UNIVERSITY FOR DEVELOPMENT STUDIES

SOCIO-ECONOMIC DETERMINANTS OF ICT USAGE AMONG RURAL CROP FARMERS IN THE NORTHERN REGION OF GHANA

BY

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DECLARATION

I certify that this thesis does not incorporate without due reference to any material that is not originally my own work and to the best of my knowledge it does not also contain any material which is published or produced by any other person(s) without due acknowledgement.

…… ……

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I hereby declare that the preparation and presentation of this thesis was supervised by me in accordance with the guidelines on supervision of thesis laid down by the University for Development Studies.

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Dr. Francis Obeng Date

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ABSTRACT

This purpose of this study was to investigate the usage of ICTs, which ones are popular among the farmers and whether certain socio-economic characteristics influenced usage. It was to fill a gap on ICT usage among crop farmers in rural communities in Northern Ghana. The study involved a multi stage sampling of 210 crop farmers with equal numbers for males and females from seven (7) districts in the Northern Region of Ghana. It involved the use of structured interview questionnaires on the key issues of ICT Knowledge and awareness, ICT usage and perceptions, the challenges and constraints as well as the benefits. The data was analyzed using simple descriptive statistics (percentages, counts and charts) and inferential statistics (Probit regression). The results indicated that the popular ICT tools among the farmers were mobile phones (48.5%), radio (34.9%) and television (13.9%). Younger farmers 40years and below were more predisposed to using ICTs than the older counterparts, with 75.21%; CI 0.28503 – 1.21918, p=0.002). Farming experience (71.50%; CI 0.23258 – 1.19742, p-value of 0.004 and ICT training (136.76%; CI 0.78537 – 1.94986; p=0.004) also influenced the use of ICT tools. The main constraints of the farmers in the study included, poor reception, language and content limitations. Others were high cost of recharge credit, high cost of ICTs - particularly televisions, computers and lack of awareness about certain ICTs like email and internet. There is the need for Government and policy makers to factor ICTs, particularly mobile phones in their programing for farmers. Mobiles phones and radio could be used by researchers to reach farmers with up-to date information.

DEDICATION

I dedicate this work to God, Rosina, Esther and Kofi Anim-Dankwa for their support during the period of my study.

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LIST OF ACRONYMS

CAD	Computer Aided Design
CAI	Computer Aided Instruction
CAM	Computer Aided Manufacturing
CBI	Computer Based Instruction
CBT	Computer Based Teaching
CD-ROMs	Compact Disk-Read Only Memory
ECOWAS	Economic Community of West African States
EDI	Electronic Data Instruction
EM	Electro-Magnetic Field
FAGRO	Food and Agricultural Show (annual fair)
FAO	Food and Agriculture Organization
FM	Frequency Modulation
GIS	Geographic Information System
GPRS	General Packet Radio Service
GPRS	Ghana Poverty Reduction Strategies
GPS	Global Positioning System
GSM	Global System for Mobile Communications
ICTS	Information Communication Technologies
IFAD	International Fund for Agriculture Development
IICD	International Institute for Communication and Development
iOS	Iphone Operating System
IT	Information Technology
JHS	Junior High School
KMS	Knowledge Management System
MDGs	Millennium Development Goals
MMT	Mobile Money Transfer

MTN	Mobile Telecommunications Network
NCA	National Communications Authority
NETTEL	Net Telecoms. Africa
PC	Personal Computer
RCC	Regional Co-ordinating Council
RFID	Radio-Frequency Identification
SEND	Social Enterprise Foundation
SMS	Short Messages System
TAM	Technology Adoption Model
TEL	Technology Enhanced Learning
UHF	Ultra High Frequency
UN	United Nations
UNDP	United Nations Development Program
VLE	Virtual Learning Environment
WAAPP	West Africa Agricultural Productivity Programme
WBT	Web Based Teaching
WSIS	World Summit on the Information Society

CHAPTER 1

1.0 INTRODUCTION

1.1 Background of the study

In Africa, agriculture provides a livelihood for most of the 75 percent of the people who live in rural areas (IFAD, 2009). Unfortunately, the rural areas in Africa have the largest concentration of poverty and food insecurity. One of the causes of poverty or low incomes in rural Africa is the low productivity of agriculture (World Bank, 2009). Therefore, any attempt to reduce poverty should pay particular attention to transforming the agricultural sector, especially through sustained improvement of land and labour productivity in the sector, facilitated by remunerative markets. Lack of technological and market information has been given as the major reason for the low productivity in African agriculture (Asenso-Okyere & Mekonnen, 2012).

According to the UN (2005), increasing agricultural production is a major challenge facing present economies. Smallholder farmers, which dominate the landscape of developing world, need to improve farming through acquiring adequate knowledge and information. This can be done through the use of information communication technologies as indicated by Koutsouris (2006) who recognized the contributions of the Information Communication Technologies (ICTs) to economic development. According to Dauda, Anonguku & Kpamor,(2010), communication is critical to finding solutions to problems of food production through facilitating research-farmer linkage through ICT usage.

Agricultural extension services provide critical access to the knowledge, information and technology that farmers require to improve the productivity and thus improve the quality of their lives and livelihoods. It is hence crucial to provide farmers with the knowledge and information in a quality and timely way. Agricultural education and extension can play a critical role in the transformation process to transfer technology, support learning, assist farmers in problem-solving, and enable farmers to become more actively embedded in the agricultural knowledge and information system (Christoplos, Farrington & Kidd, 2001).

The diffusion of ICTs is becoming a central policy issue for developing countries, being identified by international policy-makers and scholars as an important driver for knowledge innovation and economic growth (Balboni, 2010). The role of ICTs in mass communication has been acclaimed worldwide for the support they have provided in the provision of information to increase productivity, for information on access to markets, information on innovations as a cheaper and more reliable way of reaching a mass of people. ICTs have helped to convey lots of information on health and social issues like water and food preservation. According to Richardson (1996), the revolution in the information and communication technologies has provided opportunities for globalization of agricultural practices in rural communities. Yekini & Hussein (2007) write that "rural communities require information on supply of inputs, new technologies, early warning systems (on drought, pests and diseases), credit, market prices and competition". ICTs are increasingly shaping our world in the way we transfer information and lately even money transfer to relations, business partners and friends who are miles apart.

ICTs have the potential of getting information to farmers, quickly, timely, in appropriate packages, and with a higher cost effectiveness and can be "used alongside the traditional media" (Fagbola & Adebisi-Adelani, 2007). ICTs when properly used have the potential of improving the quality of life and for social cohesion. Usage of ICTs, however, depends on various factors. ICTs are used mainly when the type is known, has become familiar, is understood and has been accepted by whole communities and societies. There are instances where some ICTs are touted as effective but would be found to be less used in some communities. These instances include situations where ICTs are changing how known jobs are done, Dunne (2016), where job losses are occurring as ICT systems evolve, costs of ICTs are exorbitant and physical environment characteristics. Other issues like affordability, education level, language and a host of others come into play. For smallholder farmers the nature of the social system and how individuals inter-relate could determine the choice of one media over the other.

During the last two decades, the world has witnessed an unprecedented growth in the area of ICT (Hosseini, Nikanami & Nejad, 2009). Despite the potentials of ICT use among farmers, its use in Sub Sahara Africa has remained minimal (Kiplang'at, 1999). More so, farmers who are hooked up to new technologies do better, however, few (Spore, 2004). Therefore, information on improved farm technologies and its effect on productivity and income of farmers needs to be investigated in an attempt to bridge the digital divide between the rural and urban areas, and between developed and developing countries (Adejo & Haruna, 2009).

In spite of the increasing popularity of ICTs it is not well documented the impact it is having in certain areas of agriculture. According to Heeks (2009) – "Billions of US dollars are invested each year by the public, NGO and private sectors in information and communication technologies for development (ICT4D) project. Yet we have very little sense of the effect of that investment".

In the northern region of Ghana where illiteracy and poverty are high, (GLSS 6, 2014) it is not likely that many of the smallholder farmers will be using ICTs towards the improvement of their productivity and lives.

1.2 Research Problem statement

ICTs have been shown to have an increasing impact on agricultural sector and on the processes associated with food production (Blurton, 2010). ICTs play an important role in exposing rural communities to development (Hassan, Samah, Shaffril & D'Silva, 2011). Due to its impact, ICT has witnessed an upsurge in recent years in almost all areas of rural life in several African countries despite the persisting problems of access, connectivity, literacy, content and costs (CTA, 2000). ICTs through radio, television, computers, internet and telecommunications have all helped to offer unprecedented information storage capacity, increase in processing power and speed coupled with a dramatic reduction in costs.

With the current need for efficiency in understanding market price trends, accessing inputs and support services, farmers and traders need to use more efficient and appropriate new ICTs to take advantage of the existing opportunities. Timely access to market information,

inputs and other necessary services like weather changes, pest control techniques and others would increasingly enable small-scale farmers and traders make timely, reliable, realistic and economically viable decisions concerning what crops to grow, when to grow them, what products are for sale when and where, what inputs to use and how to use them (Asenso-Okyere & Mekonnen, 2012). Access to the relevant information will help farmers to improve their yields, improve lives and overall help to achieve the Sustainable Development Goals (SDGs).

However, while ICTs boosts information, improve farm technologies and the resultant effect on productivity and income of farmers, the great challenge is that most farmers living in the rural areas are illiterates, hence they have little or no knowledge of the use of ICT facilities like computer and Internet (Omotayo, 2005). Technical Centre for Agriculture (CTA) Spore (2004) report agrees that, the numbers of farmers who are hooked to new technologies through ICTs are few.

