoned Action, which was proposed by Martin Fishbein together with Icek Ajzen in 1980 (Cote et al., 2012). A core factor in the Theory of Planned Behaviour is the individual's "intention" to behave in a certain manner. The theory suggests that intentions to form a behaviour can be predicted from motivational factors such as attitudes toward the behaviour, subjective norms, and perceived behavioural control (ibid). These intentions together with perceptions of behavioural control, account for considerable differences in actual behaviour (Ajzen, 1991). Ajzen (1991) posits that intentions capture motivational factors such as how hard people are willing to try a behavior and how much effort they are planning to exert to perform the behaviour. As a general rule, the stronger the intention of person to engage in a behaviour, the more likely the person will actually performance the behaviour.

As mentioned above, the motivational factors that determine intentions includes attitudes toward the behaviour, subjective norms, and perceived behavioural control. From the point of view of social psychology, Palaiah et al. (2016) defined attitude as the degree of positive or negative relationship with some psychological objects towards which people can differ in varying degrees. Fishbein and Ajzen (1975) view attitude as a mental and neutral state of readiness, organized through experiences which exert a directive or dynamic influence upon the individual's response to all objects and situations. Attitudes are action tendencies and as such they can facilitate or hinder action at individual, group, community, state, and national levels. Individuals register an immediate and automatic

reaction of "good" or "bad" towards everything they encounter in less than a second, even before they are aware of having formed a behaviour. Attitude is reactional and quick whilst behaviour is formed over a longer time. An immediate and automatic reaction is driven by attitude but a person can decide at will to perform or not to perform a particular behaviour. The performance of most behaviours to some extent depends on availability of the requisite opportunities and resources such as time, money, skills, cooperation of others (Ajzen, 1991).

Another factor that affects behavioural intention which intend determines behavior is subjective norm. Subjective norm is the perceived social pressure to perform or not to perform the behaviour in question (Ajzen, 1991). Subjective norms are assumed to have two components which interact with each other and they are normative beliefs and motivation to comply.

Perceived behavioural control is another motivational factor that affect behavior and it refers to the perceived ease or difficulty of performing the behaviour in question (ibid). Perceived behavioural control is assumed to reflect past experience as well as anticipated impediments and obstacles. It is determined by control beliefs about the power of both situational and internal factors to inhibit or facilitate the performing of the behaviour. Control beliefs and influence of control beliefs interact to determine perceived behavioural control which subsequently determines behavioral intention and behavior. Perceived behavioural control is an external variable that has both a direct effect on actual behaviour and an indirect effect on actual behaviour through intentions. Bandura (1977) has provided empirical evidence that people's behaviour is strongly influenced by the confidence they have in their ability to perform the behaviour. The direct path from perceived behavioural control to actual behaviour is assumed to reflect the actual control an individual has over performing the behavior. According to Ajzen (1985) if an intention is held constant, the effort needed to perform the behaviour is likely to increase with perceived behavioural control. For example, if two people have equally strong intentions to learn how to prepare compost, and both try to do so, the person who is confident that he or she can master this activity is more likely to prepare it than the person who doubts his or her ability.

The relative importance of attitude, subjective norm, and perceived behavioral control in the prediction of intention is expected to vary across behaviours and situations. Each of

them influences behavior differently. Similarly, the different combinations of these motivational factors influence behavior differently. The theory of planned behaviour assumes that, human beings are basically rational and make systematic use of information available to them when making decisions (Ajzen 1991).

The Theory of planned behavior is considered superior to the theory of interpersonal behavior which was proposed by Triandis (1980). As noted by Triandis (1980), the theory of interpersonal behavior assumes that moral norm is a key determinant of behavioural intention. The moral norm refers to a person's feeling of moral obligation towards performing a given behaviour. The interpersonal behavior has limitations such as a significant risk of confounding between attitudes and norms since attitudes can often be reframed as norms and vice versa and the assumption that an individual who formed an intention to act will freely do so without limitation. Meanwhile, the theory of planned behavour overcomes these limitations as it acknowledges that in practice, constraints such as limited ability, time, environmental or organizational limits, and unconscious habits will limit the freedom to act irrespective of the intentions formed. Due to the superiority of theory of planned behavior, this study adopted it as a tool to measure farmers' attitude towards the use of mobile phone technology for agricultural extension delivery. Figure 1 below shows a schematic diagram of the theory of planned behavior.

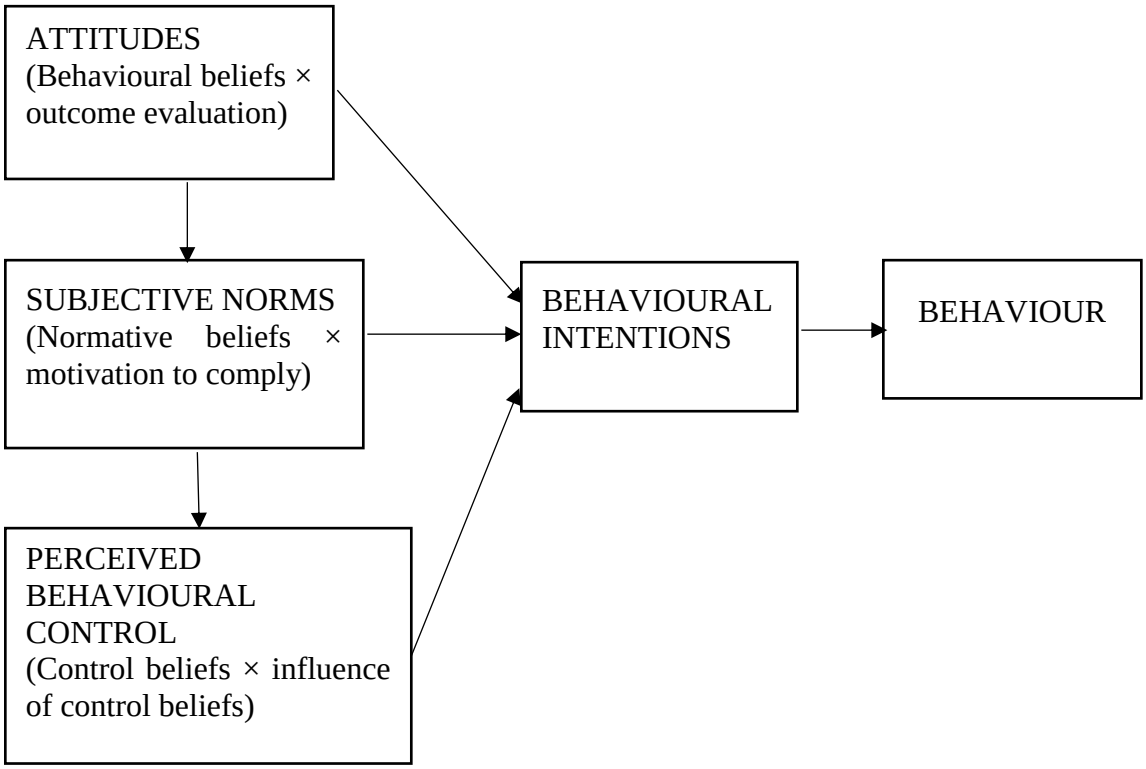

Figure 1: The Theory of Planned Behaviour adopted from Ajzen (1991)

3.3 Conceptual Framework

The conceptual framework illustrated in Figure 2 below provides the scope for the study and is an adaptation of the theoretical framework in Figure 1 above. The detailed elements in each of the three components of the theoretical framework are: attitudes (geographical location, household size, age, gender, educational background, approaches farmers patronize), subjective norms (farmers' attitude towards mobile phone approach and the perceived behavioural control (extension approaches - mobile phone extension, participatory video, direct contacts with extension agents and gender, educational level of extension agent) are illustrated in the conceptual framework below. The elements in attitude component are geographical location, household size, age, gender, educational background, and type of extension delivery approaches farmers patronize. Farmer internal attitudes are driven by perceived behavioural control, subjective norm as explained in the theoretical framework. Lastly, the outward behaviour of the farmer towards the various extension approaches is influenced by external factors such as costs, availability of resources etc. The three components are linked by arrows which show the influence of each components. The interaction of all three components results in the intention of the farmer to adopt and use a particular extension approach or a set of approaches. In the conceptual framework, the effectiveness of a particular approach is determined by farmers' intention and use of the approach. This framework helps to bring out issues that may act as drivers or barriers to positive or negative behaviour towards mobile phone adoption and use in extension as well to assess the its effectiveness in extension services delivery.

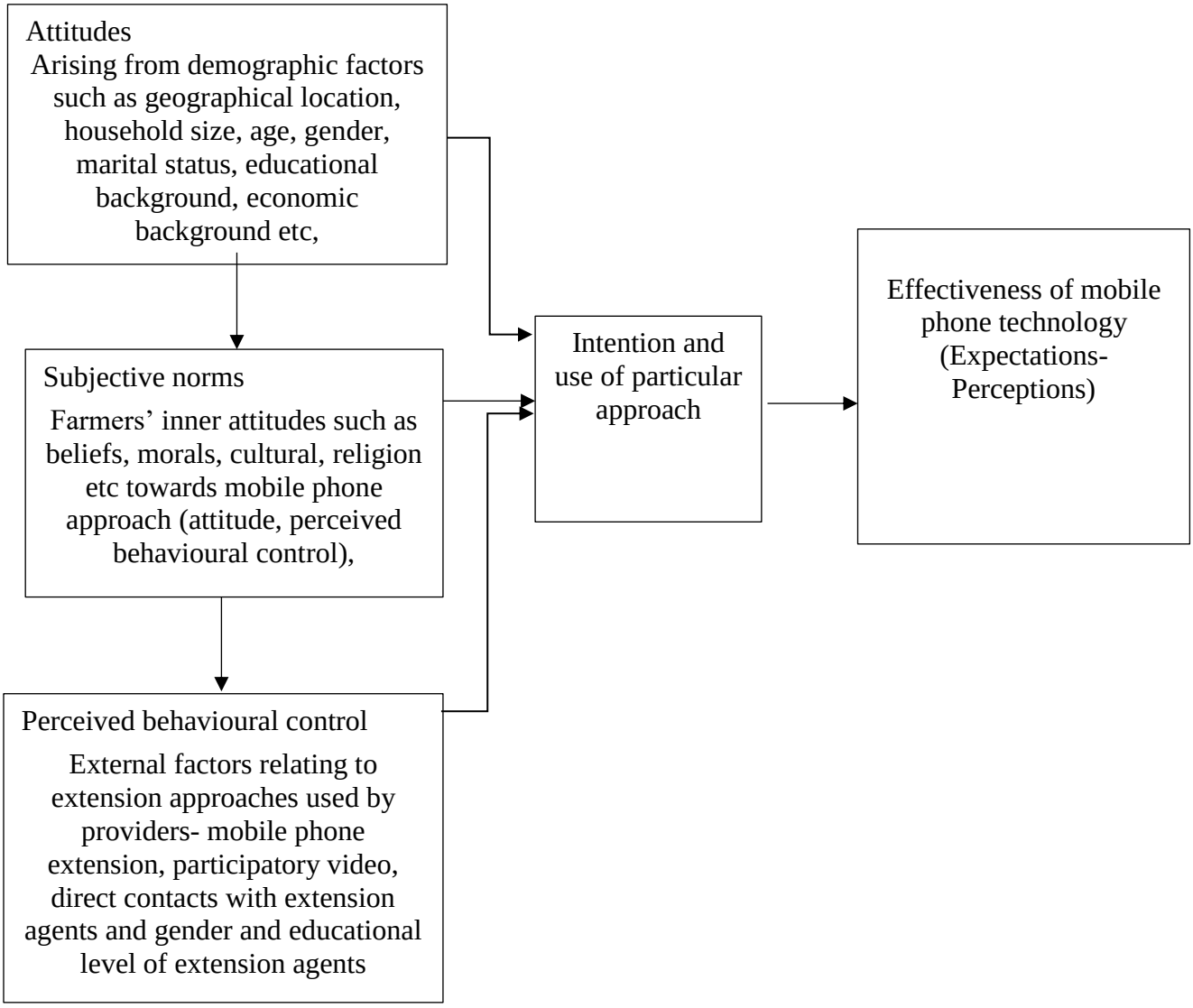

Figure 2: Conceptual Framework

Source: Author

3.4 Data Analysis

Data processing involves the transformation of data into information by collating, sorting, classifying, retrieving, disseminating information manually or through the use of computer software (Bourque, 2006). The goal is to fish out useful information, suggest conclusions and make recommendations to support decision making. After primary data from the field

had been checked for completeness and accuracy the responses were coded and entered into the Statistical Package for Social Sciences (SPSS) version 2.0 and analyzed, using frequencies and percentages. Content analysis and interpretation of responses from respondents are used to analyze qualitative data. Once raw data were collected, quantitative and qualitative methods of data analysis were employed. Descriptive statistical tools such as frequency tables and percentages were used. Each objective of the research was analyzed employing appropriate statistical analytical tools. The demographic data was analyzed using descriptive statistics and results are presented in the form of tables and percentages.

The first objective was to assess the relationship between intention and attitude of farmers towards the use of mobile phones for agricultural extension delivery. A five point Likert scale containing items with response categories ranging from Strongly Agree (SA) with a score of five to Strongly Disagree with a score of one for each statement was developed. Each of the statements indicates the intention of farmers using mobile phone for agricultural extension delivery. Spearman's rank correlation which is an inferential statistical tool was used for the analysis. This is because it has the ability to determine the level of correlation between farmers' attitude and intention of the use of mobile phone to receive agricultural extension information.

In order to determine the effects of theory of plan behavior predictors, namely attitude (ATT), perceived behavioural control (PBC), subjective norm (SN) on farmers' intention to use mobile phone to receive agricultural extension services, this study used multiple linear regression as indicated in equation (1) below:

$$Y_i = \alpha_o + \alpha_1 ATT_i + \alpha_2 PBC_i + \alpha_3 SN_i + \varepsilon_i \qquad (1)$$

Where:

Y_i = the overall intention of the ith farmer to use mobile phone

α_o = the intercept

α_1, α_2, and α_3, represent the standardized regression coefficients which respectively measure the magnitude of impacts of attitude (ATT), perceived behavioural control (PBC)

and subjective norm (SN) on farmers' intention to use mobile phone for agricultural extension service delivery.