This is further compounded by vicious cycle of poverty that continues to hamper the capacity of rural farmers to improve their standard of living. Reviewers of rural ICT development have not only established a number of constraints to ICT development in rural areas, but also have the general consensus that the current trend of ICT development tends to be biased against the rural population (FAO, 2004). Nkwocha *et al.*, (2009) found out that, there were more prevalent factors limiting access to ICT in Okigwe zone (predominantly in the rural areas) of Imo State, South East Nigeria. Similarly, Shah (2009) reported that, access to broadband Internet services is substantially low in rural areas and poor urban neighbourhoods of many developing countries than in the metropolitan urban.

Presently, it is still quite unclear whether rural farmers in Northern Region of Ghana are adequately exposed to information and communication technology."

Despite the prevalence of various ICT facilities and services in Ghana, little is known in terms of the socio-economic determinants of farmers' access and utilization of these facilities for enhancing agricultural production in the area. The need for unlimited access and utilization of current (ICTs) for improving the living standard of farmers and agricultural production, calls for adequate knowledge of the socio-economic determinants of usage of ICT tools among rural crop farmers in Northern Region of Ghana.

Closing such a knowledge gap will enable policy makers to strategize to improve ICT usage and the improvement of livelihoods among rural crop famers in the Northern region of Ghana.

1.3 Research question

The main research question for the study is; what are the socio-economic factors that are influencing the use of ICT tools among rural crop farmers in the northern region of Ghana?

The specific research questions for this study are:

i. What are the socio-economic characteristics of the rural smallholder crop farmers?

ii. What ICT tools are currently in use among rural smallholder crop farmers?

iii. What socio-economic factors affect the use of ICT tools?

iv. What kinds of information are smallholder farmers getting through the use of ICTs?

v. What are the constraints to ICT use among crop farmers in the northern region?

1.4 Objectives of the study

1.4.1 Main objective

The main objective of this study is to assess the socio-economic factors that significantly determine ICT usage among smallholder farmers and choices they make in the Northern region of Ghana.

1.4.2 Specific objectives

The specific objectives of the study arising out of the main objective are to;

i. describe the socio-economic characteristics of crop farmers in the Northern region,

ii. identify the ICT tools which are currently in use in the northern region,

iii. assess the socio-economic factors affecting the usage of ICT tools,

iv. determine the kinds of information being accessed with the ICT tool in use and

v. identify the constraints to ICT usage by the crop farmers.

1.5 Justification

In spite of the potential of the potential of ICT use to improve agriculture, its use in the sub-Saharan Africa has remained minimal (Kiplang'at, 1999). It has been established that farmers who are using new technologies do better however few (Spore, 2004). According to Omotayo, (2005) most farmers in rural areas are illiterate and have no knowledge of ICTs. Since ICTs are increasingly becoming the key drivers for socio-economic growth

worldwide (Hellerstein, 2005), it is important to investigate the current usage of ICTs among rural crop farmers. The study will help identify the status, help to channel the needed resources and to create the enabling policy for the sector. The current situation is that there is not enough published data on who is using what and how well it is supporting the increase in agricultural production among smallholder farmers.

1.6 Limitations of the study

Majority of respondents could not speak English leading to the reliance on translators. It was not certain at times whether the questions were translated properly. Sometime the responses did not meet the expected answer and there might have been certain biases. The frame for drawing the sample was not big enough.

1.7 Operational Definition of ICTs

Information Communication Technology (ICT) is commonly used to embrace a multitude of media including telephone, television, video, telex, voice information systems and fax as well as those requiring the use of personal computers fitted with a modem or supply technologies that facilitate communication processing and transmission of information by electronic means ranging from radio, television, telephone (fixed or mobile) and internet (Warren, 2001; CTA, 2003; Omotayo, 2005). Adejo & Haruna (2010) classified ICT into conventional ICT (radio, television) and contemporary ICT (telephones, computer and Internet).

Based on the initial assessment of the ICT devices/tools available in the communities, in this study the term ICT will be referring to Radio, Mobile phones, Television, Computers, email and Internet and not to the complex array of tools available globally.

CHAPTER 2

2.0 LITERATURE REVIEW

2.1 Introduction

The literature review looks at the definitions of ICTs, its importance for rural development, impact it has had in other continents and in other parts of Africa, the barriers or challenges and what has influenced the usage in other parts of the world in similar rural situations and in Ghana.

2.2 Definitions of ICT

There are a couple of definitions for ICTs. Chapman & Slaymaker (2000) think, "ICTs are those technologies that can be used to interlink information technology devices such as personal computers with communication technologies such as telephones and their telecommunication networks". The PC and laptop with e-mail and Internet provides the best example. Michiels & Van Crowder (2001) have defined ICTs 'as a range of electronic technologies which when converged in new configurations are flexible, adaptable, enabling and capable of transforming organizations and redefining social relations'. The range of technologies is increasing all the time and 'there is a convergence between the new technologies and conventional media'.

According to Chapman & Slaymaker, (2000) this rapid and on-going convergence means that devices such as digital cameras, digital video cameras and players, personal digital assistants, slide projectors and mobile telephones are also compatible with more traditional media such as radio (digital, satellite), television (cable, digital, satellite). By this, most devices can now be linked to others to share and exchange information and allow it to be

used in such a way that they can also be categorized as ICTs. “Even books are being incorporated into ICTs either through the potential for informal web publishing or more formal digital book publishing with designated readers or ‘e-books’. ICTs, therefore, are an expanding assemblage of technologies that can be used to collect, store and share information between people using multiple devices and multiple media”.

2.2.1 ICT Tools

2.2.1.1 Computers

A computer is an electronic device, operating under the control of instructions stored in its own memory unit, which can store data, perform arithmetic and logical operations on data, and produce output from the processing. Shaminus (2008) stated that computers invention started from a large vacuum tube mainframe engines. The first generation computers were invented before 1959 and performed functions in the Central processing Units. The second-generation between1959-1964 developed into transistors while third generations 1964-1967 were of integrated circuits by making use of microelectronics with chips. The fourth generation advanced into microelectronic concepts to get further circuits densities.

2.2.1.2 Internet and email

Computers were connected to work stations of networks connected to Wide Area Network, which culminated into the Internet called World Wide Web (WWW) where information could be accessed. Utilization of internet depends on microwave functionality and electricity regularity. Computer and internet usability are very expensive to purchase and maintain.

Temmel *et al.*, (2014) observed that internet is becoming more and more important for most people in developed countries, as it is one of the newest and most forward looking media and surely the medium of the future. Ability to disseminate and promote one's research work is an important component of managing and communicating information. By disseminating information, an organisation can reach members of its target audience and have a greater impact on policy and programming. The internet can serve as an invaluable tool in this effort to communicate information across a wide audience. Information can be disseminated through listening or through the use of the websites designed to promote information for outside and member sources

2.2.1.3 Radio

According to Wikipedia (accessed, 12th July 2015), Radio is the technology of using radio waves to carry information, such as sound, by systematically modulating properties of electromagnetic energy waves transmitted through space, such as their amplitude, frequency, phase, or pulse width. When radio waves strike an electrical conductor, the oscillating fields induce an alternating current in the conductor. The information in the waves can be extracted and transformed back into its original form.

Radio systems need a transmitter to modulate (change) some property of the energy produced to impress a signal on it, for example using amplitude modulation or angle modulation (which can be frequency modulation or phase modulation). Radio systems also need an antenna to convert electric currents into radio waves, and radio waves into an electric current. An antenna can be used for both transmitting and receiving. The electrical

resonance of tuned circuits in radios allow individual stations to be selected. The electromagnetic wave is intercepted by a tuned receiving antenna.

The use of radio for transmitting information has been in existence for a while. Advances in technology have given people more ways to access an increasing amount of information. Local and international news can be read in the newspaper, listened to on radio, watched on television and found on cell-phones or online. For those with access to these options, a wealth of information is always readily available. In countries where free expression is suppressed, access to technology is expensive or illiteracy rates are high, radio continues to play an important role in information sharing.

Transistor radio was the premier channel of information communication. It has been in use several decades before the invention of other information communication channels. Its existence could be dated back to the twentieth century. Wikipedia (2012) asserted that a transistor is a semi-conductor device with at least these terminals per connection to an electric circuit. The first patent for the field effect principle was filed in Canada by Austrian Hungarian Physicist Julius Edigar Lilienfeld on October, 22, 1925. Lilienfield (1925) opined that the invention of the transistor was filed in 1925 but Lilienfield published no research articles about his devices and his work was ignored by industry.

Tracing the historical development of radio from distribution system to radio diffusion or radio fusion and transistor radio dry cell battery was the only source of power and its radio batteries are very cheap and readily available even in the most remote areas of Nigeria but now digital radio had replaced the transistor radio. However, black and white television was invented and source of power is electricity or via a generating set. It consumes a high

electric voltage. As civilization unfolds, the technological development has transform black and white into coloured digital television.

Nakabugu (2000) writes, radio in rural areas contributes in creating awareness of research findings, mobilising community - to best practices, Simplifying research findings, Translating into user language. It also helps in Linking NGO to community. Linking Extension to community and provides an avenue to link Research to extension to community and then to government. She concludes that Radio programmes cannot grow more food. However, planned radio campaigns complementing face-to-face advice and extension, with administrative and material support available can motivate, can inform, can entertain, can unify and can contribute towards desirable change.

2.2.1.4 Mobile Phone

The coming of Global System for Mobile Communications (GSM) has made it possible for people irrespective of their social status to use phone. Students, drivers, market women, farmers, civil servants etc. Chisita (2010) opined that mobile ICT's have also impacted heavily on access to information relating to markets, weather, and other essential services because this information can easily be accessed through the use of mobile phones.