ATT_i, PCB_i, and SN_i, represent perceived attitude, behavioural control and subjective norm

ε_i represents the error term which measures the factors that affect ith farmer's intention to use mobile phone for agricultural extension service delivery but not included in the model.

The second objective of the study was analyzed using Pearson Chi–square statistical test in order to test the significance of relationships between respondents' personal characteristics (Age gender, educational level) and farmers' readiness to use mobile phone technology for receiving agricultural information. It is used because it can measure well respondents' personal characteristics (age gender, educational level) fit into expected variables. A significance level of 5% was used for the test. Results are presented in the form of frequencies and percentages in tables, and are used to simplify the understanding of the findings.

The third objective of the study was analyzed using descriptive statistics and the results presented in tables in the form of frequencies and percentages.

The fourth objective as stated was analyzed using the SERVQUAL (Parasuraman *et al.,* 1985, 1988) methodology. The SERVQUAL instrument was used to ascertain any actual perceived gap between customer expectations and perceptions of the services offered. Service gaps were recorded for five (5) main SERVQUAL dimensions.

1. Tangibility. Physical facilities, equipment and appearance of personnel.
2. Reliability. Ability to perform the promised service dependably and accurately.
3. Responsiveness. Willingness to help customers and provide prompt service.
4. Assurance. Knowledge and courtesy of employee and their ability to inspire trust and confidence (including competence, courtesy, credibility and security).
5. Empathy. Caring and individualised attention that the service providers provides to its customers (including access, communication, understanding the customer).

In the questionnaire, 19 statements (Appendix I) of expected and perceived service quality were used to measure the performance of three extension service approaches across the five SERVQUAL dimensions.

A five-point Likert scale containing items with response categories ranging from Strongly Agree (SA) with a score of five points to Strongly Disagree with a score of one point for each statement was developed. Reliability of the questionnaire data was tested, and the Cronbach's alpha coefficient value was 0.771, indicating the high reliability of the SERVQUAL questionnaire data. This shows that the items on the subscales were internally consistent when compared to the minimum of 0.50 suggested by Nunnally (1967). The Farmers' responses were analyzed using SPSS. The average of expected service quality and perceived service quality statements were calculated, after which the resultant value of perceived statements subtracted from the expected statements. The value obtained after calculating the difference was then taken as the gap score.

The total weighted SERVQUAL value was used to determine whether farmers are satisfied with the extension delivery approach or not. The interpretation of the gap values (Parasuraman et al., 1985s) were analyzed considering the following statements:

a) "When Expectations (ESs) > Perceptions (PS); perceived quality is less than satisfactory and will tend toward totally unacceptable quality, with increased discrepancy between ES and PS".
b) "When ES=PS; perceived quality is satisfactory
c) When ES< PS; perceived quality is more than satisfactory and will tend towards ideal quality, with increased discrepancy between ES and PS"
Multiple linear regression analysis was used to assess the impact of SERVQUAL dimensions on the intention to use extension approaches. The equation was represented below as:

$$Y_i = \beta_o + \beta_1 X_{1i} + \beta_2 X_{2i} + \beta_3 X_{3i} + \beta_2 X_{4i} + \beta_5 X_{5i} + e_i \qquad (2)$$

Where

Y_i = the overall intention of ith farmer to use mobile phone

β_o = the intercept

β1, β2, β3, β4 and β5 represent the standardized regression coefficients which respectively measure the magnitude of impacts of tangibility, reliability, responsiveness, assurance and empathy on farmers' intention to use mobile phone for agricultural extension service delivery.

X1i, X2i, X3i, X4i and X5i represent tangibility, reliability, responsiveness, assurance and empathy respectively of the farmer.

ei represents the error term which measures the factors that affect farmers' intention to use mobile phone for agricultural extension service delivery but not included in the model.

Although SERVQUAL was developed within the marketing sector, it is also used in a variety of organizational settings, including libraries and information centers (Kettinger et al., 1994). Some reviewers of research reports have frequently criticized that the choice of parametric methods such as correlation and regression for ordinal variables questions as faulty. Reasons such as small sample sizes, non-normal distribution of data, and the ordinal nature of data from a Likert scale are given to justify the impropriety of using parametric statistics. However, many studies, dating back to the 1930s consistently show that parametric statistics are robust with respect to violations of these assumptions. Hence, challenges like those above are unfounded, and parametric methods can be utilized without concern for "getting the wrong answer" (Norman, 2010).

3.5 Sources of Data

The research made use of both primary and secondary sources of data. The primary source of data was mainly from communities under Tolon, Kumbungu and Sagnarigu districts. An initial elicitation study was conducted by designing and administering unstructured questionnaires to elicit farmers' view of extension delivery approaches they patronize. Semi-structured questionnaires were later administered by enumerators seeking farmers' views on the use of mobile phone in extension delivery. AEAs were also interviewed on issues relating to extension delivery approaches they use to communicate to farmers. The secondary sources of data include published articles from journals on the internet.

3.6 Study Area/ Population

Tolon district is one of the study areas in the Northern region of Ghana. It is situated west of the Northern Regional capital, Tamale. The district capital, Tolon, is 26 Kilometres away from Tamale. The district consists of typically agrarian communities; thus, farming is the major occupation of the people in the communities. The district was part of the then Tolon/Kumbungu district before it was split into two and named Tolon district by the local government act – 1993 (ACT 462), under the 1992 constitution of Ghana, with Tolon named as the district capital. The population of then Tolon/ Kumbungu district according to the 2010 Population and Housing Census was 72,990, representing about 2.9 percent of the region's total population. Almost ninety percent (88.4%) of the population is rural with the urban population accounting for 11.6%, (GSS, 2013). The target population is made up of farmers and AEAs of MoFA in the Tolon district of Northern region. The actual population of farmers is currently unknown since there has not been any major census after the district was split into two.

Kumbungu is one of the districts to the north of Sagnarigu district. It shares its boundaries with Tolon, Savelugu and Yagba-Kubore district. It is a new district born out of the split of the then Tolon/Kunbungu district in 2011. The actual population of farmers in the district is unknown, however farmers from the district were selected for the study.

The Sagnarigu district is one of the study areas, which was also separated from the Tamale Metropolis. It shares boundaries with Savelugu-Nantong district to the north and the Tolon district to the west of the Northern region. The population of the district is not actually known since it was formed after the last population census was conducted in 2010. However, some farmers from this district responded to the questionnaire.

3.7 Sample Size

The actual population of farmers in the three districts where the data was collected is unknown. This is because the districts were formed in 2011 after the national population census in 2010. However, the farmer population can be considered as an infinite population since the number is estimated to be over 50,000. This justifies the application of the Godden formula (2004). Following Godden (2004), the sample size can be determined using the formula:

$$ss = \frac{z^2 \times (p) \times (1-p)}{c^2} \qquad (3)$$

Where

SS = Sample Size
Z = Z-value A (e.g., 1.96 for a 95 percent confidence level)
P = Percentage of population picking a choice, expressed as decimal B
C = Confidence interval, expressed as decimal (e.g., .04 = +/- 4 percentage points)

If P = 60%
C = 45% (0.04 = ± 4)
Z = 1.96 for 95% confidence level (1.69)
P = 60% (0.6)

$$ss = \frac{1.96^2 \times (0.6) \times (1-0.6)}{0.04^2},$$

SS = 455.3

For the purpose of proportionate allocation, the sample size of 450 respondents among the three selected districts was used for the study.

3.8 Sampling Procedure

Three districts purposively selected for the study are namely; Tolon Municipality, Kumbungu and Sagnarigu districts. Purposive sampling was done based on the fact that three of the extension approaches assessed are being implemented in these three districts by MoFA and other extension organizations. MoFA provides extension services to farmers by means of direct contacts/visits with farmers and through E-extension, involving the use of mobile phones. Other extension organisations provide extension services to farmers through participatory video and mobile phone extension approach. 30 communities were randomly selected for the sample population based on the local area council zoning in the district. 15 respondents were randomly selected from each of the 30 communities to represent the sample size for the research.

3.9 Methods of Data Collection

Different data collection techniques were employed to collect data for the survey. Semi-structured questionnaire, interviews, and focus group discussions were employed to

collect data for the study. To ensure the validity of the questionnaire, pre-testing was conducted.

The questionnaire was divided into two main parts. The first part was made up of questions concerning the socio-demographic characteristics of the respondents. And the second part of the questionnaire consisted of questions addressing the four main objectives of the research work.

Interviews were conducted over phone and face-to-face to obtain information relating to the extension delivery services in the area from AEAs working in the selected districts for the research work. Focus group discussions were also held to obtain data from some selected respondents to validate the information that was obtained by enumerators from interviews and semi-structured questionnaire. The focus group discussion was also used to gather farmers' views to serve as a basis for developing the theory of planned behavior questionnaire.

The triangulation method was employed to strengthen the findings obtained from respondents. Triangulation is the process of strengthening the findings obtained from a qualitative enquiry by cross-checking information from multiple data and information sources. The reason for employing triangulation stems from the fact that a researcher who argues that his or her findings are derived from many different sources across many different situations will be more convincing than another researcher whose conclusions are based on observations of one source in one setting (Potter, 1996). Secondary data was obtained from journals, the Tolon district MoFA office, and libraries.

3.9 Pretesting of Questionnaires

Initial elicitation studies were conducted on TPB to ascertain the behavioural profiles of farmers. Twenty-five (25) respondents were used for the elicitation study. The complete questionnaire for the study was then designed from the responses from the elicitation study.

It is widely assumed that no matter how much developmental and pretesting work is done on a questionnaire, the instrument must still be tested under field conditions (Fowler, 1993; Czaja and Blair, 1996). Field testing generally means administering a questionnaire to respondents selected from the target population using the procedures that are planned

for the main study. Respondents were selected on convenience sampling and 20 questionnaires tested on the respondents from the population of the study.

Reliability of the questionnaire data was tested and the Cronbach's alpha coefficient value was 0.9, indicating the high reliability of the questionnaire data. This shows that the items on the subscales were internally consistent when compared to the minimum of 0.50 suggested by Nunnally (1967).

CHAPTER FOUR

RESULTS AND DISCUSSION

4.0 Introduction

This chapter discusses the socio-demographic characteristics of farmers and their responses towards the extension delivery approach they patronize. The demographic characteristics examined included age, gender, marital status, household size, educational level and farm group. The chapter also presents analysis and discussions of the results obtained from applying the methodology.

4.1 Age distribution

Table 4.1 below shows the percentage distribution of the ages of the farmers. The highest percentage of the respondents (33.6%) falls within 31-40 years; 28.2% of the respondents were 21-30 years; 18.7% were 41-50 years; and 51-60 years were 7.8% while 6.0% were 18-20. Those 60 years and above constituted 5.8% of the respondents. The study revealed that most of the farmers were independent young and adult people in the rural communities.

Table 4. 1: Age distribution of farmers

Age	Frequency	Percentage (%)
18-20	27	6.0
21-30	127	28.2

31-40	151	33.6
41-50	84	18.7
51-60	35	7.8
60 and above	26	5.8
Total	450	**100**

Source: Field survey, 2017

4.1.2 Gender

Table 4.2 shows the percentage distribution of the gender of farmers who were interviewed. About 92% of the farmers were males whilst 8% were females. The study recorded high percentage of males because most of the women were engaged in house chores and were not available for interview. Also, the culture in Northern Region restricts women from having access to land to farm on their own.

Table 4. 2: Gender of the farmers

Gender	Frequency	Percentage
Male	413	92%
Female	37	8%
Total	450	**100**

Source: Field survey, 2017

4.1.3 Marital Status

Table 4.3 shows the marital status of farmers who were interviewed. 366 (81.3%) of the farmers were married, 80 (17.8%) were single, 1 (0.2%) divorced, and 3 (0.7%) were widowed. This indicates that most of the farmers who were interviewed are married.

Table 4. 3: Marital status of the farmers

Marital Status	Frequency	Percentage
Married	366	81.3%
Single	80	17.8%
Divorced	1	0.2%
Widowed	3	0.7%
Total	450	**100%**

Source: Field survey, 2017

4.1.4 Household Size of Farmers

The household size of farmers in the areas surveyed are exhibited in Table 4. The highest household size category recorded was (0-10 members) representing 314 (69.8%) respondents, 116 (25.8%) respondents had households with 11-20 members; 17 (3.8%) respondents had households with 21-30 members; while 2 (0.4%) and 1 (0.2%) respondents each had households with 31-40 members and above 41 members respectively.

Table 4. 4: Household size

Household size	Frequency	Percentage
0-10	314	69.8%
11-20	116	25.8%
21-30	17	3.8%
31-40	2	0.4%
41 and above	1	0.2%
Total	450	**100%**

Source: Field survey, 2017

4.1.5 Educational Level

Regarding educational levels, the study revealed that 240 (53%) of the farmers had no formal education, 66 (14.7%) had primary education, 66 (14.7%) had junior high school education, 56 (12.4%) had senior high school education, and only 22 (4.9%) percent of the farmers had tertiary education. This follows the national trend where majority of the farmers do not have formal education.

Table 4. 5: Educational level of farmers

Educational level	Frequency	Percentage
Primary School	66	14.7%
Junior High School	66	14.7%
Senior High School	56	12.4%
Tertiary	22	4.9%
Illiterate	240	53.3%
Total	**450**	**100%**

Source: Field survey, 2017

4.1.6 Belonging to Farmer Group

The survey showed that 43.6% of the farmers belong to a farmer group whilst 56.4% do not belong to any farmers' groups. This is reported in table 4.6 below.