Ilahiane (2007) noted that mobile Phones have greatly improved the way in which farmers' access, exchange and manipulate information because they have changed the way farmers interact with markets and cities and they enable farmers to extract current and relevant information critical for decision-making. Masuki *et al*., (2010) while commenting on the growth of mobile phone in developing countries asserted that; currently mobile telephony is the predominant mode of communication in the developing world. It is widely

recognized as a potentially transformative technology platform for developing. Mobile phones are transforming the lives of many users in developing countries and are widely recognized as the current and the future technology platforms for developing nations. Lehr (2007) is of the view that mobile phones are considered important for development because they offer benefits such as mobility and security to owners. Mobile phones are flexible and only require basic literacy thereby accessible to large portions of the population.

2.2.1.5 Television

Cassata & Asante (1979) opined that television broadcasting in other parts of the world has become the most pervasive, and often the most persuasive means of information diffusion in these societies. 'It can disseminate information with lightning speed and impact, as well as infuse viewers with imagery and values in subtle, perhaps almost imperceptible manners.

Saglik & Ozturk (2001) perceived television as one of the dynamic and prestigious medium of information dissemination owing to the fact that it delivers information in a dramatic audio and visual manner to an extensive and various audiences; it gives more coverage than any other communication tool, which makes it a much sought-after medium of information dissemination.

Television over the years is known for educating and informative roles and is majorly been applied to disseminate different types of information ranging from agricultural, political, religion, socio-cultural and often been used to facilitate teaching and learning.

Bates (1998) opined that television is an effective tool in expressing abstract concepts or ideas. Abstract concepts are usually produced and conveyed with words. Besides this, in

making an abstract concept concrete, the role of animation and visual experimentation is very important. The limitation here is how to combine the text, which is involving information, with moving views, animation, concrete ideas, utterance and objects like pictures.

Television plays a significant role in creating awareness and knowledge about latest agriculture technologies information among farmers (Mahmood & Sheikh, 2005). Information and Communication Technologies have radically changed the modes of production and organization of work at global and national levels and precipitated the process of development. The Millennium Declaration of the United Nations view ICTs as tools with the potential to achieve the Millennium Development Goals set by the historic UN 2000 Summit. Target 18 of Goal 8 calls upon the UN member states to cooperate with the private sector to "make available the benefits of new technologies, especially Information and Communications Technologies" (UNDP 2003). With regard to the above, developing countries have been urged to harness the full potential of the information revolution to alleviate poverty and seek sustained growth. As Jinqui, (2006) notes, the danger of not participating in the development of ICTs, highlighted by the World Bank in addressing African issue is that:

"The information revolution offers Africa a dramatic opportunity to leapfrog into the future, breaking out of decades of stagnation or decline. Africa needs to seize this opportunity, quickly. If African countries cannot take advantage of the information revolution and surf this great wave of technological change, they may be crushed by it". (World Bank, (2006).

2.3 The current state of ICTs

Consistently the power of knowledge and the renewed impetus to integrate it in many countries' development strategies, has gained momentum following the World development report (World Bank, 1999). The importance of uneven distribution of knowledge in explaining the variations in total factor production is increasingly recognized. Human capital, including education, can be more clearly linked to growth, but for any two countries with similar enrolment or attainment, an important factor in releasing the full potential of the workforce is the country's openness to innovation and knowledge (World Bank, 1999). The power of knowledge for development can be greatly enhanced by ICTs if they are harnessed to improve access and break down barriers to knowledge because 'while education develops cognitive skills, information gives content to knowledge' (UNDP, 2001). In this sense the use of ICTs is integral to realizing the potential of collective knowledge as the technologies themselves represent tools for achieving development and not merely the rewards of it (UNDP, 2001).

According to Chapman & Slaymaker, (2002), "addressing the role of ICTs in rural development strategies, is less a question of differentiating between spatial needs (rural versus urban) and more about differentiating between opportunities. It is clear that rural areas hold substantial human and natural potential to realize development goals (reduce inequality, reduce poverty, empowerment) by harnessing knowledge". It is still unlikely that there are uses for ICTs that are exclusive to rural areas but the potential of ICTs to play a comparatively greater role in rural development than elsewhere is very real (Killick, 2000). ICTs have been recognized as having a role to play in broad-based, cross-sectoral

poverty reduction strategies and universal access policies are being promoted to improve rural access to ICTs (Kenny, Navas-Sabater and Ojang. 2000).

In the 1980s and 1990s, a lot of international agencies and firms were optimistic that IT would become a tool for delivering economic growth (Heeks, 2008). This optimism has not waned with a view that ICTs have a role to play in national development and that there was no way a country can survive the global competition without this digital platform. Currently, ICTs have diffused into almost all spheres of human activity at an unprecedented rate alongside development. Joseph (2002) views ICT contribution as growth and diffusion where the former implies contribution in output, employment and export earning, resulting from the production of ICT related goods and services that are limited to just one segment of the economy. The latter is ICT induced growth through enhanced productivity, competitiveness, growth and human welfare resulting from the use of this technology by different sectors of the economy and society (Joseph, 2000).

2.4 ICT and rural development

Bhatnagar & Schware (2000) categorizes ICT applications into three purposes, namely;

(i) for decision support by public administrators,

(ii) to improve services to citizens and promote transparency and

(iii) to empower citizens to access information and knowledge.

All these functions are necessary in agriculture to ensure

(i) improvement in planning and monitoring agriculture development programmes,

(ii) enhancement of agricultural service delivery to farmers and all role players in the supply chain and

(iii) empowerment of people through training, providing access to up to date agricultural information and creating employment (Bhatnagar & Schware, 2000).

It is a modern view that ICTs can be used in almost every step in agriculture; in input procurement, production, distribution and marketing of agricultural produce. Information and the technologies that facilitate its use, exchange and reliability have been important aspects of agriculture and agriculture-related activities. Knowledge, communication and information exchange have influenced decisions on what to plant, when to plant it, how to cultivate and harvest and where to store and sell and at what price, ICT in Agriculture (Donovan, 2011). As compared to traditional methods, ICT can add value when information is time sensitive, information requires significant customization to satisfy a client's need, information needed involves standardized calculations and when there is need for significant back-and-forth interactivity over distances (Winrock, 2003). ICTs are also offering more cost-effective methods for empowering and ensuring feedback from previously marginalized agricultural communities. There is an enormous potential in the use of ICT to provide information, access resources, enhance learning and research sources. It is a rapidly growing ways of finding agricultural information, products and services.

I cannot agree more with Harindranath, Dyerson & Barnes, (2007) who asserted that 'the nature of the link between IT and development remains unclear due to lack of clarity on how ICT is conceptualized'. I also believe that ICT can play a central role in national

development but there is need to identify contextual strategies that facilitate ICT being developmental which is supported by Heeks (2008) who opines that "none should exclude themselves from the digital age but there is need to assure poor communities that ICT can be developmental and show them how to spend the little they have on it". Many ICT projects have been top down, the western world's thinking for the developing world on what help they would need to bridge the ever existing gap and whose techno-centric approach has led to multi failures in ICTs for Development (ICT4D).

2.5 Rural development

Rural development is defined as "a strategy aiming at the improvement of economic and social living conditions, focusing on a specific group of poor people in a rural area. It denotes the actions and initiatives taken to improve the standard of living in non-urban neighbourhoods, countryside and remote villages, (World Bank, 1975). Such communities are characterized by predominant agricultural activities and where economic activities relate to the primary sector, production of food stuffs and raw materials (Chambers, 1983). The South African Rural Development Framework (1997) defines rural development as helping rural people set the priorities in their own communities through effective and democratic bodies, by providing the local capacity; investment in basic infrastructure and social services. Justice, equity and security; dealing with the injustices of the past and ensuring safety and security of the rural population, especially that of women (NetTel Africa, 2006).

"In rural development the key principles are to; involve rural people in decisions that affect their lives through participation in rural local government, provision of affordable infrastructure, ensuring social sustainability in rural areas and increased employment and economic growth in rural areas" (NetTel Africa, 2006). Also, there are believes that rural areas are sparsely populated areas in which people farm or depend on natural resources, including the villages and small towns that are dispersed (NetTel Africa, 2006).

Chambers, (1997) posits that "while the assertion that information is an important focus for future rural development strategies is not particularly contentious, defining the role that information should play, is somewhat more challenging. It is not only a question of whose reality the information reflects, but who is able to make use of that information and for what purpose?" This statement underlies the need to target specific people or occupations with different technologies which will best address their needs and which will help propel them out of their poverty or improve their lives. What difference does it make if ICTs cannot make an impact in the lives of rural people?

Many times information need is not seen from the point of view of the rural people but seen only in terms of its importance for decision-making. The assumption has always been that governments and others require information for decision making in the interest of rural people forgetting that rural people also need information be able to play their roles in national governance.

Chapman and Slaymaker (2002) are of the opinion that information and communication activities are a fundamental element of any rural development activity. Rural areas are often characterised as information-poor and information provision has always been a

central component of rural development initiatives. The rural poor typically lack access to information, vital to their lives and livelihoods.

It has often been said that the rural poor depend primarily on agriculture and related activities for their livelihood, agriculture provides the bulk of their income and their main source of nutrition (IFAD, 2001). Improved systems for the management and communication of agricultural information can help poor farmers make informed choices about the opportunities and constraints associated with agricultural development strategies (FAO, 1998).

2.6 Impact of ICTs on Agriculture

Since the basic activity in most rural areas is agriculture, it is important to show what has been achieved in the last two decades for those who have had the opportunity of harnessing the power of ICTs in farming activities or in Agriculture in general. The use of ICTs in agriculture has come to be known as E-Agriculture (www.wikipedia.org, accessed, August 2015). Thankachan *et al.*, (2014) calls it, a platform for supporting marketing of agricultural produce. E-Agriculture is a global Community of Practice, where people from all over the world exchange information, ideas, and resources related to the use of information and communication technologies (ICT) for sustainable agriculture and rural development (FAO, 2005).