Table 4. 6: Membership of farmer group

Farmer group	Frequency	Percentage
Yes	196	43.6%
No	254	56.4%
Total	450	**100%**

Source: Field survey, 2017

4.2 Analysis of the Farmers' Intention to use Mobile Phone to Access Extension Service (Under the Theory of Planned Behavior- TPB)

Spearman correlation is used to determine whether or not there is a relationship between intention and the behaviour using the predictors of behaviour (Attitudes, subjective norm, and perceived behavioural control). These predictor variables are respectively defined in the methodology chapter. The condition for using the Spearman correlation is that the questionnaire data used for this analysis is ordinal.

4.2.1 Relationship between Intention and Attitude under Mobile Phone Extension Provision

As stated above, Spearman correlation is used to examine the relationship between 8 distinct attitude statements and intention to use mobile phone for accessing agricultural information. This is done for each of the individual statements. The difference between the individual score on the two variables (attitude and intention) can be calculated from the correlation of the two variables. The correlation (r) value is then used to determine the magnitude and direction of the relationship. The coefficient of determination is used to determine the percentage contribution to the variance in the association.

From the table 4.7, Spearman correlation coefficients were computed to assess the strength of the relationship between: easy access to relevant agricultural information and farmers' intention to use mobile phone; ability of farmers to use extension messages from mobile phone to plan farming activities well and farmers' intention to use mobile phone; ability of farmers to learn good farming practices through the use of mobile phone to

access agricultural extension and farmers' intention to use mobile phone; accessing agricultural extension information through mobile phone to help farmers increase yield and farmers' intention to use mobile phone; the easy with which farmers can use mobile phone to link with consumers of farm produce and farmers' intention to use mobile phone; the ease with which farmers can use mobile phone to link with input dealers and farmers' intention to use mobile phone; ability of farmers to use extension messages from mobile phone to reduce cost of farming operation and farmers' intention to use mobile phone; and the ease of understanding video agricultural extension messages received through mobile phone and farmers' intention to use mobile phone.

All the correlation coefficients of the stated statements were statistically significant at 1% implying there are relationships between the farmers attitudes and their intention to use mobile phones. The Spearman correlation coefficients of 0.856 and 0.814 indicates that there are strong positive correlations between ability of farmers to use extension messages from mobile phone to plan farming activities well and farmers' intention to use mobile phone; and ability of farmers to learn good farming practices through the use of mobile phone to access agricultural extension and farmers' intention to use mobile phone respectively. The indicative statements which have intermediate positive correlation with farmers' intention to use mobile phone are easy access to relevant agricultural information through the use of mobile phone, accessing agricultural extension information through mobile phone to help farmers increase yield, the ease with which farmers can use mobile phone to link with consumers of farm produce, ability of farmers to use extension messages from mobile phone to reduce cost of farming operation and the ease of understanding video agricultural extension messages received through mobile phones. From table 4.7, it is only correlation between the ease with which farmers can use mobile phone to link with input dealers and farmers' intention to use mobile phone that recorded a weak positive correlation.

Table 4.7: Relationship between Intention and Attitude under Mobile Phone Extension Provision

Attitude*Intention	**Correlation Coefficient (r)**	**Coefficient of determination (r^2)**	**Whether it is Barrier or a driver**

Using mobile phone helps me to access relevant agricultural information easily	0.607**	0.368	Driver
Extension messages from mobile phone helps me plan my farming activities well	0.856**	0.733	Driver
Extension messages from mobile phone helps me develop my knowledge on good farming practices	0.814**	0.663	Driver
Using mobile phone helps me increase my yield through reliance on agricultural information from this source	0.451**	0.203	Driver
Using mobile phone helps me have easy link to consumers of my farm products	0.317**	0.100	Driver
Using mobile phone helps me have easy link to input dealers	0.246**	0.060	Driver
Using mobile phone helps reduce my cost of farm operation	0.359**	0.129	Driver
Video messages makes me understand better using mobile phone	0.540**	0.292	Driver

Note: ** Correlation is significant at the 0.01 level (2-tailed). Source: Field survey, 2017

The Spearman's correlation coefficient for all the indicated statements are positive and statistically significant. This means that farmers intention to use mobile phone to access agricultural extension information increases with the positive impact attained from the range of activities performed along the key segments of the agricultural value chain.as in shown in the stated statements Table 4.7. Also, the positive correlation coefficient implies that each of the indicative statements is a driver or motivation factor that determines farmers' intention to use mobile phone to receive agricultural extension information.

4.2.2 Relationship between Intention and External Factors Influencing the use of Mobile Phone for Agricultural Extension Information

A Spearman correlation coefficient was computed to assess the relationship between "finding difficulty in interpreting/understanding extension messages using mobile phone" and farmers' intention to use mobile phone. Even though, the correlation coefficient of -0.401 is statistically significant at 1%, it shows an intermediate negative relationship between difficulty in interpreting/understanding extension messages using mobile phone and farmers' intention to use mobile phone. This implies that if farmers have difficulty in interpreting or understand extension messages using the mobile phone, then their

intention to use mobile phone for agricultural extension information will decrease. As it is seen in the table 4.8, the coefficient of determination is 0.160 indicating that 16% of the variation in farmers' intention to use mobile phone is explained by the difficulty farmers face in interpreting/understanding agricultural extension messages using mobile phone.

The correlation coefficient recorded in table 4.8 for the relationship between "I do not get information on time using mobile phone for receiving extension information" and intention to use mobile phone is -0.381. This value is statistically significant at 1% indicating an intermediate negative relationship between the two variables. It therefore implies that an increase in farmers' inability to get agricultural extension messages on time using mobile phone decreases their intention to use mobile phone for agricultural extension information.

The statement "I find it difficult to get exact information on my crop type using mobile phone for extension information" and farmers' intention to use mobile phone are correlated since the Spearman correlation coefficient is statistically significant at 1%. The correlation coefficient value of -0.374 indicates an intermediate negative relationship between the two variables. This means that if a farmer finds it difficult to get exact information on the type of crop he or she cultivates using mobile phone to access agricultural extension information, then his or her intention to use mobile phone for agricultural extension information will decrease.

Table 4. 8: Relationship between Intention and External Factors under Mobile Phone Extension Provision

Perceived Behavioural Control*Intention	Correlation Coefficient (r)	Coefficient of determination (r^2)	Whether it's a barrier or a driver
I find it difficult to interpret or understand information from Mobile phone	-0.401**	0.160	Barrier
I do not get information on time using Mobile phone for receiving extension information	-0.381**	0.145	Barrier
Sometimes I find it difficult to get exact information on my crop type using Mobile phone for extension information	-0.374**	0.139	Barrier

Note ** Correlation is significant at the 0.01 level (2-tailed). Source: Field survey, 2017

4.2.3 Relationship between Intention and personal beliefs under Mobile Phone Extension Provision

A correlation coefficient of 0.740 was obtained after estimating Spearman's correlation test in SPSS to establish the strength of the association between the personal belief statement "NGOs think that I should use mobile phone for accessing agricultural information" and farmers' intention to use mobile phone. The association between these two variables is intermediate negative association since the correlation coefficient is statistically significant, positive and lies within $0.25 \leq r < 0.75$. The statistically significant positive coefficient value recorded between the two variables means that, if NGOs recommend the use of mobile phone for accessing agricultural information to farmers, it will increase their intention to use mobile phone for such purposes. This implies that NGO's recommendations are a strong driver of farmers intention to use mobile phones for agricultural information.

The correlation coefficient between "religious leaders think I should use mobile phone to access agricultural information" and intention to use mobile phone is 0.825 and statistically significant. Since the value is greater than 0.74, the correlation between religious leaders convincing farmers to use mobile phone to access agricultural information and their actual intention to use mobile strong and positive. The positive sign means that if religious leaders recommend the use of mobile phones for extension to farmers, the latter will feel more inclined to use mobile phone for agricultural extension information. Therefore, religious leaders' recommendation of mobile phones for extension to farmers is a driver of farmers' intention to use mobile phone for agricultural extension information.

Also, the statement "agricultural extension agents think I should use mobile phone to access agricultural information" and the farmer's intention to use mobile phone is strongly correlated. This is because the correlation coefficient value of 0.873 is greater than 0.74 and statistically significant at 1%. The positive sign between the two variables means that, if extension agents recommend to farmers to use mobile phone to access agricultural extension information, it will indeed increase farmers' intention to use mobile phone for agricultural extension information.

The statement "opinion leaders think I should use mobile phone to access agricultural information" is a driver of farmers' intention to use mobile phone to access agricultural

extension information. The correlation coefficient value of 0.808 indicates a strong positive and significant relationship between opinion leader's recommendation to farmers to use mobile phone to access agricultural information and farmers' actual intention to use mobile phone to access agricultural extension information.

Table 4. 9: Relationship between Intention and Personal Beliefs under Mobile Phone Extension Provision

Subjective Norm*Intention	Correlation Coefficient (r)	Coefficient of determination (r^2)	Whether it's a barrier or a driver
NGOs think that I should use Mobile phone to access agricultural Information	0.740**	0.548	Driver
Religious leaders think that I should use Mobile phone to access agricultural Information	0.825**	0.681	Driver
Extension agents think that I should use Mobile phone to access agricultural Information	0.873**	0.687	Driver
Opinion leaders think that I should use mobile phone to access agricultural information	0.808**	0.400	Driver

Note: ** Correlation is significant at the 0.01 level (2-tailed). Source: Field survey, 2017

4.2.4 Relationship between Intention and Behaviour Predictors (ATT, PBC, SN)

The results of the Spearman correlation for the relationship between intention and behaviour predictors are shown in table 4.10. The association between intention and three predictor variables; attitude (ATT), perceived behavioural control (PBC) and subjective norm (SN), recorded correlation coefficients of 0.851, -0.323 and 0.846 respectively. The results show that both attitude and subjective norm were statistically significant at 1%. Also, they were strongly and positively associated with farmers' intention to use mobile phone to receive agricultural extension information. Conversely, PBC was negatively associated with farmers' intention to use mobile phone to receive agricultural extension information since the correlation coefficient of -0.323 fall within the range $0.25 \leq r < 0.75$. Even though the association is negative, it is not statistically significant.

The positive correlation signs show that as attitude and subjective norm increases, farmers' intention to use mobile phone to receive agricultural extension information also increases. Therefore, attitude and subjective norm contribute greatly to the overall intention of farmers to use mobile phone to access agricultural extension information. As shown in the table 4.10, the coefficient of determination for attitude, perceived behavioural control and subjective norm were 0.724 and 0.715 respectively. This means that 72.4% of the variations in farmers' intention to use mobile phone to receive agricultural extension information is explained by attitude statements. Also, 71.5% of the variations in farmers' intention to use mobile phone to receive agricultural extension information is explained by subjective norm statements.

Table 4.10: Relationship between Intention to Use Mobile Phones and Behaviour Predictors (ATT, PBC, SN)

Intention *TPB predictors	Correlation coefficient (r)	Coefficient of determination
ATT	.851**	0.724
PBC	-.323	0.104
SN	.846**	0.715

Note: ** Correlation is significant at the 0.01 level (2-tailed). Source: Field survey, 2017

4.2.5 The impact of TPB predictors (Attitudes, Perceived Behavioral Control and Subjective Norms) on Intention to Use Mobile Phone Extension Provision

The multiple linear regression model stated on page 25 was used to predict farmers' intention to use mobile phone from the attitude, subjective norm and perceived behavioural control variables. The regression coefficients of the variables are shown in table 4.11 below.

The multiple regression model recorded an overall fit value (F) of 339.047, which is significantly different from zero, hence the null hypothesis that attitude, subjective norm and perceived behavioural control has no joint influence on intention to use mobile phone is rejected. From the results, all the three predicted factors are statistically significant at 1%. This implies that attitude, perceived behavioural control and subjective norm are all

making significant unique contributions to predict farmers' intention to use mobile phone for agricultural extension delivery. The R-square value of 0.693 implies, 69.3% of variation in intention is accounted by the behaviour predictors (attitude, subjective norm and perceived behavioural control). 30.7% of the variation in intention cannot be explained attitude, subjective norm and perceived behavioural control.

As is indicated in table 4.11, the partial correlation values show that, subjective norm recorded the highest impact with a coefficient of determination of 10.8%, followed by attitude (10.6%) and perceived behavioural control contributed the least (3.2%).

Table 4. 11: Impact of TPB Predictors on Intention to Use Mobile Phone in Agricultural Extension

Predictor	β	Sig	r^2
Attitude	0.425	0.000**	0.106
Perceived behavioural control	0.101	0.000**	0.032
Subjective Norm	0.429	0.000**	0.108
$R^2 = 0.693$, F = 339.047			

**$p < .05$ source: field survey, 2007

4.3 The influence of Age, gender and Education level on Farmer's Intention to use Mobile Phone in Agricultural Extension

In this section, cross tabulation and chi-square (X^2; chi square) statistical tests are used to test the significance of relationship between respondents' personal characteristics and their perceived readiness to use mobile phone for accessing agricultural information. The Chi square test is used because it can measure well respondents' personal characteristics (age gender, educational level) fit into expected variables.

4.3.1 The influence of Respondents' Gender on Intention to Use Mobile Phone in Agricultural Extension

From table 4.12 below, the chi square test was statistically significant at 5%. As a result, the null hypothesis that gender has no influence on farmers' intention to use mobile phone for agricultural extension delivery is rejected in favour of alternate. This implies that there

is significant difference between farmers' gender and intention to use mobile phone for agricultural extension provision. As shown in the table 4.12, more males (150) have intention to use mobile phone for extension provision than females (11). This inference maybe as a result the fewer number of females included in the data sample. This situation arose because they did not make themselves available for the interview due to their busy household schedules.