According to Wikipedia, e-Agriculture involves the conceptualization, design, development, evaluation and application of innovative ways to use information and communication technologies (ICT) in the rural domain, with a primary focus on

agriculture. “E-Agriculture is one of the action lines identified in the declaration and plan of action of the World Summit on the Information Society (WSIS). The "Tunis Agenda for the Information Society," (2005) emphasizes the leading facilitating roles that UN agencies need to play in the implementation of the Geneva Plan of Action. The Food and Agriculture Organization of the United Nations (FAO) has been assigned the responsibility of organizing activities related to the action on E-Agriculture.

The WSIS Plan of Action1 (WSIS, 2003) includes e-agriculture as an area of application of information and communication technologies (ICTs) under Action Line 7:

a. that ensures the systematic dissemination of information using ICTs on agriculture, animal husbandry, fisheries, forestry and food, in order to provide ready access to comprehensive, up-to-date and detailed knowledge and information, particularly in rural areas.

b. Public-private partnerships should seek to maximize the use of ICTs as an instrument to improve production, marketing and food safety standards.

FAO (2006) proposes the following definition: “e-Agriculture” is an emerging field in the intersection of agricultural informatics, agricultural development and entrepreneurship, referring to agricultural services, technology dissemination, and information delivered or enhanced through the Internet and related technologies. More specifically, it involves the conceptualization, design, development, evaluation and application of new (innovative) ways to use existing or emerging ICTs.

E-Agriculture goes beyond technology, to promote the integration of technology with multimedia, knowledge and culture, with the aim of improving communication and learning processes between various actors in agriculture locally, regionally and worldwide. Facilitation, support of standards and norms, technical support, capacity building, education, and extension are all key components to e-Agriculture. There are several types of activity related to e-agriculture applications that are widely recognized around the world today. The delivery of agricultural information and knowledge services (i.e. market prices, extension services, and others) using the Internet and related technologies falls under the definition of e-Agriculture. More advanced applications of e- agriculture in farming exist in the use of sophisticated ICTs such as satellite systems, Global Positioning Systems (GPS), advanced computers and electronic systems to improve the quantity and quality of production.

Technology-based Solutions Applications of e-Agriculture in intensive agricultural systems in developed countries are gearing towards using sophisticated technologies to improve the quantity and quality of production, in order to maximize profits. This is the case in precision agriculture in which farmers are harnessing computer and satellite technologies to cut costs, improve yields and protect the environment; and e-commerce (or e-marketing) in which the marketing and sale of agricultural products is conducted over electronic networks such as the Internet and extranets. On the other hand in many developing countries farmers' access to information is improved through grass root level initiatives of using ICTs as well as distance education modalities to enhance the knowledge base among service providers.

2.6.1 Precision Agriculture

In precision agriculture or site-specific farming, farmers are using ICTs and other technologies to obtain more precise information about agricultural resources, which allow them to identify, analyze, and manage the spatial and temporal variability of soil and plants for optimum profitability, sustainability, and protection of the environment.

Precision agriculture is described as: "a system to manage farm resources better (Rains and Thomas, 2009). According to Rains and Thomas, (2009), Precision farming is an information technology- based management system now possible because of several technologies currently available to agriculture. These include global positioning systems, geographic information systems, yield monitoring devices, soil, plant and pest sensors, remote sensing, and variable rate technologies for application of inputs. Rains and Thomas (2009) indicate that " Precision agriculture makes use of five major components of technology:

1) Geographical Information Systems (GIS) for analysis and management of spatial data and mapping;
2) Remote Sensing (RS) to identify,
3) Global Positioning Systems (GPS) to locate and define spatial features or activities that contribute to the quality of site-specific practices;
4) Variable Rate Technology (VRT) allowing targeted, site-specific input applications; and
5) Yield monitoring for recording crop productivity as an historical database for crop management.

Rains &Thomas (2009) write, "e-Commerce in Agriculture improved productions and high yields result in the need to look for profitable markets beyond local communities, and electronic markets are providing an opportunity to farmers to market and sell their produce to buyers at the global level. Electronic commerce (e- commerce), simply defined as the general exchange of goods and services via the Internet, is already having a significant impact on agriculture".

According to Wikipedia, the sum is that the applications used must facilitate quick and timely sending or retrieval of information for the benefit of the community or for policy. ICT tools used include, tools used to;

- Record text, drawings, photographs, audio, video, process descriptions, and other information in digital formats,
- Produce exact duplicates of such information at significantly lower cost,
- Transfer information and knowledge rapidly over large distances through communications networks.
- Develop standardized algorithms to large quantities of information relatively rapidly.
- Achieve greater interactivity in communicating, evaluating, producing and sharing useful information and knowledge

Some of the main ICT tools used in Agriculture include:

- Office automation
- Networks – Physical and Wireless technologies
- Global Positioning Systems
- Geographic Information Systems

- Computer-controlled devices (automated systems)
- Radio-frequency Identification (RFID)
- Knowledge Management Systems (KMS)
- E-learning
- E-commerce
- Agricultural Resources and Services Management
- Computer-Aided Manufacturing (CAM)
- Computer-Aided Design (CAD)
- Traditional Radios
- Mobile Telephony

According to Cespedes (2013), in *How ICT tools are improving efficiency of agricultural development*, experts from various fields and organizations around the world shared their experiences and discussed the ways in which they were using ICT – mobile phones, tablets, applications and software were being used to collect data in the field, and to perform Monitoring and Evaluation (M&E) in development projects, while also working closely with rural communities and taking their feedback. The discussion has been summarized in a policy brief and outlines the benefits of using ICT for data collection. Several examples of the applications were also showcased in the discussion, among them were three important mobile and data collection and M&E applications that requires no paper or connection and is available worldwide. They are the iFormBuilder, the Cropster and the Episurveyor.

Cespedes (2013) continues that experts who participated in the e-forum also agreed on important factors that should not be overlooked in discussing new technologies:

- Technology itself is not sufficient, a well-trained team is also required: case studies show that investing solely in technology will not ensure successful implementation of ICT applications; it is necessary to invest in a team that can effectively perform M&E tasks, as well as to invest in capacity development of the end users who can ensure the sustainability of the project.
- Complex ICT or complex platforms are not necessarily essential: technologies already being used by farmers should be taken into consideration. For example, USAID's Feed the Future project employs a combination of traditional instruments to collect basic data in the field, which is then recorded in Excel sheets and subsequently shared free of cost with potential buyers in real-time through Drop Box.
- Contextual factors: local factors such as the lack of adequate resources must be taken into account beforehand (e.g. electricity, gender issues, limited network coverage and low bandwidth, local languages). Implementation approaches need to identify the specific needs of the intended users by working in collaboration with them. There is not one single solution that fits all projects: context, policies, marketing efforts and incentives are all essential factors to ensure participation from community members.

There and several others are remarkable examples of various development agencies currently using ICT for data collection and M&E in the agricultural sector worldwide.

Some of these technologies eventually can be used by rural farmers for their own assessment of the improvements they are making in their communities.

2.7 Barriers to ICT usage by farmers in developing countries

The usage of ICT by farmers in developing countries particularly rural areas is fraught with a lot of barriers. Some of these barriers clearly inhibit farmers from accessing the benefit of ICTs. In this section, I present some critical ones.

2.7.1 Poor Technical infrastructure

In many rural communities, there is poor technical infrastructure. This is because the resources needed to put in place any serious infrastructure are too prohibitive (Guermazi and Satola, 2005). Similar observations were made by Jorge (2002) and Tlabela, Roodt & Paterson. (2007).

2.7.2 Lack of access to ICT

From the lack of ICT infrastructure in rural communities, it follows naturally that there will be poor access to ICT services. Marker *et al*., (2002) notes that poor people do not have access to information, knowledge and communication. The majority of populations in rural areas in Africa depend mainly on radio, television and newspapers as the widest forms of communication (Kenny, 2002). Raju (2004) acknowledges that traditional media like radios, videos, televisions, slides, pictures, exhibitions and field demonstrations have been used to speed up information flow in rural areas within developing countries. It is a fact that computers, Internet cafes, Tele-centres, GPS and other modern ICTs are virtually

absent in rural communities if they have not been sent by NGOs, private operators or in the case of Government projects supported by donor agencies which normally ends with the project duration. This is consistent with observations made by (Maru & Ehrle, 2003) and Rao (2004) who noted the absence of cafes, Tele-centres and computer based ICT usage in their studies.

2.7.3 High cost of ICTs

In cases where the penetration of private investors has led to the availability of ICT infrastructure in rural communities, it is always beyond the reach of the ordinary farmers. This is a fact attested to by Jorge (2002). Fors and Moreno, (2002) opined that "Personal computers, faxes, printers and some ICT equipment are expensive and unaffordable to the majority of developing countries' inhabitants, even for middle-class families, thereby cutting down the populations who are able to use the technology". This is consistent with findings by Galloway and Mochrie, (2005)

2.7.4 Lack of ICT awareness and training

One of the main barriers to ICT development is lack of awareness due to illiteracy in many rural communities. According to Ifinedo (2005), all countries in Sub-Saharan Africa with the exception of South Africa and its neighbours have a poor e-readiness score. This is supported by (Colle & Roman, 2003). There is the need for a concerted effort to raise awareness about what can be done with ICTs. This also requires not only sensitization but also training of people who could pass it on to others (Chetty, 2005).

2.7.5 Local content limitations

Compounding the problem of rural farmers in rural Africa is that even when the awareness is created about the efficacy of ICTs, the language and content are not local. Tembo (2005) writes that content in local language is very important if ICTs are to make a difference in people's lives. Attempts by Google and other search engine service providers to provide content in local languages have not yielded the desired results. Even when the languages are provided the bottom line is that the people cannot read them. They probably can only listen to them.

2.7.6 Gender inequalities in the uptake of ICTs

Pigato (2007) mentions gender inequalities as one of the barrier of ICT use in most developing economies. Cullen (2001) mentioned women and girls among the specific groups of people disadvantaged in the uptake of ICT. Most women are still facing discrimination in terms of access to public services such as education and politics, due to increasing levels of illiteracy in African women. The female population remains confined to the rural areas to practice agriculture while men are participating in the modern industrial and service sector economy. A number of limitations facing women hinder them from benefiting from ICT services as compared to men. Among other things, Jorge (2002) identifies lack of gender focus in telecommunications and ICT policy as a major barrier that a lot of women in developing countries are facing. To address these gender disparities, the International Service for National Agricultural Research (ISNAR), (2002) proposed that (i) rural women should be enabled to use ICT to improve their livelihoods and share

their views in local and national programs, and (ii) development actors are supposed to use gender sensitive approaches in their programs especially in agriculture and rural development.

2.7.7 Attitudinal barriers

A critical barrier to adoption of ICTs is attitude. According to Kabede (2004), attitudinal barriers are mainly cultural and behavioural towards ICTs pertaining to its appropriateness, usefulness and relevance. Kabede, (2004) notes that, attitude portrays either positive or negative views towards a person, place, thing or event and that, a positive attitude is an important requirement for ICT usage. Shiro (2008) notes that, the rural communities sometimes have a positive attitude towards ICT and they welcome any ICT project to be developed in their areas. This is emphasized and proved by a number of previous studies (Kenneth & Liquat, (2006); Simpson, (2005) and Loh *et al.*, (2009). However, Cullen (2001) believes that cultural beliefs in some societies impede the adoption of ICTs. He notes that there is a belief in rural areas that, ICTs are difficult to use or that they belong to the affluent in society.

2.8 ICT usage in Agriculture in Ghana

According to the Food and Agriculture Show publication, (FAGRO, 2011), ICT applications in agriculture have become increasingly important due to the growing demand for higher quality products, which also offers opportunities for improving the livelihoods of rural communities. Realizing these opportunities requires compliance with more stringent quality standards and regulations for the production and handling of agricultural

produce. New approaches and technical innovations are required to cope with these challenges and to enhance the livelihoods of the rural population.

The use of ICT tools enhances agricultural production by increasing the efficiency, productivity and sustainability of small-scale farms. According to FAGRO (2011),

"ICT can be utilized to provide accurate, timely, relevant information and services to the farmers, thereby facilitating an environment for more remunerative agriculture. Since farming involves risks and uncertainties, with farmers facing many threats from poor soils, drought, erosion and pests, key improvements will therefore stem from information about pest and disease control, especially early warning systems, new varieties, new ways to optimize production and regulations for quality control".

According to the Millennium Development Goal eight (8F), MDG Taskforce Report, (2015) "In cooperation with the private sector, make available benefits of new technologies, especially information and communications"

2.8.1 ICT initiatives in Ghana

IICD (2006), an impact-study on Livelihoods, indicates that ICT has helped to shape and improved livelihoods of farmers especially those living in rural areas across the world. In Ghana, the set-up of price and market information systems piloted by the International Institute for communication and Development (IICD) supports the Social Enterprise Foundation of West Africa (SEND) in linking rural soybean producers to mills, through the use of satellite, databases and mobile phones, thereby ensuring a fair income for producers and a steady supply of raw materials for the mills,

(http://iicd.org/documents/ghanaian-farmers-get-better-prices-for-their-crops-by-using-mobile-phones/) last assessed in August, 2015.

Daniel Kenu (2014) indicates that test-runs of an e-Agriculture project have begun in all the regions to complement the work of extension officers and make technology easily accessible to farmers. About 35,000 farmers with access to smart phones with inbuilt voicemail in six local languages have subscribed to the platform.

According to VOTO (2014), it is an initiative that is helping to break the barriers of Mobile communication in Ghana. VOTO amplifies the voice of the under-heard. It uses mobile phone notification and survey platform to remove the barriers to insightful mobile communication between African citizens and the organizations that serve them. VOTO is using ICT particular mobile communication in promoting Behaviour Change. VOTO is using the technology to ensure that that information and regular reminders are delivered through mobile phones to help create and reinforce behaviour change. VOTO's notification tools are being piloted by NGOs in the health, hygiene, and agriculture sectors. It is worthy to note that through the system specific information can be sent through voice in particular languages to the targeted audiences irrespective of their literacy levels for the intended ends.

Additionally, services developed by Esoko, a local company, include placement of buy/sell orders by farmers and traders. Esoko has a network of agents that collect price information on about 20 agricultural commodities in 30 markets in the country. They have a system for providing price information to farmers and others on a subscription basis (Martiz, 2011).

Experiences from Southern Ghana, show that mobile phones can be used by cocoa farmers to obtain production and marketing information. A pilot program called Cocoalink, launched by the Ghana Cocoa Board, provides cocoa farmers with useful information about improving farming practices, farm safety, crop disease prevention, post-harvest 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 (Martiz, 2011).

2.9 ICT Usage in Africa

In a study by Adegbidi, Mensah, Vidogbena and Agossou, (2012) of the determinants of ICT use by rice farmers in Benin found that over 90% of their respondents used radio. After radio, the three most common types of tools used were mobile call-up (41%), Television (17%) and Mobile SMS (10%). The study further indicated that the Use of CD-ROMs, Video and internet /email was very low among farmers at a range of 3.2-4% of respondents. In a similar study conducted in Nigeria, Okoedo-Okojie and Omoregbee (2012) indicates that apart from Radio, the Mobile Phone (GSM) was the highest used ICT tool. The use of the computer, Email and Internet were very low. This is further corroborated by Sekebira, Bonabana & Asingwire, (2010) who also found out in their study in Uganda that more farmers were using the mobile phone, traditional phone booth than the use of Internet, Email and other modern ICTs.

The use of radio by a majority of the respondents in the studies is a result of the cheaper cost of modern transistor radios and the proliferation of FM stations. Here the issue is not so much of listening to news and other local information but how rural people can make

their voice heard through the medium. Outside of special programs conducted by the broadcast companies, the most convenient way of being heard is to call into a program. Adegbidi *et al*. (2012) found out that only a small fraction of the rice farmers called into a program. This might be due to several factors including the cost of credit for the mobile phone to be used.

The key drivers of the use of ICTs for Agriculture by the studies reviewed were the cost of transport to the produce market, use of information from an agricultural project, land ownership and the favourable condition for farming. Fallow periods tended to affect use of ICTs negatively Adegbidi *et al*., (2012). An interesting finding by Adegbidi *et al*., (2012) was that farmers were more predisposed to using ICTs if they were involved in an ICT project implemented by Agricultural agencies. The finding by Adebgidi *et al.,* (2012) confirms studies that awareness creation and deliberate government programs for farmers could increase their use of ICTs.

In the study of Kirui, Okello, Nyikal and Rose, (2012) on determinants of use and intensity of use of mobile phone-based money transfer services among small-holder agriculture in Kenya, awareness of the use of the mobile money transfer, distances to banks, distances to the extension agent, distances to the Mobile Money transfer (MMT) agent and the number of MMT businesses, affected the use of the mobile phones and the patronage of the services.

Education, particularly the number of years spent in school greatly affected the use of ICTs (Adegbidi *et al.,* 2012), Sekebira *et al.,* (2012), and Tembo (2010). The researchers mentioned agree that literacy was a determinant in the choice and use of ICTs.

2.9 Some determinants of ICT usage

A key determinant of ICT usage has been found to be membership of a farmer's organization or group. Kirui *et al*. (2012) and Sekabira *et al.* (2012) agreed on the impact of membership of a farmer's association or group. According to them, the cooperative and collective action requires that if one member accesses a new device it will quickly be adopted by a large number of members. Maumbe and Okello (2013), support this assertion A major determinant is the role of a dynamic and well-trained Extension agent. The expertise and active usage of ICTs by the extension agent will directly influence the use of ICTs by farmers. The daily usage will raise questions from the farmers and since the opinion of the agent matters, this will move the local farmers to adopt the ICT tool (Ibrahim, Ayazi, Nasrmalek and Nakhat, 2012). This is supported by Dixon (2009) that frequent usage and exposure to ICTs has an effect on adoption and usage of ICTs.

Another notable determinant include location characteristics. In a study by Kilangi, (2013) Firms located in the rural areas have limited access to ICT vendors, internet service providers (ISPs), ICT technicians, and institutions that provide ICT support and training courses. Similarly, Results of a study conducted in Europe indicated that ICT adoption and eventually its usage in SMEs were reflected in their size and location (DTI, 2002). People living in an area close to a vibrant marketing centre are likely to be influenced by the clash of cultures and the diversity of people coming to the market, Kirui *et al.*, (2012).

The main reasons for non-adoption of technology are weak perceptions of technology and low education of farmers, low-teaching capacities, limited knowledge among extension workers, disorganization, geographical conditions, and inadequate resources and funds. There is a positive correlation between level of education and the acceptance of ideas by farmers (Ajala, 1992). Literate individuals are keen to get information and use it. Low levels of human capital, especially low secondary education and scarcity of technicians limit the range of goods that can be produced and negatively affect the ability to absorb new technologies (Tybout, 2000). In general, it is difficult to separate the factors that drive diffusion of ICT from the effects of ICT. For example, education is a precondition to use advanced computer based ICTs but at the same time, ICT might help to improve education through distant learning programs.