Table 4. 12: Influence of Respondents' Gender on Intention to Use Mobile Phone Extension Provision

Gender and Intention to use mobile phone	Intention to use mobile phone		
Gender	(frequency)	(frequency)	Total
	Yes	No	
Male	150	263	413
Female	11	26	37
Total	**161**	**289**	**450**

Source: Field survey, 2017 $X^2 = 0.387$, df = 1, p =0.038

4.3.2 The influence of Respondents' Age on Intention to use Mobile Phone in Agricultural Extension

From the table 4.13 below, the chi square value of 13.999 is statistically significant at 5% indicating that the null hypothesis; there is no significant difference between farmers' age and the intention to use mobile phone in agricultural extension. This means that there is a significant difference in farmers' intention across different age groups. As it is in the table 4.13, the mean rank for the age group of 21-30 was the highest followed by 18-20, 31-40, 60+, 51-60, and 41-50 age ranges. This means that the age group 21-30 had the highest intention to use mobile phone followed by 18-20, then 31-40, 60+, 51-60 and 51-60 age categories. It was noticed that, even though the age group of 31-40 had a frequency higher than the 21-30 age group, it recorded a mean less than the latter. This means that young farmers with some years of experience and relatively high curiosity to innovate have more intention to use mobile phone than old farmers. Also, the results obtained indicate that affinity for mobile phone decreases as age increases.

Table 4. 13: Influence of Respondents' Age on Intention to Use Mobile Phone Extension Provision

Age	Readiness to use mobile phone frequency		Total frequency	Mean Rank
	Yes	No		
18 - 20	12	15	27	265.80
21 - 30	44	83	127	266.35
31 – 40	61	90	151	237.26
41 – 50	23	61	84	199.83
51 – 60	9	26	35	200.73
60+	12	14	26	227.46
Total	161	289	450	

Source: Field survey, 2017 $X^{2} = 7.694$, df = 5, P = 0.016,

4.3.3 The influence of Respondents' Educational Level on Intention to Use Mobile Phone in Agricultural Extension

The probability value of 0.016 obtained from the chi-square test implies that test is statistically significant at 5%. Hence, the null hypothesis that farmers' intention to use mobile does not depend on their educational level is rejected in favour of alternate. This means that intention to use mobile phone depends on the educational level of the farmer. As shown in the in the table 4.14 below, farmers with formal education (87) were more ready to use mobile phones in agricultural extension than farmers without formal education (74). Also, within farmers who had no intention to use mobile phone for extension provision, farmers who had no formal education were more than those with formal education. This means that, farmers' intention to use mobile phone depends on their educational level.

Table 4. 14: Influence of Respondents' Educational Level on Intention to Use Mobile Phone in Agricultural Extension

Educational level	Readiness to use mobile phone (frequency)		Total (frequency)
	Yes	No	
Primary school	23	43	66
Junior high school	24	42	66
Secondary/vocational school	31	25	56
Tertiary institution	9	13	22

No formal education	74	166	**240**
Total formal education	87	123	**210**
Total	161	298	450

Source: Field survey, 2017 $X^{2=}$ 12.183, df = 4, P = 0.016

4.4 Modes of Agricultural Knowledge Acquisition by farmers

Table 4.15 below shows the knowledge acquisition approaches used by extension agents and patronized by farmers in the study area. The farmers generally patronized mobile phone, participatory video and direct contacts approaches used by agricultural extension officers. 161 farmers (representing 35.7%) patronized the mobile phone extension approach, 60 farmers (representing 13.3%) used the participatory video extension approach, and 229 farmers (representing 50.9%) patronized direct contacts with extension officers. The 35.7% and 13.3% values recorded for mobile phone approach and participatory video approach indicate that ICT-based extension approaches are gaining grounds in agricultural extension service delivery in the study area.

Table 4. 15: Means of Agricultural Knowledge Acquisition by Farmers

Knowledge Dissemination Approach	Number of Farmers	Percentage
Mobile phone	161	35.7%
Participatory video	60	13.3%
Direct contacts with Extension officers	229	50.9%
Total	**450**	**100**

Source: Field survey, 2017

4.5 Using the SERVQUAL Methodology to Measure the Effectiveness of Agricultural Extension Delivery Approaches

As stated in chapter 3.7, the SERVQUAL methodology can be used to measure the effectiveness of extension service delivery. After the elicitation study and discussions with farmers during the focus group meetings, all the five SERVQUAL dimensions were deemed appropriate for the research. Farmers were asked nineteen (19) statements (see appendix

1) to gauge the effectiveness of extension service delivery. The rationale for some the statements are provided as follows: The tangibility statement was included to measure the attractiveness of the physical facilities used by the service provider since it could also be a means to attract farmer's patronage to a particular extension approach. However, the statement on how neat the service provider appears was removed because, for instance under mobile phone extension, the farmer cannot see the service provider. The empathy dimension was included to measure how caring service providers are, and the individualized attention extension providers provide to its customers. The reliability statements measured the ability of the service providers to perform the promised service dependably and accurately. The responsiveness statements measured willingness of service providers to help customers and provide prompt service. And finally, the assurance statement measured the knowledge and courtesy of service providers and their ability to inspire trust and confidence.

4.5.1 Measuring Effectiveness of Mobile Phone Technology Extension Delivery Provision Using Gap Scores

Table 4.16 represents the gap analysis score on mobile phone extension approach. The table represents (perceptions and expectations) statements under the SERVQUAL dimensions

Table 4. 16: Gap Scores of Mobile Phone Extension Provision

Statement	Expectation (E)	Perception	Service Gap (P)
Tangibility			
Physical facilities	4.5	3.0	1.5
		Average gap score	1.5
Reliability			
Deliver services on promised time	5.0	4.0	1
Accurate market information	5.0	3.6	1.4
Trustworthy information	5.0	4.3	0.7
Reliable weather information	5.0	4.3	0.7
		Average gap score	0.95
Responsiveness			
Time space on feedback	4.7	3.5	1.2

Ready and willing to help	4.4	3.6	0.8
Prompt response to needs	4.9	4.0	0.9
Teaches improved practices	4.9	4.3	0.6
		Average gap score	0.88
Assurance			
Store information	4.9	4.0	0.9
Assurance of solving problem	4.4	3.5	0.9
I have gained more knowledge	5.0	4.0	1.0
Up-to-date information	5.0	3.3	1.7
Satisfied with the approach	5.0	3.8	1.2
		Average gap score	1.14
Empathy			
Difficulty to interpret message	5.0	2.6	2.4
Service providers are polite	4.9	3.3	1.6
Personal attention	4.8	2.8	2.0
Access to information on inputs	5.0	3.6	1.4
Access to information on improved practices	5.0	4.0	1.0
		Average gap score	1.68

Source: Field survey, 2017

The difference between the mean of customer's expectation statements and perception statements of service is the 'service gap' (Gap score = expectation – perception) and these values are then averaged for each dimension to compute the average gap score. The statement with a gap score equal to zero is means service is satisfactory. The statement with the highest gap score is the most unsatisfactory and the statement with the least gap score is the least satisfactory. As can be seen in the table 4.7, the responsiveness statement 'Teaches improved practices' recorded the least gap scores (0.6), indicating that it is the most satisfactory among all the SERVQUAL statements. In the same vain, the Assurance statement 'up-to-date information' recorded the highest gap scores (1.7), indicating that it is the most unsatisfactory among all the SERVQUAL statements

4.5.2 Weighted SERVQUAL Scores for Mobile Phone Extension Provision

From Table 4.17, it is seen that empathy is the dimension with the highest gap score (1.68), followed by tangibility (1.5), assurance (1.14), reliability (0.95) and responsiveness with the least gap scores (0.88). This means that empathy dimension is the most unsatisfactory, followed by tangibility, assurance, reliability and responsiveness being the least. Using the

gap score analysis, farmers are most dissatisfied with the dimension of empathy, followed by tangibility, assurance, reliability and responsiveness in the order of least dissatisfaction. In order to obtain weighted SERVQUAL score, respondents were asked to allocate points summing up to 100 among the five dimensions according to the relative importance they place on each of them. Allocation of the points among the dimensions is shown in table 4.17.

From table 4.17, it was seen that empathy was deemed very important by the respondents since it had the highest weight (24.7%), followed by assurance (24.3%), then reliability (20%), responsiveness (18.9%) and with tangibility given the least weight (12.1%).

The weighted SERVQUAL score is achieved by multiplying the average scores of each dimension by farmers' weightings. The weighted SERVQUAL score for the various dimensions really explains the level and magnitude of satisfaction or dissatisfaction as compared to the gap score since the respondents are given the opportunity to score dimensions with points in order of importance.

With regards to the weighted SERVQUAL score, the empathy dimension was the least (0.41) contributor to overall service quality of mobile phone extension approach followed by assurance (0.27), reliability (0.19), tangibles (0.18) and responsiveness (0.17). Decreasing weighted SERVQUAL scores mean less deficiencies or shortcomings for the dimension. The values for the weighted SERVQUAL score show how much each dimension was deficient in contributing to the satisfaction of mobile phone extension users. Service quality is satisfactory if perception meets expectation, hence overall SERVQUAL gap score equal to zero (0) means service is satisfactory. Alternatively, overall SERVQUAL score above zero denotes unsatisfactory services. The higher the weighted average SERVQUAL score for a dimension, the more deficient that dimension is in contributing to service quality and vice versa. The overall weighted SERVQUAL score of positive 1.22, means services delivered by extension providers is unsatisfactory. This means that farmers who receive agricultural extension services from mobile phone are highly dissatisfied with the services received. This means that mobile phone extension provision has not been effective in delivering extension services.

In solving the issue of effectiveness, all the SERVQUAL dimensions should be thoroughly worked on to reduce the service gap and make mobile phone extension more effective.

Table 4. 17: SERVQUAL Scores for Mobile Phone Extension Service Provision

Dimension	Expectations	Perceptions	Gap scores	Weightings	Weighted Average
Tangibility	4.5	3.0	1.5	12.1	0.18
Reliability	5	4.05	0.95	20	0.19
Responsiveness	4.73	3.85	0.88	18.9	0.17
Assurance	4.86	3.72	1.14	24.3	0.27
Empathy	4.94	3.26	1.68	24.7	0.41

Overall Average weighted SERVQUAL score = 1.22 Source: Survey, 2017

4.5.3 The Relative Importance of Each Dimension in Predicting Overall Service Quality of Mobile Phone Extension Service Provision

A regression analysis was performed to examine the relative importance of each of the five dimensions of SERVQUAL on the overall satisfaction of mobile phone extension delivery services. The multiple regression model had an F value of 547.179 and a p value of 0.000. All the SERVQUAL dimensions are making significant contributions to the prediction of intention with $p < 0.01$.

The Adjusted R-square value was 0.859, it implies 85.9% of variation in intention can be explained by all the five dimensions (Tangibility, reliability, responsiveness, assurance and empathy). Conversely 14.1% cannot be explained. As shown in the table 4.18 below, Empathy (0.547) provided the highest contribution to the overall service quality. Followed by assurance (0.314), then reliability (0.107), responsiveness (0.013) and tangibility (0.005).

Comparing the significant values of the independent variables to a p value of 0.05, empathy, assurance and reliability variables make a unique significant contribution to the prediction of Intention to use mobile phone in extension provision while responsiveness and tangibility did not. Empathy contributed (21.3%), followed by assurance (7.7%), then reliability (1.5%), responsiveness (0.0%), and tangibility (0.0%).

Table 4. 18: Impact of SERVQUAL Dimensions on Mobile Phone Extension Provision

Predictor	β	Sig	r^2
Average Tangibility	0.005	0.873	0.00006
Average Reliability	0.107	0.010	0.01464
Average Responsiveness	0.013	0.773	0.00019
Average Assurance	0.314	0.000	0.07728
Average Empathy	0.547	0.000	0.21344
$R^2 = 0.859$, F = 547.173			

**$p < .05$ source: field survey, 2007

4.5.4 Effectiveness of Participatory Video Extension Provision

Table 4.19 represents the gap score analysis of participatory video extension approach. The table represents (perceptions and expectations) statements under the dimensions of tangibility, reliability, responsiveness, assurance and empathy. The difference between the mean of customer's expectation statements and perception statements of service is the 'service gap' which is then averaged for each dimension.

Table 4. 19: Gap Score Analysis of Participatory Video Extension Provision

Statement	Expectation (E)	Perception	Service Gap (P)
Tangibility			
Physical facilities	4.7	4.0	0.7
		Average gap score	0.7
Reliability			
Deliver services on promised time	4.9	3.6	1.3
Accurate market information	4.9	3.0	1.9
Trustworthy information	5.0	4.0	1.0
Reliable weather information	5.0	3.8	1.2
		Average gap score	1.1
Responsiveness			
Time space on feedback	4.9	3.0	1.9
Ready and willing to help	4.7	3.4	1.3

Prompt response to needs	4.9	3.5	1.4
Teaches improved practices	4.9	4.3	0.6
		Average gap score	1.3
Assurance			
Store information	5.0	3.4	1.6
Assurance of solving problem	4.9	3.0	1.9
I have gained more knowledge	5.0	4.2	0.8
Up-to-date information	5.0	4.1	0.9
Satisfied with the approach	5.0	3.3	1.7
		Average gap score	1.38
Empathy			
Difficulty to interpret message	5.0	2.7	2.3
Service providers are polite	6.0	4.0	2.0
Personal attention	4.9	3.4	1.5
Access to information on inputs	5.0	5.0	0
Access to information on improved practices	5.0	4.0	1.0
		Average gap score	1.36

Source: Field survey, 2017

From table 4.19, gap scores between expectations and perceptions in some of the statements are very high; which means that farmers are not satisfied with the service relating to these issues. The following statements that relate to reliability include: deliver services on promised time (1.3), trustworthy information (1), reliable weather information (1.2), For responsiveness, the scores for the following statements are; Time space on feedback (1.9) , ready and willing to help (1), prompt response to needs (1.2). With regard to Assurance, the scores for the following statements are; Store information (1.6), Assurance of solving problem (1.9), I have gained more knowledge (0.8), Up-to-date information (0.9), satisfied with the approach (1.7) For the dimension of Empathy, the scores for the different statements are; difficulty to interpret message (2.3), service providers are polite (2.0), personal attention (1.5), access to information on improved practices (1.0).