Education improves human resources, and the skills won through it are likely to impact on the ability of the enterprises to adopt advanced technologies including ICTs. Notably, schooling has allocative effects as it increases the ability to deal with disequilibria, e.g. changing factor and product prices (Weir 2000, Shultz 1975).

According to Jayathilake, Jayaweera and Waidyasekera. (2008), the most important limiting factor, which affects the use of ICT in agriculture, is cost of technology. At the level of cost, there is also some evidence that the Internet is used more widely where political and civil freedom exists (ILO, 2001). Robinson and Crenshaw (1999) furthermore show that other variables being equal, a 10 % rise in economic inequality results in 8.9 % decrease in Internet hosts. They conclude those unequal economies, or those that have a

strong disparity between their modern sector and the traditional subsistence sector, are much less able to make use of Internet development than are other nations.

Furthermore, in a number of local studies by Saleh (2009); Hayrol, Sallah & Bahaman, (2009), Abu Samah, Shaffril, Hassan & Ismail,(2009) have agreed with findings by Truong (2008) which accentuated on factors such as, negative perceptions, lack of capital, small land areas, ineffective infrastructure facilities, and limited capacity of extension workers as the main drivers that led to low technology adoption. Additionally, factors such as the knowledge level of extension workers, methods of organization and management of extension programs, and local conditions are also highlighted as the drivers for technology adoption. Based on a study conducted by Truong (2008), there are many obstacles to running a successful technology strategy.

Still others determinants identified included, Lack of training and inability of farmers to use ICT. The factors namely; trust level in the ICT system, lack of technological infrastructure and lack of ICT proficiency are the third level category that affects the use of ICT in agriculture (Adegbidi *et al*., 2012); Finally, other determinants incudes incomes, household sizes, assets and distance to the nearest bank among a host of others.

From the above literature on the socio-economic determinants of I ICT usage, I have decided to investigate, age, sex, educational level of crop farmers, marital status, household sizes, farming experiences, ICT training received and income levels of farmers. Others include head of household, ownership of land and cultivation of crops (yam, maize rice and millet). These socio-economic determinants have been chosen because of their preponderance in the northern region and will help to compare with other studies done elsewhere.

2.10 Theoretical Framework

This section looks at the theoretical framework for ICTs diffusion it looks at three main theories underpinning the diffusion of innovation and assess the relevance to the study. The three main models analyzed in relation to the study are; Innovation diffusion, Technology adoption model, the Theoretical adoption model and the Information innovation model

2.10.1 The Innovation Diffusion Theory

Bakkabulindi, Nkata & Amin (2009) considered ICT as an innovation, which was best diffused, based on its characteristics. Rogers (1964), one of the main pillars of innovation diffusion defines innovation diffusion as a process by which innovation is communicated over various channels over time within a social system. ICT as an innovation depends on behaviour or attitudes within the society to the innovation and five key variables in the adoption process. The variables included;

i) Knowledge of the product,

ii) Persuasion - where the individual or groups require more information about the product,

iii) Decision – where the individual has an opportunity to weigh the advantages or the disadvantages of the innovation for its continued usage or rejection,

iv) Implementation – where the innovation is employed to a certain degree or seek more information about it and

v) Confirmation – when the individual finalizes the decision to continue or to discontinue usage of the innovation.

Rogers (2003) further posits that an innovation was likely to be adopted based on the characteristics of the innovation itself. An innovation will be adopted based on its relative

advantage, presumably in comparison to others available. Rogers (2003), indicates that the greater the perceived relative advantage of an innovation, the more rapid its adoption. Another characteristic was compatibility to the social practices as well as to the vocation for which the innovation was being sought. The compatibility helped an individual to give meaning to it (Bakkabulindi et al., 2009).

In addition, a characteristic, which will facilitate adoption, was the complexity or the relative ease with which the innovation can be used. A further characteristic was the trialability of the innovation. If an individual can experiment with the innovation, it can influence usage of the innovation. This comes on the back of the risk associated with new products and the fear of losing out completely. ICTs have hardware and software components. There are ICTs with software parts, which are not so open to observation. These have slower rates of adoption (Rogers, 2003). Many factors can be associated with attitude towards ICT usage. D' Silva, Samah, Shaffril and Hassan (2010), in their study, have specifically focused on six variables that have the potential to influence attitude towards ICT usage. The variables are; self-efficacy, perceived usefulness, perceived ease of use, subjective norm compatibility and job relevance.

Adegbidi et al. (2012) posit that "usually attitude portrays either positive or negative views towards a person, place, thing or event. A positive attitude is an important requirement for ICT usage". Based on what has been completed by Shiro (2008), rural communities are noted to have a very positive attitude towards ICT and they welcome any ICT project to be developed in their areas. However, lack of ICT knowledge by these communities prohibit

them from using ICT frequently. Dixon (2009), has stressed that frequent usage and exposure to ICT must be considered if someone wanted to form a positive attitude towards ICT. When people frequently use and are exposed to ICT, it will inform them that ICT is helpful and beneficial to them thus creating a positive attitude towards ICT usage. Zhang and Aikman (2007) have revealed that attitude can be a mediator toward an object or behavioural intention. Theoretically, ICT adoption falls within the ambit of diffusion of innovation and consonance with socio-economic characteristics of farmers this might explain the ICT tool usage pattern of farmers.

2.10.2 Technology Adoption Model

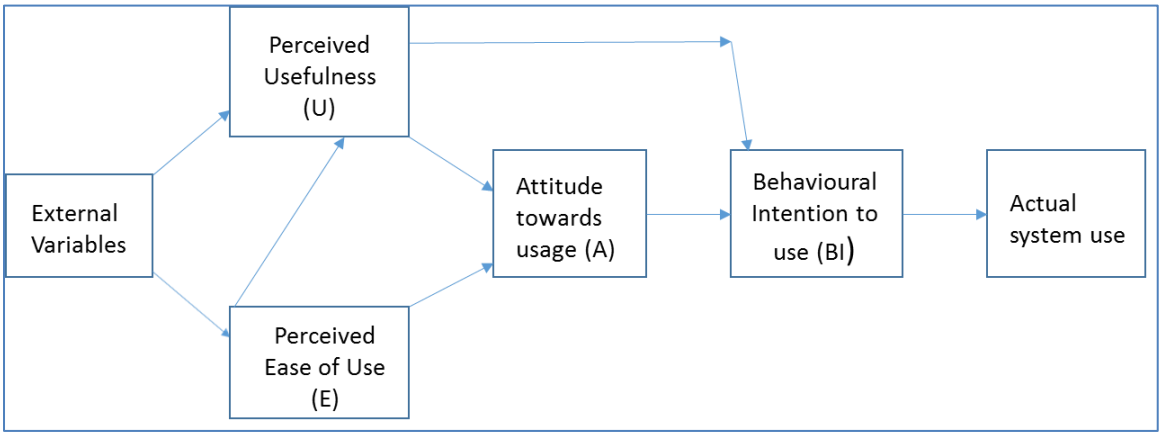
The Technology Acceptance Model (TAM) is an information systems theory that models how users come to accept and use a technology. The model suggests that when users are presented with a new technology, a number of factors influence their decision about how and when they will use it, notably:

Perceived usefulness (U) - This was defined by Davis (1989) as "the degree to which a person believes that using a particular system would enhance his or her job performance".

Perceived Ease-Of-Use (E) – This has been defined as "the degree to which a person believes that using a particular system would be free from effort" (Davis 1989).

Fred Davis and Richard Bagozzi (Davis 1989, Bagozzi, Davis and Warshaw 1992) developed the Technology adoption model.

Figure 2.1: Technology Adoption Model (TAM)



Source: Venkatesh and Davis (1996, p.453)

External variables affect perceived usefulness and perceived ease of use directly or indirectly, and they influence the perception about these two major factors of technology adoption. Perceived usefulness is the degree to which using technology would improve performance and perceived ease-of-use is the degree to which using technology is expected to be effortless (Lu, Deng and Wang, 2003). Perceptions, attitudes towards ICT and ICT usability are important and suitable for this study but other aspects such as beliefs, behavioural intentions and habits are not taken into account in this study. However, the adoption model represents a scenario that is similar to the situation on the ground in the Northern region.