It is observed that more gaps are observed in reliability, responsiveness, assurance and empathy dimensions. Service providers therefore need to work extensively to reduce these gaps in order to improve upon quality of extension delivery to farmers.

Also, in Table 4.19 lower gap scores are found between expectations and perceptions in the following dimensions; Tangibility - physical facilities (0.7), Reliability - accurate market information (0.9), responsiveness - teaches improved practices (0.6), Assurance - I have gained more knowledge (0.8), Assurance- up-to-date information (0.9). The lower gap score means that farmers are somehow satisfied with the service in these dimensions. However, service providers need to put some effort to improve upon the services with gaps.

4.5.5 SERVQUAL Scores for Participatory Video Extension Service Provision

From Table 4.20, it is seen that assurance is the dimension with the highest gap score (1.38), followed by empathy (1.36), then reliability (1.35), responsiveness (0.85) and tangibility with the least gap scores (0.88). This means that assurance dimension is the most unsatisfactory, followed by empathy, reliability, responsiveness and tangibility. Using the gap score analysis, it means that farmers are most dissatisfied with the dimension of assurance, followed by empathy, reliability, responsiveness and tangibility being least dissatisfied.

To obtain the weighted SERVQUAL score, respondents were asked to allocate points summing up to 100 among the five dimensions according to the relative importance they place on each of them. Allocation of the points among the dimensions is shown in the table 4.20. From table 4.20, it was seen that assurance was deemed very important by the respondents since it had the highest weight (24.3%), followed by responsiveness (21.9%), then reliability (20%), empathy (18.7%) and with tangibility given the least weight (15.1%). The weighted SERVQUAL score is achieved by multiplying the average scores of each dimension by farmers' weightings. The weighted SERVQUAL score for the various dimensions really explains the level and magnitude of satisfaction or dissatisfaction as compared to the gap score since the respondents are given the opportunity to score dimensions with points in order of importance.

Analyzing the weighted SERVQUAL score, assurance has a score of 0.34 meaning it is most deficient followed by reliability (0.27), then empathy (0.25), responsiveness (0.18) and with tangibility being the least deficient (0.11). The values for the SERVQUAL weighted score show how much each dimension was deficient in contributing to the satisfactory delivery of participatory video extension services to users. Service quality is

satisfactory if perception meets expectation, hence overall SERVQUAL gap score equal to zero (0) means service is satisfactory. Alternatively, overall SERVQUAL score above zero denotes unsatisfactory services. The overall weighted SERVQUAL score is 1.15. Since the overall weighted SERVQUAL value is greater than zero, it means farmers who receive agricultural extension services from providers using participatory video are highly dissatisfied with the services received. This means that participatory video extension provision has not been effective in delivering extension services. In solving the effectiveness of this approach, all the SERVQUAL dimensions should be thoroughly worked on based on the magnitude of the scores in order to reduce the service gap and make participatory video extension more effective.

Table 4. 20: SERVQUAL Scores for Participatory Video Extension Service Provision

Dimension	Expectations	Perceptions	Gap scores	Weightings	Weighted Average
Tangibility	4.7	4.0	0.7	15.1	0.11
Reliability	4.95	3.6	1.35	20	0.27
Responsiveness	4.48	3.63	0.85	21.9	0.18
Assurance	4.98	3.6	1.38	24.3	0.34
Empathy	5.18	3.82	1.36	18.7	0.25

Overall Average weighted SERVQUAL score = 1.15 Source: Field survey, 2017

4.5.6 The Relative Importance of Each Dimension Predicting Overall Service Quality of Participatory Video Extension Provision

To examine the relative importance of each dimension in predicting the overall service quality of participatory video extension delivery services, a regression analysis was performed.

Table 4. 21: Relative Impact of SERVQUAL Dimensions on Participatory Video Extension Provision

Predictor	β	Sig	r^2
Average Tangibility	0.008	0.790	0.00017
Average Reliability	0.083	0.031**	0.01040
Average Responsiveness	0.003	0.930	0.00002
Average Assurance	0.356	0.000**	0.11156
Average Empathy	0.556	0.000**	0.24701
$R^2 = 0.049$, F = 4.6			

**$p < .05$ source: field survey, 2007

The multiple regression model had an F value of 654.480 and a p value of 0.000 meaning that all the SERVQUAL dimensions are making significant unique contributions to the prediction of intention. The p value of 0.00 is lower than 0 .01. The Adjusted R-square value was 0.879, it implies 87.9% of variation in intention can be explained by all the five dimensions (Tangibility, reliability, responsiveness, assurance and empathy). Conversely 12.1% cannot be explained.

As shown in the table 4.21, Empathy (0.556) provided the highest contribution to the overall SERVQUAL dimension. This was followed by assurance (0.356), then reliability (0.083), tangibility (0.008) and responsiveness (0.003). Comparing the p values of the independent variables to at a significance level of 0.05, assurance, empathy and reliability made a unique significant contribution to the prediction of intention to use participatory video provision while reliability, tangibility and responsiveness did not. Empathy contributed 24.7%, followed by assurance (11.1%), reliability (1.0%), responsiveness (0%), and tangibility (0%).

4.5.7 Effectiveness of Direct Contacts with Extension Officers Extension Approach

Table 4.22 represents the gap score analysis of direct contacts approach by extension agents. The table represents (perceptions and expectations) statements under the

dimensions of tangibility, reliability, responsiveness, assurance and empathy. The difference between the mean of customer's expectation and perception statements of service is the 'service gap' which is then averaged for each dimension. From table 4.22 gap scores between expectations and perceptions in some of the statements were very high; which means that farmers were not satisfied with the direct contact service. The dimensions of the respective statements are: Reliability - deliver services on promised time (1.3), trustworthy information (1), reliable weather information (1.23), accurate market information (1.63), and reliable weather information (1.13). With responsiveness - Time space on feedback (1.24), prompt response to needs (1.14). On Assurance- store information (1.53), assurance of solving problem (1.21), Up-to-date information (1.21), satisfied with the approach (1.0). Regarding Empathy- difficulty to interpret message (2.20), access to information on improved practices (1.31). Looking at the high gap scores, service providers have to work to reduce these gaps in order to improve upon quality of direct contact extension delivery to farmers.

Table 4.22 also shows lower gap scores between expectations and perceptions; which means that farmers are somewhat satisfied with the service in these dimensions and statements. For the reliability dimension and its respective statements, the scores are Tangibility - physical facilities are visually appealing (0.67), Reliability - trustworthy information (0.80), Responsiveness- ready and willing to help (0.93), Assurance - I have gained more knowledge (0.92), Empathy - service providers are polite (0.74), personal attention (0.93) and teaches improved practices (0.89). Even though the gap scores are low, the service providers need to put effort to improve upon these services.

Table 4. 22: Gap Score Analysis of Direct Contacts with Extension Agents Extension

Statement	Expectation (E)	Perception	Service Gap (P)
Tangibility			
Physical facilities are visually appealing	4.48	3.81	0.67
		Average gap score	0.67
Reliability			
Deliver services on promised time	4.96	3.73	1.23
Accurate market information	4.93	3.30	1.63
Trustworthy information	4.97	4.17	0.80
Reliable weather information	4.98	3.85	1.13
		Average gap score	1.20
Responsiveness			

Time space on feedback	4.88	3.64	1.24
Ready and willing to help	4.87	3.94	0.93
Prompt response to needs	4.94	3.80	1.14
Teaches improved practices	4.94	4.13	0.81
		Average gap score	1.03
Assurance			
Store information	4.91	3.38	1.53
Assurance of solving problem	4.86	3.65	1.21
I have gained more knowledge	4.97	4.05	0.92
Up-to-date information	4.98	3.77	1.21
Satisfied with the approach	5.00	4.00	1.00
		Average gap score	1.17
Empathy			
Difficulty to interpret message	5.00	2.80	2.20
Service providers are polite	4.94	4.20	0.74
Personal attention	4.77	3.84	0.93
Access to information on inputs	4.99	3.68	1.31
Access to information on improved practices	5.0	4.11	0.89
		Average gap score	1.21

Source: Field survey, 2017

4.5.8 SERVQUAL Scores for Direct Contacts with Extension Agents Extension Service Provision

From Table 4.23, it is seen that assurance is the dimension with the highest gap score (1.24), followed by empathy (1.24), then reliability (1.20), responsiveness (1.03) and tangibility with the least gap scores (0.66). This means that assurance dimension is the most unsatisfactory, followed by empathy, reliability, responsiveness and tangibility being the least. Using the gap score analysis, these high values mean farmers are most dissatisfied with the dimension of assurance, followed by empathy, reliability, responsiveness with tangibility being the least dissatisfied dimension.

In calculating the weighted SERVQUAL score, respondents were asked to allocate points summing up to 100 among the five dimensions according to the relative importance they place on each of them. The weighted scores for the dimensions are shown in the Table 4.23.

It is seen from the Table that responsiveness was deemed very important by the respondents since it had the highest weight (26.8%), followed by assurance (24.3%), then reliability (23.2%), empathy (17.5%) and with tangibility given the least weight (8.2%). The weighted SERVQUAL score is computed by multiplying the average scores of each dimension by farmers' weightings. The weighted SERVQUAL score for the various dimensions really explains the level and magnitude of satisfaction or dissatisfaction as compared to the gap score since the respondents are given the opportunity to score dimensions with points in order of importance.

Analysis of the weighted SERVQUAL score, indicates that assurance (0.3) is most the deficient dimension in contributing to the overall service quality followed by reliability (0.28), then responsiveness (0.27), empathy (0.21) and tangibility been least deficient (0.05). The values for the SERVQUAL weighted score show how much each dimension was deficient in contributing to the satisfaction of direct contacts with extension agents' provision users. Service quality is satisfactory if perception meets expectation, hence overall SERVQUAL gap score equal to zero (0) means service is satisfactory. Alternatively, overall SERVQUAL score above zero denotes unsatisfactory services. The overall weighted SERVQUAL score is 1.11. This means that farmers who receive agricultural extension services from direct contacts with extension agents' provision are dissatisfied with the services received. This means that direct contacts with extension agents' extension provision has not been effective in delivering extension services.

To tackle the issue of effectiveness of extension service delivery, all the SERVQUAL dimensions and related scores should be looked at and those with the highest scores worked on based to reduce the service gap and to improve the impact of direct contacts of extension agents with farmers.

Table 4.23: SERVQUAL scores for Direct Contacts with Extension Agents' Extension Service Provision

Dimension	Expectations	Perceptions	Gap scores	Weightings	Weighted Average
Tangibility	4.47	3.81	0.66	8.2	0.05
Reliability	4.96	3.76	1.20	23.2	0.28
Responsiveness	4.91	3.88	1.03	26.8	0.27
Assurance	4.94	3.7	1.24	24.3	0.30
Empathy	4.94	3.73	1.21	17.5	0.21

Overall Average weighted SERVQUAL score = 1.11 Source: Field survey, 2017

4.5.10 Relative Impact of SERVQUAL Dimensions on Direct Contacts of Extension Agents with Farmers in Agricultural Extension Service Provision

Regression analysis was performed to assess the impact of each of the five dimensions of SERVQUAL on the overall satisfaction of direct contacts extension approach used by extension agents in extension provision. The multiple regression model had an F value of 398.740 and a p value of 0.000. This means that all the SERVQUAL dimensions make significant unique contributions to the intention to use mobile phones as the p is less than 0.05.

The Adjusted R-square value was 0.816 and it implies 81.6% of variation in intention to use direct contact can be explained by all the five dimensions (Tangibility, reliability, responsiveness, assurance and empathy). Conversely 18.4% cannot be explained. As shown in the table 4.24, Empathy with a value of 0.503 provided the highest contribution to the overall SERVQUAL dimension. This is followed by assurance (0.424), then reliability (0.127), responsiveness (-0.104), and tangibility (0.003). Comparing these values of the independent variables at the significance level of 0.05, assurance, empathy and reliability can be said to have made a significant contribution to the prediction of Intention to direct contacts in extension provision while tangibility and responsiveness did not. Empathy contributed (15.0%), followed by assurance (10.5%), reliability (1.6%), responsiveness (0. %), and tangibility (0%).

Table 4. 24: Impact of SERVQUAL Dimensions on Direct Contacts with Extension Agents' Extension Provision

Predictor	β	Sig	r^2
Average Tangibility	0.003	0.938	0.00002
Average Reliability	0.127	0.008***	0.01588
Average Responsiveness	-0.104	0.036**	0.00980
Average Assurance	0.424	0.000***	0.10498
Average Empathy	0.503	0.000***	0.14977
$R^2 = 0.049$, F = 4.6			

**$p < .05$; ***$p < .01$ source: field survey, 2007

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.0 Introduction

Summary, conclusions and recommendations as well as the implications of the present study findings are presented in this chapter. The conclusions presented in this chapter are derived from the research findings and seek to provide answers to the research questions. In the recommendations, proposals are made about institutional and policy actions that need to be taken to strengthen the role and perceived effectiveness of mobile phone technology within the area of agricultural extension in Ghana.

5.1 Summary

1. Analysis of the means by which farmers in the survey areas acquire agricultural knowledge show that direct contact extension approach was highly patronised (50.3%) followed by mobile phone (35%) and then participatory video approach which was 13.3%.
2. In using regression to analyse the relationship between the intention to use mobile phone extension and the behaviour predictors (Attitudes, Perceived Behavioural Control and Subjective Norms), the study shows that attitudes and subjective norms significantly influenced the intention to use mobile phone extension. On other hand, perceived behavioural control did not influence the intention to use mobile phone extension approach.
3. Using the SERVQUAL methodology, the overall weighted SERVQUAL score is for the intention of farmers to use direct contact agricultural extension is 1.11. This figure implies that farmers in the study areas surveyed show great disaffection with the services provided through the direct extension approach. The most deficient dimensions contributing to the disaffection to direct contact extension are assurance reliability, responsiveness and tangibility in order of decreasing importance.
4. Under participatory video extension approach, all the five dimensions -tangibility, reliability, responsiveness, assurance and empathy explained the intention to use this extension approach. For the participatory video extension approach, the overall weighted SERVQUAL score was 1.15 implying that farmers are disaffected with this

mode of extension services provision. The SERVQUAL dimensions contributing to the disaffection of the farmers are assurance, reliability, tangibility and responsiveness in decreasing order of importance.