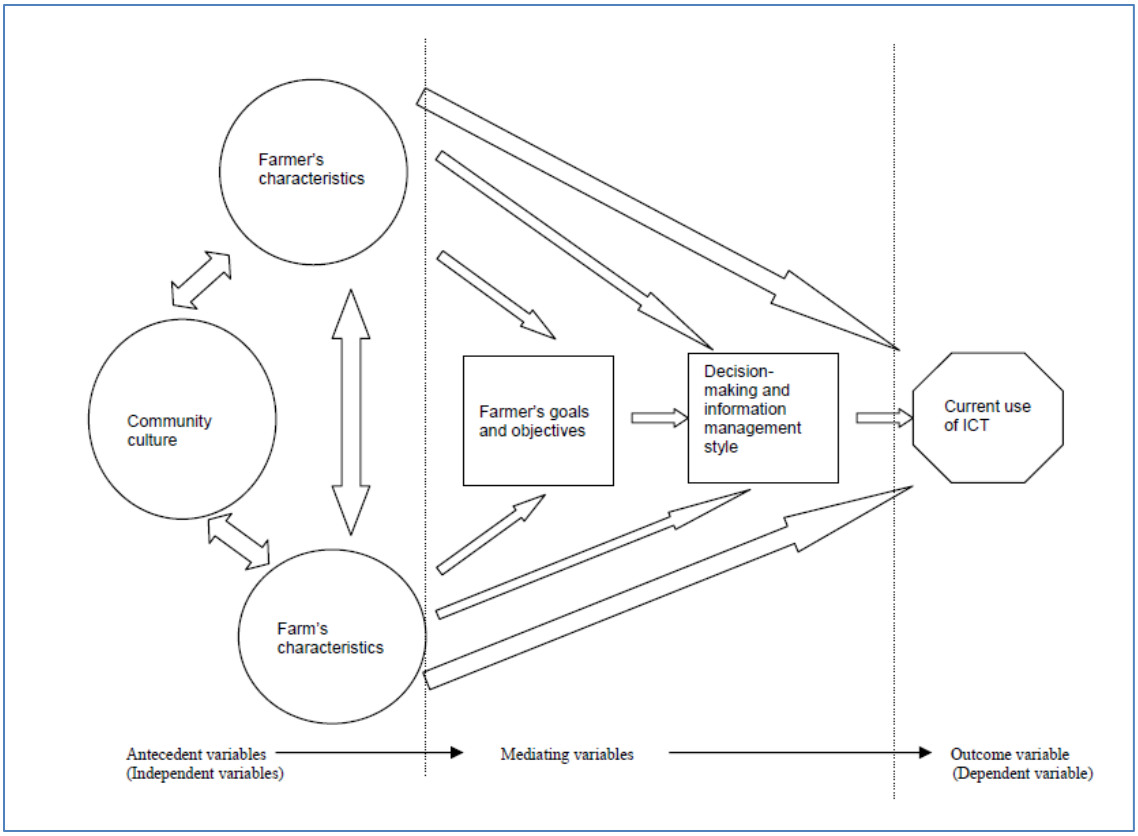
2.10.3 Theoretical Model of Adoption

Another model derived from the diffusion of innovation theory and the social learning theory is Marcus' theoretical model of adoption (Ankem, 2004). This model identifies a number of key influential factors of ICT adoption. These factors included associate innovation costs (personal and institutional), availability of necessary resources (money,

equipment, training, time, prior experience and relevant skills), the value of the technology (benefit minus cost) and communication between potential adopter and other adopters. Ankem (2004) used this model to investigate the factors influencing the use of Internet resource value added processes. The model has many important relevant factors that are investigated in this study including income, training experience, land ownership and farming experience. However, the costs and benefit analysis was not part of this study and the model is mainly employed to study innovative behaviour, which is not the purpose of this study.

2.10.4 Information Innovation adoption model

Since this study was interested in investigating the socio-economic factors that determine the use of ICT, it employed the information innovation adoption model to explain farmer ICT use behaviour. It was the best existing model that was found to explain ICT use in agriculture. The model uses behavioural modelling concepts proposed by Kline (1998) and uses mediating variables to assess the relationships. It was developed, adopted and used by Alvarez and Nuthall (2006) to investigate the use of computer based information systems by dairy farmers in Canterbury, New Zealand and Florida, Uruguay. They used this model and modified it to develop an enhanced model for computerized system adoption



Source: Alvarez and Nuthall (2006)

Figure 2.2: Information Innovation adoption model

The model shows that the use of ICTs by farmers relied on certain variables and that the relationship among the variables was not a simple direct one. The first group of variables is composed of antecedent variables that are indicated by circles in Figure 2.2. An antecedent variable is an underlying cause for a situation or scenario. In this model, the variables include farmer's socio-economic characteristics such as age, formal education and income, sex; farm characteristics such as farm size and crops grown on the farm, and community culture. Community culture was the farming culture that involved the values, ideas, and principles that were shared by the farming community when farmers were children and developed or shaped their thinking. The second group of variables included mediating variables indicated by rectangles in Figure 2.2. Mediating variables are variables

that describe how, rather than when, effects will occur by accounting for the relationship between the independent and dependent variables. Mediating variables are introduced to explain why an antecedent variable affects the outcome variable. Examples are coping styles of farmers, use of ICT in decision-making, information management style, and objectives and goals pertaining to ICT. The inclusion of mediating variables like personality traits, education, income, household headship, types of crops cultivated, learning styles and farmer's goals provide a more comprehensive explanation and better understanding of information management behaviour.

CHAPTER THREE

3.0 RESEARCH METHODOLOGY

3.1 Introduction

This section of the work covers the study area, study design, study population, study unit, sample size, sampling method, variables and data sources and study instruments. This descriptive cross-sectional study was carried out in seven districts of the Northern Region, namely, Savelugu, Tolon, Gushiegu, Yendi, Saboba, Nanumba North and East Gonja, among crop farmers in February 2015.

3.2 Study Area

The study sites (i.e. Savelugu, Tolon, Gushiegu, Yendi. Saboba, Nanumba North and East Gonja are located in one geographical location, namely, the Northern Region (Fig. 3.1 below). The Region occupies an area of about 70,384 square kilometres and is the largest region in Ghana in terms of land mass with its capital as Tamale. It lies within latitude 9.35338° N and Longitude, -0.9670655° E. It shares boundaries with the Upper East and the Upper West regions to the north, the Brong Ahafo and the Volta regions to the south, Togo to the east, and Côte d'Ivoire to the West as indicated in Figure 3.1. There are currently 26 districts in the Region (Ghana Government Portal- http://www.ghana.gov.gh/index.php/about-ghana/regions/northern, accessed on March 18, 2015).

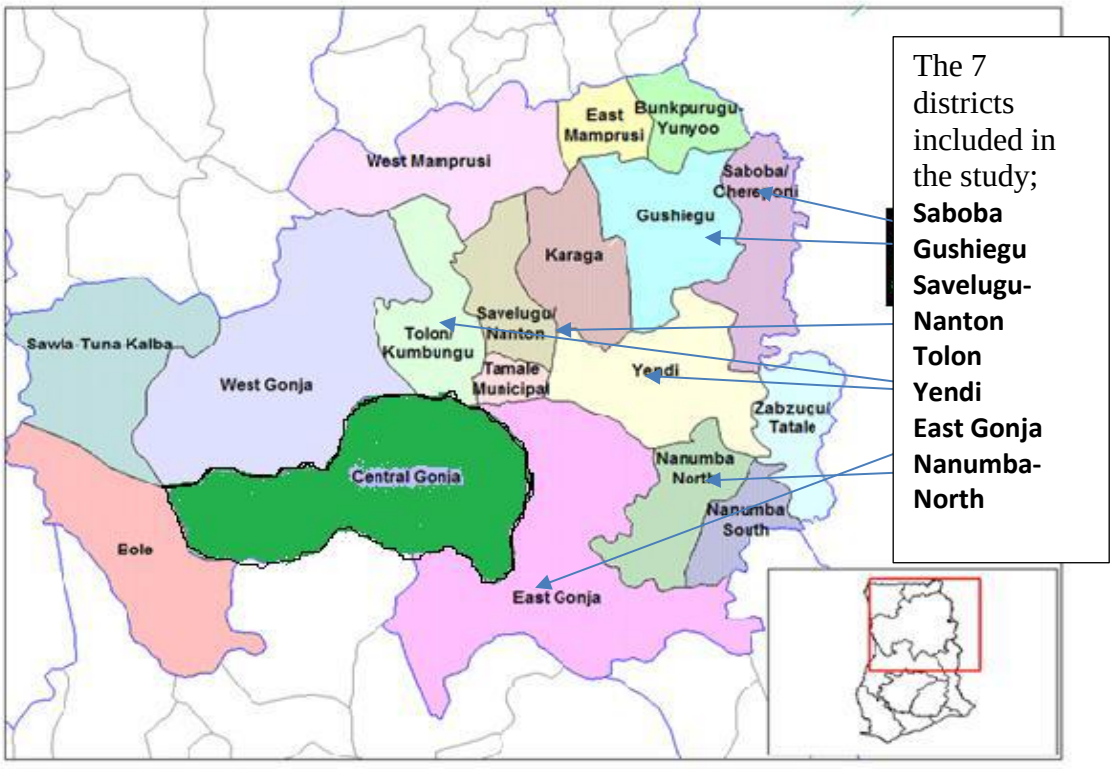


Figure 3.1: Map of the Northern region showing the selected districts

Source: Ghana Statistical Service. (2012)

3.2.1 Population

According to 2010 National Population and Housing Census conducted by Ghana Statistical Service (GSS), the population of the northern region was 2,479,461 comprising 1,229,887 males and 1,249,574 females (GSS, 2012). Majority of the population are between the ages of 15 and 40. The population structure of the region can be said to be young. The current growth rate of the population is 3% and the population represents 9.6 per cent of the total population of the country (GSS, 2012).

3.2.2 Climate

The climate of the region is relatively dry, with a single rainy season that begins in May and ends in October (GSS, 2012). The region is characterised by low and erratic rainfall, less than 1000 to 1250 mm. The prolonged November-April dry season includes a period with exceptionally strong and dry winds, the harmattan. A further problem is accelerated desertification, most especially in the overcrowded areas (Gyasi *et al.,* 1995) and Saito *et al.,* (2017).

3.2.3 Vegetation and soils

The main vegetation is grassland, interspersed with guinea savannah woodland, characterised by drought-resistant trees such as acacia, (*Acacia longifolia*), mango (*Magnifera indica*), baobab (*Adansonia digitata*), shea (*Vitellaria paradoxa),* dawadawa, and neem *(Azadirachta indica).*

The soils, with exception of the limited alluvial ones, do not appear particularly productive. They are dominated by the difficult to cultivate shallow, easily waterlogged groundwater laterites overlying iron pan formations and by savannah ochrosols. This last type of soil, like the groundwater laterites, are humus-deficient due to the low organic matter from the sparse vegetation. Other farming limitations include soil erosion, bush fire, poor transportation and storage facilities (Gyasi *et al.,* 1995).