5. Finally, under mobile phone extension approach, all the five dimensions strongly influence the intention to use mobile phones in seeking for agricultural information. The overall average weighted SERVQUAL score for mobile phone extension approach is 1.22. For the farmers surveyed in the study areas, empathy, assurance, reliability, reliability, responsiveness and tangibility significantly influence farmers intention to use mobile phone in that increasing order of importance.
6. The research results show that demographic variables such as gender, age and educational level have significant influence on the farmers' intention to use mobile phone for accessing agricultural information. Respondents' age and educational level are more influential than gender. The age group 21-30 had the highest intention to use mobile phone followed by 18-20, then 31-40, 60+, 51-60 and 51-60 age categories. Among farmers who were ready to use mobile phone in agricultural extension service provision, farmers with formal education had more intention to use mobile phones than farmers without formal education.

5.2 Conclusions

1. The study results indicate that opinion leaders, extension agents and NGOs have significant influence on farmers' decision to use mobile phone in agricultural extension service provision. NGOs are more influential in increasing farmers' intention to use mobile phone to access agricultural information.
2. Considering that the introduction ICT (mobile phone and video) in agricultural extension has been relatively recent, the high percentage of farmers patronizing it shows that it is a growing trend which must be acknowledged by policy makers. The two ICT approaches total 49.0% almost equal to the old traditional form of direct contacts extension (51%)
3. Behaviour predictors are important factors to be considered in developing mobile phone extension approach. In this regard, specific demographic factors have to be taken into account in developing the approach. Extension service providers should therefore make sure that extension messages are relevant, easy to interpret and

understand before it is delivered to farmers. Also, if messages sent to farmers are not related to farmers' cultivated crops, it will diminish farmers' interest in patronizing mobile phone extension provision.

4. The SERVQUAL weighted average scores show generally that farmers are generally dissatisfied with ICT extension approaches. This means that these ICT approaches including the mobile phone approach have not been very effective due to the inadequate services provided by the telecommunication service providers.

5.3 Recommendations

1. There is need for institutional collaboration between MoFA, the telecommunication networks and key stakeholders in agriculture to develop a strategy to speed up and to implement effective mobile phone technology in agricultural extension. As has been indicated in the conclusion, opinion leaders, extension agents and NGOs are key stakeholders in agricultural extension with influence on the behaviours of farmers so their perspectives are very important in developing an all-encompassing mobile phone package for agricultural extension.
2. Since ICT extension approaches are in vogue and are becoming highly patronised, policy makers should review and update the E policy in agriculture. For instance, voice and video messages in local languages should be used as part of integrated means of transferring knowledge. In addition, the range of information provided should be expanded to include weather and marketing extension messages. For these measures to be effective and to achieve their intended objectives, MoFA, Development Partners and agricultural projects should mount vigorous campaigns to sensitize and educate farmers on the use of ICT in agricultural extension. This recommendation is more critical at this period when the government is implementing very ambitious agricultural interventions such as the Planting for Food and Jobs programme(PFJ) and developing a new agricultural investment plan. Agricultural extension agents who generally assist farmers in the use of mobile phone technology also must have their capacities enhanced. They should be provided with smart phones/tablet computers and their technical skills built. This will enable them to effectively support farmers.

3. As Shown in Fig 2, an enabling environment is critical to enhance the effectiveness of ICT used in agricultural extension service provision. Also, all the average weighted SERVQUAL scores indicate that the five dimensions which contribute to service quality relate to the services provided by telecommunications networks. In this regard, government must provide the enabling environment for the service providers to install the requisite infrastructure and software to aid the effectiveness of ICT services in agricultural extension.

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APPENDICES

APPENDIX I: SURVEY QUESTIONNAIRE
QUESTIONNAIRE ON EFFECTIVENESS OF AGRICULTURAL EXTENSION APPROACHES ON EXTENSION SERVICES DELIVERY IN NORTHERN GHANA.

As you know, agricultural extension delivery approaches vary widely. Some farmers receive extension through personal visits, others received through ICT-based extension approaches by use of tools such as mobile phone and participatory video. The present survey is part of an investigation that tries to discover the effectiveness these agricultural extension approaches on extension services delivery. Please read each question carefully and answer it to the best of your ability. There are no correct or incorrect responses; we are merely interested in your personal point of view. However, all responses to this survey are completely confidential.

A. Demographic data

1. Name of community? …….
2. Name of farmer: ……
3. Gender 1. Male [ ] 2. Female [ ]
4. Age. a. 18-20 [ ] b. 21-30 [ ] c. 31-40 [ ] d. 41-50 [ ] e. 51- 60[ ] g. 61 and above [ ]
5. Marital status. 1. Married [ ] 2. Single [ ] 3. Divorced [ ] 4. Widowed [ ]
6. What's the size of your household? ……..
7. Educational level? 1. Primary school [ ] 2. Junior high school [ ] 3. Secondary/vocational institute [ ] 4. Tertiary[ ] 5. No formal education[ ]
8. Are you a member of a farm group? a. Yes [ ] b. No [ ]

B. Effectiveness of extension services delivery

1. Have you ever receive/patronized extension service using one of the following knowledge management approaches?
   a) Mobile phone **Yes = 1** **No = 2**
   b) Participatory video **Yes = 1** **No = 2**
   c) Direct contacts with extension officers **Yes = 1** **No = 2**
2. For how long have you received/ patronised extension services using this approach?

_____

3. How are these knowledge management services provided to you? a. Through periodic sms/voice messages [ ]
b. through demonstrations [ ] c. Through community video streaming session [ ] d. Others (specify)……

4. What perceived need does the service address for you? _____

5. In what areas do you think the knowledge management approaches should address your needs?

_____

6. Before adopting one of these extension approaches, how did you plan your farming activities?

_____

7. Are you willing to pay for the approach you have chosen? a. Yes [ ] b. No [ ]

8. Do you plan to continue patronising knowledge management service/s? a. Yes [ ] b. No [ ]

C. Farmers' Expectations and Perceptions with regards to Knowledge Management Approach Patronised

Please indicate your response to the following statements which describes the possible outcomes from your engagement in the following knowledge management approaches (mobile phone, participatory video, direct contacts with extension officers).

C1. Farmers' Expectations

The physical facilities (materials) used by the knowledge management approach should be visually appealing.	Strongly disagree (-2)	Disagree (-1)	Don't know (0)	Agree (+1)	Strongly Agree (+2)
I should get personal attention as an individual patronizing the knowledge management approach	Strongly disagree (-2)	Disagree (-1)	Don't know (0)	Agree (+1)	Strongly Agree (+2)
It should not take more time than I expect before I receive feedback from the service, when I request certain information.	Strongly disagree (-2)	Disagree (-1)	Don't know (0)	Agree (+1)	Strongly Agree (+2)
Service providers should always be willing and ready to help me solve my problems	Strongly disagree (-2)	Disagree (-1)	Don't know (0)	Agree (+1)	Strongly Agree (+2)
This approach should help me store information already delivered to me and should be retrieved when the need arises.	Strongly disagree (-2)	Disagree (-1)	Don't know (0)	Agree (+1)	Strongly Agree (+2)
This approach should provide its services at the time it promises to do so.	Strongly disagree (-2)	Disagree (-1)	Don't know (0)	Agree (+1)	Strongly Agree (+2)
This knowledge management approach should provide me with accurate and timely market information on agricultural products and transport costs	Strongly disagree (-2)	Disagree (-1)	Don't know (0)	Agree (+1)	Strongly Agree (+2)
The knowledge management approach should provide me with weather information which helps me plan my planting activities	Strongly disagree (-2)	Disagree (-1)	Don't know (0)	Agree (+1)	Strongly Agree (+2)
The knowledge management approach should provide services that promptly addresses my concerns	Strongly disagree (-2)	Disagree (-1)	Don't know (0)	Agree (+1)	Strongly Agree (+2)
The knowledge management approach should help me in the use of improved practices (e.g. fertilizer application, storage etc.)	Strongly disagree (-2)	Disagree (-1)	Don't know (0)	Agree (+1)	Strongly Agree (+2)
When I present my problems to the service provider, I should have assurance that it shall be solved immediately	Strongly disagree (-2)	Disagree (-1)	Don't know (0)	Agree (+1)	Strongly Agree (+2)
The information provided by the knowledge management approach should be trustworthy	Strongly disagree (-2)	Disagree (-1)	Don't know (0)	Agree (+1)	Strongly Agree (+2)
Service providers must be always polite in communicating with me	Strongly disagree (-2)	Disagree (-1)	Don't know (0)	Agree (+1)	Strongly Agree (+2)
I should be able to source improved farm machinery (e.g. tractor, harvester etc.) since I have started patronizing this knowledge management approach	Strongly disagree (-2)	Disagree (-1)	Don't know (0)	Agree (+1)	Strongly Agree (+2)
I should expanded my scale of production always, patronizing this knowledge management approach	Strongly disagree (-2)	Disagree (-1)	Don't know (0)	Agree (+1)	Strongly Agree (+2)
I should have access to agricultural information on inputs patronizing this Knowledge management approach	Strongly disagree (-2)	Disagree (-1)	Don't know (0)	Agree (+1)	Strongly Agree (+2)
I should receive agricultural information on improved practices/new technologies patronizing this Knowledge management approach	Strongly disagree (-2)	Disagree (-1)	Don't know (0)	Agree (+1)	Strongly Agree (+2)
I should gain more knowledge in managing my farm and increased in income patronizing this knowledge management approach	Strongly disagree (-2)	Disagree (-1)	Don't know (0)	Agree (+1)	Strongly Agree (+2)
I should not difficult interpreting messages from the knowledge management approach	Strongly disagree (-2)	Disagree (-1)	Don't know (0)	Agree (+1)	Strongly Agree (+2)
The knowledge management approach should give me up-to-date information	Strongly disagree (-2)	Disagree (-1)	Don't know (0)	Agree (+1)	Strongly Agree (+2)
I should be satisfied with the knowledge management approach I patronize	Strongly disagree (-2)	Disagree (-1)	Don't know (0)	Agree (+1)	Strongly Agree (+2)

C2. Farmers' Perceptions

The physical facilities used by the knowledge management approach are visually appealing.	Strongly disagree (-2)	Disagree (-1)	Don't know (0)	Agree (+1)	Strongly Agree (+2)
I do get personal attention as an individual patronizing the knowledge management approach	Strongly disagree (-2)	Disagree (-1)	Don't know (0)	Agree (+1)	Strongly Agree (+2)
It does not take more time than I expect before I receive feedback from the service, when I request certain information.	Strongly disagree (-2)	Disagree (-1)	Don't know (0)	Agree (+1)	Strongly Agree (+2)
Service providers are always willing and ready to help me solve my problems	Strongly disagree (-2)	Disagree (-1)	Don't know (0)	Agree (+1)	Strongly Agree (+2)
This approach helps me store information already delivered to me and can be retrieved when the need arises.	Strongly disagree (-2)	Disagree (-1)	Don't know (0)	Agree (+1)	Strongly Agree (+2)
The approach provides its services at the time it promises to do so.	Strongly disagree (-2)	Disagree (-1)	Don't know (0)	Agree (+1)	Strongly Agree (+2)
The knowledge management approach provides me with accurate and timely market information on agricultural products and transport costs	Strongly disagree (-2)	Disagree (-1)	Don't know (0)	Agree (+1)	Strongly Agree (+2)
The knowledge management approach provides me with weather information which helps me plan my planting activities	Strongly disagree (-2)	Disagree (-1)	Don't know (0)	Agree (+1)	Strongly Agree (+2)
The knowledge management approach provide services that promptly addresses my concerns	Strongly disagree (-2)	Disagree (-1)	Don't know (0)	Agree (+1)	Strongly Agree (+2)
The knowledge management approach has helped me in the use of improved practices (e.g. fertilizer application, storage etc.)	Strongly disagree (-2)	Disagree (-1)	Don't know (0)	Agree (+1)	Strongly Agree (+2)
When I present my problems to the service provider, I have assurance that it shall be solved immediately	Strongly disagree (-2)	Disagree (-1)	Don't know (0)	Agree (+1)	Strongly Agree (+2)
The information provided by the knowledge management approach is trustworthy	Strongly disagree (-2)	Disagree (-1)	Don't know (0)	Agree (+1)	Strongly Agree (+2)
Service providers are always polite in communicating with me	Strongly disagree (-2)	Disagree (-1)	Don't know (0)	Agree (+1)	Strongly Agree (+2)
I am able to source improved farm machinery (e.g. tractor, harvester etc.) since I have started patronizing this knowledge management approach	Strongly disagree (-2)	Disagree (-1)	Don't know (0)	Agree (+1)	Strongly Agree (+2)
I have expanded my scale of production since I started patronizing this knowledge management approach	Strongly disagree (-2)	Disagree (-1)	Don't know (0)	Agree (+1)	Strongly Agree (+2)
I have access to agricultural information on inputs patronizing this Knowledge management approach	Strongly disagree (-2)	Disagree (-1)	Don't know (0)	Agree (+1)	Strongly Agree (+2)
I receive agricultural information on improved practices/new technologies patronizing this Knowledge management approach	Strongly disagree (-2)	Disagree (-1)	Don't know (0)	Agree (+1)	Strongly Agree (+2)
I have gained more knowledge in managing my farm and increased in income patronizing this knowledge management approach	Strongly disagree (-2)	Disagree (-1)	Don't know (0)	Agree (+1)	Strongly Agree (+2)

I find it difficult interpreting messages from the knowledge management approach	Strongly disagree (-2)	Disagree (-1)	Don't know (0)	Agree (+1)	Strongly Agree (+2)
The knowledge management approach gives me up-to-date information	Strongly disagree (-2)	Disagree (-1)	Don't know (0)	Agree (+1)	Strongly Agree (+2)
I am satisfied with the knowledge management approach I patronize	Strongly disagree (-2)	Disagree (-1)	Don't know (0)	Agree (+1)	Strongly Agree (+2)

D. Farmers' Intention

Intention

1a. I intend to use Mobile phone/Participatory video/Direct contacts with extension officers for accessing agricultural information next year

Strongly Disagree (-2) Disagree (-1) Don't Know (0) Agree (+1) Strongly agree (+2)

1b. For me, to use Mobile phone/Participatory video/Direct contacts with extension officers for accessing agricultural information next year is

Extremely unlikely (-2) unlikely (-1) Don't Know (0) likely(+1) Extremely likely(+2)

E. Farmers' attitudes

What do you see as the advantages of your use of mobile phone/participatory video /direct contacts with extension officers?

1a. Using mobile phone/participatory video /direct contacts with extension officers helps me to access relevant agricultural information easily

Strongly Disagree (-2) Disagree (-1) Don't Know (0) Agree (+1) Strongly agree (+2)

1b. For me, having easy access to relevant agricultural information, using Mobile phone/Participatory video/Direct contacts with extension officers is

Extremely undesirable (-2)	Undesirable (-1)	Don't Know (0)	Desirable (+1)	Extremely desirable (+2)

2a. Extension messages from Mobile phone/Participatory video/Direct contacts with extension officers helps me plan my farming activities well

Strongly Disagree (-2) Disagree (-1) Don't Know (0) Agree (+1) Strongly agree (+2)

2b. For me, to plan my farming activities well using extension messages from Mobile phone/Participatory video/Direct contacts with extension officers is

Extremely undesirable (-2)	Undesirable (-1)	Don't Know (0)	Desirable (+1)	Extremely desirable (+2)

3a. Extension messages from Mobile phone/Participatory video/Direct contacts with extension officers helps me develop my knowledge on good farming practices

Strongly Disagree (-2)	Disagree (-1)	Don't Know (0)	Agree (+1)	Strongly agree (+2)

3b. For me, to develop my knowledge on good farming practices using Extension messages from Mobile phone/Participatory video/Direct contacts with extension officers is

Extremely undesirable (-2)	undesirable (-1)	Don't Know (0)	Desirable (+1)	Extremely desirable (+2)

4a. Using Mobile phone/Participatory video/Direct contacts with extension officers helps me increase my yields through reliance on agricultural information from this source.

Strongly Disagree (-2)	Disagree (-1)	Don't Know (0)	Agree (+1)	Strongly agree (+2)

4b. For me, to increase yields using Extension messages from Mobile phone/Participatory video/Direct contacts with extension officers is

Extremely undesirable (-2)	undesirable (-1)	Don't Know (0)	Desirable (+1)	Extremely desirable (+2)

5a. Using Mobile phone/Participatory video/Direct contacts with extension officers helps me have easy link to consumers of my farm products

Strongly Disagree (-2)	Disagree (-1)	Don't Know (0)	Agree (+1)	Strongly agree (+2)

5b. For me, to have easy link to consumers Using Mobile phone/Participatory video/Direct contacts with extension officers is

Extremely undesirable (-2)	undesirable (-1)	Don't Know (0)	Desirable (+1)	Extremely desirable (+2)

6a. Using Mobile phone/Participatory video/Direct contacts with extension officers helps me have easy link to input dealers.

Strongly Disagree (-2)	Disagree (-1)	Don't Know (0)	Agree (+1)	Strongly agree (+2)

6b. For me, to have easy link to input dealers using Mobile phone/Participatory video/Direct contacts with extension officers is

Extremely undesirable (-2)	undesirable (-1)	Don't Know (0)	Desirable (+1)	Extremelydesirable (+2)

7a. Using Mobile phone/Participatory video/Direct contacts with extension officers helps reduce my cost of farm operation.

Strongly Disagree (-2)	Disagree (-1)	Don't Know (0)	Agree (+1)	Strongly agree (+2)

7b. For me, to reduce my cost of farm operation using Mobile phone/Participatory video/Direct contacts with extension officers is

Extremely undesirable (-2)	undesirable (-1)	Don't Know (0)	Desirable (+1)	Extremely desirable (+2)

8a. On-farm demonstrations makes me understand better using Mobile phone/Participatory video/Direct contacts with extension officers.

Strongly Disagree (-2)	Disagree (-1)	Don't Know (0)	Agree (+1)	Strongly agree (+2)

8b. For me, to understand better during on-farm demonstrations using Mobile phone/Participatory video/Direct contacts with extension officers is

Extremely undesirable (-2)	undesirable (-1)	Don't Know (0)	Desirable (+1)	Extremely desirable (+2)

F. Perceived Behavioral Control

1a. I find it difficult to interpret/understand information from Mobile phone/Participatory video/Direct contacts with extension officers.

Strongly Disagree (-2)	Disagree (-1)	Don't Know (0)	Agree (+1)	Strongly agree (+2)

1b. For me, the difficulty associated with interpreting/understanding information using Mobile phone/Participatory video/Direct contacts with extension officers is

Extremely undesirable (-2)	undesirable (-1)	Don't Know (0)	Desirable (+1)	Extremely desirable (+2)

2a. I do not get information on time using Mobile phone/Participatory video/Direct contacts with extension officers

Strongly Disagree	Disagree	Don't Know	Agree	Strongly agree
(-2)	(-1)	(0)	(+1)	(+2)

2b. For me, not getting information on time using Mobile phone/Participatory video/Direct contacts with extension officers is

Extremely undesirable (-2)	undesirable (-1)	Don't Know	Desirable	Extremely desirable
		(0)	(+1)	(+2)

3a. Sometimes, I find it difficult to get the exact information on my crop type using Mobile phone/Participatory video/Direct contacts with extension officers.

Strongly Disagree	Disagree	Don't Know	Agree	Strongly agree
(-2)	(-1)	(0)	(+1)	(+2)

3b. For me, to find it difficult getting the exact information on my crop type using Mobile phone/Participatory video/Direct contacts with extension officers is

Extremely undesirable	undesirable	Don't Know	Desirable	Extremely desirable
(-2)	(-1)	(0)	(+1)	(+2)

G. Past behaviour

1a. During last year I used Mobile phone/Participatory video/Direct contacts with extension officers for accessing agricultural information

Strongly Disagree (-2) Disagree (-1) Don't Know (0) Agree (+1) Strongly agree (+2)

1b. My use of Mobile phone/Participatory video/Direct contacts with extension officers for accessing agricultural information last year was

Extremely undesirable (-2)	undesirable (-1)	Don't Know	Desirable	Extremely desirable
		(0)	(+1)	(+2)

H. Normative Referents

1a. NGOs think that I should use Mobile phone/Participatory video/Direct contacts with extension officers to access agricultural information

Strongly Disagree	Disagree	Don't Know	Agree	Strongly agree
(-2)	(-1)	(0)	(+1)	(+2)

1b. For me to use Mobile phone/Participatory video/Direct contacts with extension officers to access agricultural information, as recommended by NGOs is

Extremely unlikely	Unlikely	Don't Know (0)	Likely	Extremely likely
(-2)	(-1)		(+1)	(+2)

2a. Religious leaders think that I should use Mobile phone/Participatory video/Direct contacts with extension officers to access agricultural information

Strongly Disagree	Disagree	Don't Know	Agree	Strongly agree
(-2)	(-1)	(0)	(+1)	(+2)

2b. For me to use Mobile phone/Participatory video/Direct contacts with extension officers to access agricultural information, as recommended by religious leaders is

Extremely unlikely	unlikely	Don't Know	Likely	Extremely likely
(-2)	(-1)	(0)	(+1)	(+2)

3a. Extension agents think that I should use Mobile phone/Participatory video/Direct contacts with extension officers to access agricultural information

Strongly Disagree	Disagree	Don't Know	Agree	Strongly agree
(-2)	(-1)	(0)	(+1)	(+2)

3b. For me to use Mobile phone/Participatory video/Direct contacts with extension officers to access agricultural information, recommended by extension agents is

Extremely unlikely	unlikely	Don't Know	Likely	Extremely likely
(-2)	(-1)	(0)	(+1)	(+2)

4a. Opinion leaders think that I should use Mobile phone/Participatory video/Direct contacts with extension officers to access agricultural information

Strongly Disagree	Disagree	Don't Know	Agree	Strongly agree
(-2)	(-1)	(0)	(+1)	(+2)

4b. For me to use Mobile phone/Participatory video/Direct contacts with extension officers to access agricultural information, recommended by opinion leaders is

Extremely unlikely	unlikely	Don't Know	Likely	Extremely likely
(-2)	(-1)	(0)	(+1)	(+2)

5. Please list the individuals or groups who are most likely to use mobile phone/participatory video/direct contacts with extension officers for accessing farming information.

[ ] Commercial farmers [ ] My friends/Peers [ ] opinion leaders

[ ] Others (specify) _____

I. Control Factors

Please list any factors or circumstances that would make it easy or enable you to use mobile phone/participatory video/direct contacts with extension officers for accessing farming information.

1a. I am confident that I will use mobile phone/ participatory video /direct contacts with extension officers for accessing agricultural information if I am able to interpret extension messages from it.

Strongly Disagree	Disagree	Don't Know	Agree	Strongly agree
(-2)	(-1)	(0)	(+1)	(+2)

1b. For me to use mobile phone/ participatory video /direct contacts with extension officers for accessing agricultural information interpreting extension messages from it is entirely up to me

Strongly Disagree	Disagree	Don't Know	Agree	Strongly agree
(-2)	(-1)	(0)	(+1)	(+2)

2a. I am confident that incurring high cost when accessing agricultural information will make it difficult for me to use mobile phone/ participatory video/direct contacts with extension officers.

Strongly Disagree	Disagree	Don't Know	Agree	Strongly agree
(-2)	(-1)	(0)	(+1)	(+2)

2b. For me to incur high cost accessing agricultural information using mobile phone/ participatory video /direct contacts with extension officers is entirely up to me

Strongly Disagree	Disagree	Don't Know	Agree	Strongly agree
(-2)	(-1)	(0)	(+1)	(+2)

3a. I am confident that I will use mobile phone/ participatory video /direct contacts with extension officers for accessing farming information if incentives are given for best adoption practices

Strongly Disagree	Disagree	Don't Know	Agree	Strongly agree
(-2)	(-1)	(0)	(+1)	(+2)

3b. For me to use mobile phone/ participatory video /direct contacts with extension officers for accessing farming information if incentives are given for best adoption practices is up to me

Strongly Disagree	Disagree	Don't Know	Agree	Strongly agree
(-2)	(-1)	(0)	(+1)	(+2)

4a. I am confident that I will use mobile phone/ participatory video /direct contacts with extension officers for accessing farming information if it links me with tractor services

Strongly Disagree	Disagree	Don't Know	Agree	Strongly agree
(-2)	(-1)	(0)	(+1)	(+2)

4b. For me to use mobile phone/ participatory video /direct contacts with extension officers if it links me to tractor services is up to me

Strongly Disagree	Disagree	Don't Know	Agree	Strongly agree
(-2)	(-1)	(0)	(+1)	(+2)

J. Influence of Knowledge Management Approaches on Farmers' Adoption

1. Do you use mobile phone to seek extension services? a. Yes [ ] b. No [ ]
2. Do you always receive the information required on time using mobile phone? a. Yes [ ] b. No [ ]
3. Are you able to interpret the messages you receive on your mobile phone? a. Yes [ ] b. No [ ]
4. Are you satisfied with the mobile phone extension services? a. Yes [ ] b. No [ ] c. Don't know [ ].
5. If you are not satisfied with the services provided, what do you expect from the services that you don't get?

   _____
   __
6. How will you rate the mobile phone knowledge management approach?
7. Very bad [ ] b. Bad [ ] c. Good [ ] d. Extremely good [ ] e. Don't know [ ].
8. How do you find the use of mobile phone technology? a. Very easy [ ] b. Easy [ ] c. Fairly difficult [ ] d. Extremely difficult [ ] e. Don't know [ ].
9. Do you patronise participatory videos for extension information? a. Yes [ ] b. No [ ]
10. Are you able to interpret messages from participatory video? a. Yes [ ] b. No [ ] c. Don't know [ ].
11. Are you satisfied with the participatory video knowledge management approach? a. Yes [ ] b. No [ ] c. Don't know [ ]
12. If you are not satisfied with the services provided by this approach, what do you expect from the services that you don't get?

    _____
    _____
13. How will you rate participatory video approach? a. Very bad [ ] b. Bad [ ] c. Good [ ] d. Extremely good [ ] e. Don't know [ ].
14. Do you contact extension officers for your agricultural information? a. Yes [ ] b. No [ ].
15. Do you always receive the information required on time when you are contacting extension officers? a. Yes [ ] b. No [ ].
16. Are you satisfied with the direct contact with extension officers system? a. Yes [ ] b. No [ ] c. Don't know [ ].
17. If you are not satisfied with the services provided by this approach, what do you expect from the services that you don't get?

    _____
    _____
18. How will you rate the direct contacts with extension agents' delivery system?
    a. Very bad [ ] b. Bad [ ] c. Good [ ] d. Extremely good [ ] e. Don't know [ ].

19. Where do you gain extension knowledge to manage your farm?
    a. Through mobile phone [ ] b. Through participatory video [ ] c. Through direct contacts with extension agents [ ].
20. What are the advantages of the approach you have mentioned? …… ……
21. What are the disadvantages of the approach you have mentioned? …… ……
22. What are the outcomes of the use of the knowledge management options available to you? …… ……
23. What are the things that would place an impediment on the use of the knowledge management options available to you?

…… ……

24. What are the things that would facilitate the use of the knowledge management options available to you?

…… …… ……

Thank you.

APPENDIX II.
RELASHIONSHIP BETWEEN RESPONDENTS' GENDER AND READINESS TO USE MOBILE PHONE TECHNOLOGY

Gender * Have you ever received/patronised extension services using Mobile phone? Crosstabulation

			Have you ever received/patronised extension services using Mobile phone?		Total
			Yes	No	
Gender	1	Count	150	263	413
		% within Gender	36.3%	63.7%	100.0%
		% within Have you ever received/patronised extension services using Mobile phone?	93.2%	91.0%	91.8%
		% of Total	33.3%	58.4%	91.8%
	2	Count	11	26	37
		% within Gender	29.7%	70.3%	100.0%
		% within Have you ever received/patronised extension services using Mobile phone?	6.8%	9.0%	8.2%
		% of Total	2.4%	5.8%	8.2%
Total		Count	161	289	450
		% within Gender	35.8%	64.2%	100.0%
		% within Have you ever received/patronised extension services using Mobile phone?	100.0%	100.0%	100.0%
		% of Total	35.8%	64.2%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.642[a]	1	.423		
Continuity Correction[b]	.387	1	.534		
Likelihood Ratio	.659	1	.417		
Fisher's Exact Test				.478	.270
N of Valid Cases	450				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 13.24.
b. Computed only for a 2x2 table

Symmetric Measures

		Value	Approx. Sig.
Nominal by Nominal	Phi	.038	.423
	Cramer's V	.038	.423

N of Valid Cases	450	

a. Not assuming the null hypothesis.
b. Using the asymptotic standard error assuming the null hypothesis.

APPENDIX III
THE IMPACT OF BAHAVIOUR PREDICTORS ON INTENTION TO USE MOBILE PHONE PROVISION

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.834[a]	.695	.693	2.531

a. Predictors: (Constant), Weighted_Sum_of_SN, Weighted_Sum_of_PBC, Weighted_Sum_of_Attitude

b. Dependent Variable: intention for mobile phone use

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	6514.258	3	2171.419	339.047	.000[b]
	Residual	2856.400	446	6.404		
	Total	9370.658	449			

a. Dependent Variable: intention for mobile phone use

b. Predictors: (Constant), Weighted_Sum_of_SN, Weighted_Sum_of_PBC, Weighted_Sum_of_Attitude

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Correlations			Colline
	B	Std. Error	Beta			Lower Bound	Upper Bound	Zero-order	Partial	Part	Tolera
1 (Constant)	.934	.479		1.949	.052	-.008	1.877				

	Weighted_Sum_of_Attitude	.069	.010	.425	7.273	.000	.051	.088	.808	.326	.190
	Weighted_Sum_of_PBC	-.036	.009	-.101	-3.818	.000	-.054	-.017	-.074	-.178	-.100
	Weighted_Sum_of_SN	.118	.016	.429	7.323	.000	.086	.149	.802	.328	.191

a. Dependent Variable: intention for mobile phone use

Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions			
				(Constant)	Weighted_Sum_of_Attitude	Weighted_Sum_of_PBC	Weighted_Sum_of_SN
1	1	3.766	1.000	.00	.00	.01	.00
	2	.173	4.662	.00	.02	.68	.02
	3	.051	8.586	.88	.01	.28	.07
	4	.010	19.329	.12	.97	.03	.91

a. Dependent Variable: intention for mobile phone use

Chi-Square Tests

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	7.694[a]	5	.174
Likelihood Ratio	7.796	5	.168
N of Valid Cases	450		

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 9.30.

Symmetric Measures

		Value	Approx. Sig.
Nominal by Nominal	Phi	.131	.174
	Cramer's V	.131	.174
N of Valid Cases		450	

a. Not assuming the null hypothesis.
b. Using the asymptotic standard error assuming the null hypothesis.

APPENDIX IV

RELASHIONSHIP BETWEEN RESPONDENTS' EDUCATIONAL LEVEL AND READINESS TO USE MOBILE PHONE TECHNOLOGY

Educational level * Have you ever received/patronized extension services using Mobile phone? Crosstabulation

			Have you ever received/patronised extension services using Mobile phone?		Total
			Yes	No	
Educational level	1	Count	23	43	66
		% within Educational level	34.8%	65.2%	100.0%
		% within Have you ever received/patronised extension services using Mobile phone?	14.3%	14.9%	14.7%
		% of Total	5.1%	9.6%	14.7%
	2	Count	24	42	66
		% within Educational level	36.4%	63.6%	100.0%
		% within Have you ever received/patronised extension services using Mobile phone?	14.9%	14.5%	14.7%
		% of Total	5.3%	9.3%	14.7%
	3	Count	31	25	56
		% within Educational level	55.4%	44.6%	100.0%
		% within Have you ever received/patronised extension services using Mobile phone?	19.3%	8.7%	12.4%
		% of Total	6.9%	5.6%	12.4%
	4	Count	9	13	22
		% within Educational level	40.9%	59.1%	100.0%
		% within Have you ever received/patronised extension services using Mobile phone?	5.6%	4.5%	4.9%
		% of Total	2.0%	2.9%	4.9%
	5	Count	74	166	240
		% within Educational level	30.8%	69.2%	100.0%
		% within Have you ever received/patronised extension services using Mobile phone?	46.0%	57.4%	53.3%
		% of Total	16.4%	36.9%	53.3%
Total		Count	161	289	450
		% within Educational level	35.8%	64.2%	100.0%
		% within Have you ever received/patronised extension services using Mobile phone?	100.0%	100.0%	100.0%
		% of Total	35.8%	64.2%	100.0%

Chi-Square Tests

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	12.183[a]	4	.016
Likelihood Ratio	11.773	4	.019
N of Valid Cases	450		

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 7.87.

Kruskal Wallis Test

Symmetric Measures

		Value	Approx. Sig.
Nominal by Nominal	Phi	.165	.016
	Cramer's V	.165	.016
N of Valid Cases		450	

a. Not assuming the null hypothesis.
b. Using the asymptotic standard error assuming the null hypothesis.

Ranks

	Age	N	Mean Rank
I intend to use Mobile phone for accessing agricultural information next year	18-20	27	265.80
	21-30	127	226.35
	31-40	151	237.26
	41-50	84	199.83
	51-60	35	200.73
	60 and above	26	227.46
	Total	450	

Test Statistics[a,b]

	I intend to use Mobile phone for accessing agricultural information next year
Chi-Square	13.996
df	5
Asymp. Sig.	.016

a. Kruskal Wallis Test

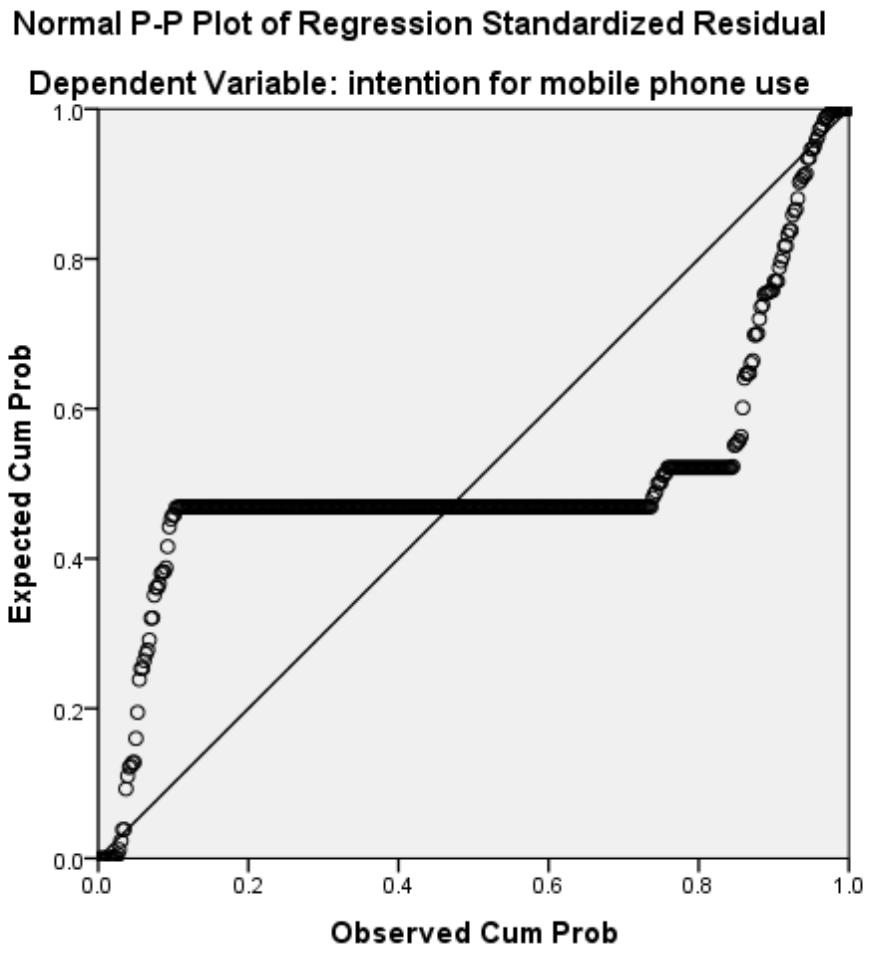
b. Grouping Variable: Age

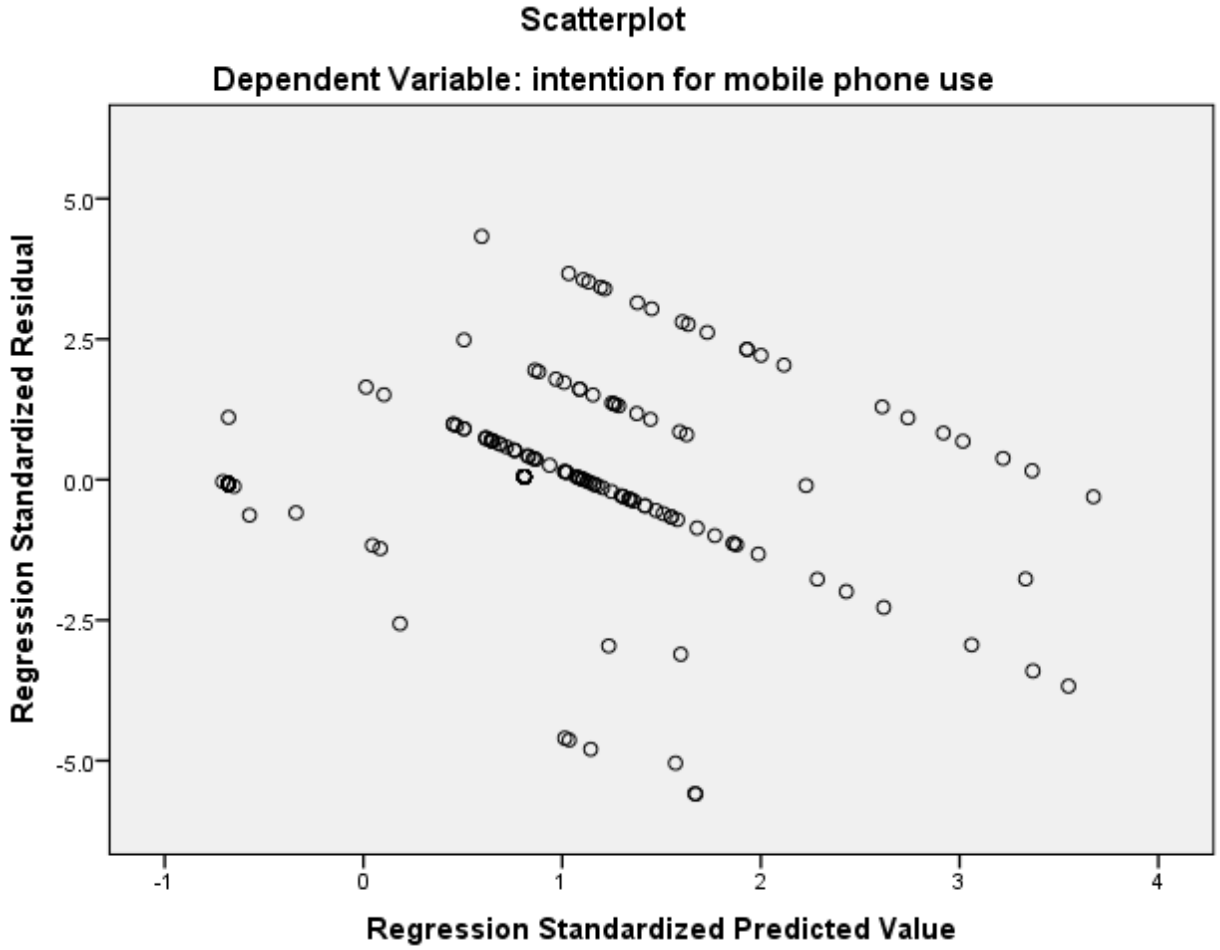
APPENDIX V
NORMALITY PLOT ON INTENTION TO USE MOBILE PHONE TECHNOLOGY

Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	9.09	25.77	11.78	3.809	450
Std. Predicted Value	-.707	3.673	.000	1.000	450
Standard Error of Predicted Value	.146	.595	.213	.108	450
Adjusted Predicted Value	9.09	25.80	11.78	3.818	450
Residual	-14.156	10.951	.000	2.522	450
Std. Residual	-5.594	4.327	.000	.997	450
Stud. Residual	-5.655	4.353	.000	1.006	450
Deleted Residual	-14.491	11.083	-.001	2.571	450
Stud. Deleted Residual	-5.863	4.444	-.002	1.022	450
Mahal. Distance	.487	23.805	2.993	4.555	450
Cook's Distance	.000	.202	.005	.021	450
Centered Leverage Value	.001	.053	.007	.010	450

a. Dependent Variable: intention for mobile phone use


Normal P-P Plot of Regression Standardized Residual
Dependent Variable: intention for mobile phone use
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0



APPPENDIX VI

RELIABILITY TESTS

Case Processing Summary

		N	%
Cases	Valid	450	100.0
	Excluded[a]	0	.0
	Total	450	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.849	182