3.2.4 Occupation

The majority of people in the region are engaged in agriculture. Agriculture employs the largest proportion of the population aged 15 years and above (GSS, 2012). The region experienced an increase in proportion of labour force in agriculture at the expense of manufacturing and other industrial activities. The proportion of the working population aged 15 years and above engaged in agriculture as their main job increased from 78.3% in 2000 to 90.5% in 2008 (GSS 2012) The crops they produce include yam, maize, millet, guinea corn, rice, groundnut, beans, soya bean and cowpea. At Gushie in the Savelugu-Nanton District, there is a large plantation of grafted mangoes cultivated by out growers. Bontanga in the Kumbungu District has a big irrigation dam where farmers engage in large-scale rice cultivation during the dry season.

3.2.5 ICT connectivity in Northern Region

The recent surge by Telecommunication companies has led to a spread of the services to various parts of the region. There are over 26 registered radios stations called Frequency Modulation (FM) stations in the Northern Region (National Communication Authority (NCA), 2013). According to the NCA (2016) at the end of May 2016, the total number of mobile voice subscribers had increased from 35,395,116 at the end of April 2016 to 36,534,611 as at the end of May 2016. The total penetration rate for May 2016 was 103.2% at the national level, which has an impact on the northern region. In spite of the significant growth over the past decade (2004-2014), particularly the mobile market, Africa still lags behind other regions

(see Figure 4) both in terms of the percentage of people with access to the full range of communications services the amounts and manner in which they can be used (ITU, 2010).

3.3. Research Design

The research employed the cross sectional design in collecting and analysing data. The reason for the choice of this method was to describe ICT usage by crop farmers, as it existed at the time of the survey. The data was recoded to help ascertain the socio-economic determinants of ICT usage. In this regard, the binary regression procedure was preferred to enable the researcher to determine the extent of relationship existing between variables -independent and dependent variables. It also enabled the researcher to test the hypothesis about the relationship between variables as well as to assess the magnitude and direction of the relationship. Furthermore, regression in SPSS is commonly used because it is relatively easy to design and conduct (Ary, Jacobs & Razavieh, 2006).

3.4 Study Population

According to Zikmund (2003), one of the challenges of any type of research is the definition of the study population from which the respondents are selected. Therefore, the cases of the study refer to the entire set of relevant units or population that fit into a certain specification. According to Puopiel (2014), the study population refers to the specific individuals/units/agents within the population in an organization from whom one can obtain the required primary or secondary data. In other words, they point to where information about the study topic can be obtained.

He further posited that the study population must be relevant to avoid sampling error. In this light, the study targeted crop farmers in the Northern Region of Ghana. They were targeted because they provided in-depth and relevant data on the study topic. In this study, the population was made of 630 smallholder rural crop farmers across the seven districts.

3.5 Determination of Sample Size

In determining the sample size, the Slovin (1960) formula below was used; Slovin's fomula is used if a researcher has no idea about a population's behavior,

To find the sample size

$$n = \frac{N}{(1 + Ne^2)}$$

Where n is the sample size number

N =the total population = the total number of smallholder rural crop farmers from the 7 districts).

e = error = 5% = $(0.05)^2 = 0.0025$

And 95% = confidence level

$$\frac{630}{1+630\times0.0025} = 244.7$$

Hence, sample size of 245 smallholder crop farmers were targeted to participate in the study. However, 210, representing 86%, were available during the time of the study. On this note 30 farmers comprising 15 men and 15 women were selected from each of the seven districts selected for the study as in Table 3.1. The equal

representation of men and women was a balance response of the two sexes as farming is done by both of them.

Table 3.1: Districts and Communities of sampled population

No.	District	Community	Men	Women	Number of farmers
1	Gushiegu	Kpahikpaba	15	15	30
2	Saboba	Tandjemle	15	15	30
	Nanumba				
3	North	Pusuga	15	15	30
4	Gonja East	Dashie	15	15	30
5	Tolon	Gbulahagu	15	15	30
6	Savelugu	Zogu	15	15	30
7	Yendi	Gbungbalga	15	15	30
	Total		105	105	210

Source: Author's Construct, September 2015

3.6 Sampling Techniques and Procedure

The study used multistage sampling technique. The following sampling techniques and procedures were used in selecting the study sites and units (i.e. crop farmers) for the study: purposive, quota and stratified sampling techniques.

Firstly, the 7 districts were selected randomly because the small holder rural crop farmers are in all the districts of the Northern region. Secondly, the 7 communities across the 7 districts were selected using purposive sampling technique because they were from very rural communities (Table 3.1). Purposive sampling technique allows a researcher to select special people to participate in a study on the basis of the respondents' knowledge and practices on the issues under investigation

(Kuranchie, 2014). The list of members of a household survey were used in reaching the members who were selected to participate in the study by virtue of their availability.

Again, quota-sampling technique was used to select 30 respondents from each community in each district. According to Kusi (2012), with this sampling technique, a researcher sets specific number to select from groups of the population. When there is the need to have proportional representation of members from different groups, Kuranchie (2014) has indicated that quota sampling is the best sampling technique to adopt.

Moreover, farmers in selected communities were further stratified into male and female farmers to ensure a fair representation of both sexes. As indicated by Puopiel (2014) stratified sampling technique arises when the sampling population is heterogeneous in which each group must be represented in the sample. This therefore made it necessary to disaggregate the sample population since the farmers in the area comprised of both men and women. The individual farmers were also selected through random sampling.

3.7 Data Sources

Data for the study were gathered from two main sources namely secondary and primary sources. Data from secondary sources were obtained from books, journals, thesis reports and records to review literature on socio-economic factors that determine ICT usage among farmers. Secondly, the primary data were obtained both

qualitatively and quantitatively on the specific objectives of the study. This was to validate and ensure reliability of data obtained from the secondary sources.

3.8 Data Collection Instruments and Methods

The primary data was collected using structured questionnaires designed and administered to the farmers in the sampled areas. Close-ended questions were used to capture numerical and quantitative data that links theory to research (quantitative method) which enabled the researcher to describe the magnitude of the findings statistically. Open-ended questions and other qualitative attributes (qualitative method) also referred to as interpretive research methods (Bogdan & Biklen, 2009) were utilized. To facilitate the analysis, respondents' perceptions/opinions on the benefits of ICT were measured using a 5-point Likert scale of 1 to 5 scores. The scale was from; 1 = Strongly agree, 2 = Agree, 3 = Neutral, 4 = Disagree, 5 = Strongly disagree. This was used to determine the awareness and access of crop farmers to ICTs. It was also used to determine the ICT devices owned and used by the farmers and the types of information obtained and disseminated and to identify the constraints to ICT use.

For the purpose of the study, people who understand the local languages, Dagbanli, Gonja and Likpakpan in their respective communities were used as translators of the questionnaire to the respondents. However, since many of the people understood Dagbanli, it was easier to use it as a major language to explain the questions, which were set in English, to the respondents.

3.8.1 Pre-testing of the Questionnaire

Before the data collection took place, the questionnaire was pre-tested. This was to ensure the reliability of the instrument. In this regard, the pre-testing was done at Yong (near Savelugu) with 30 respondents who were crop farmers. The pre-testing revealed the need to reduce the number of questions and to focus on the key ICT tools prevalent in the rural areas, since many of the farmers were not knowledgeable about computers, CD-ROMS, DVDs, Scanners, Email, Internet and other emerging ICT tools. The crop farmers involved in the pre-testing gave an indication that they were not conversant with some of the tools, which were earlier listed, and other farm application tools. In addition, the pre-testing revealed that all the crop farmers knew about at least one ICT tool though they might not possess it. The questionnaire was reviewed and adjusted to fit into the capacity of respondents and brought out the issue of using binary logistic regression to analyse the direction.

3.9 Data Analysis

Data was analysed using Statistical Package for Social Sciences, (IBM SPSS software version 20.0). Descriptive statistics were used to compute frequencies and percentages for the description of the socio-economic characteristics of the crop farmers. Frequencies and percentages were also used to describe the ICT tools available in the northern region as well as the constraints to the use of ICTs. The cross tabulations helped to identify differences between and within variable groups affecting the use of the ICTs by the farmers. This is how each objective was analysed.

i) **Describe the socio-economic characteristics of crop farmers in the Northern region:** Descriptive statistics were used to compute the frequencies and percentages of the socio-economic characteristics of the farmers. The results were presented in tables and pie chart.

ii) **Identify the ICT tools, which are currently in use in the northern region:** the data were analysed using frequencies and percentages to describe the tools used. Cross tabulations helped to explain the relationships between and within the variable groups.

iii) Assess the socio-economic factors affecting the use of ICT tools: Stata software was used to run Probit regression, which helped to identify and predict the socio-economic determinants of ICT usage among the farmers. The model is explained below (see 3.9.0).

iv) **Determine the kinds of information being accessed with the ICT tool in use:** frequencies and percentages were used to describe the kinds of information being accessed among farmers.

v) **Identify the constraints to ICT usage by the crop farmers:** the data for this were analysed using frequencies and percentages to identify the most serious constraints to ICT use among farmers.

3.90 Analytical Framework

Stata (version 13) was used to run Probit regression. Probit regression model was used to identify determinants of the usage of ICT among farmers. Farmers using

ICT were coded as 1 whereas those not using ICT were coded as 0. The equation or model for the probit regression is indicated as below.

$$Yi=\beta_0+\beta_1X_1+\beta_2 X_2+\beta_3 X_3+\beta_4 X_4+\beta_5 X_5+\beta_6 X_6+\beta_7 X_7+\beta_8 X_8+\ldots\ldots\ldots+\beta_{15} X_{15}+Ui$$

(Where Y_1= dependent variable, use of ICT (1 if farmers used ICT and 0 otherwise; β_0 = Intercept, β_1 –β_{15} = parameters to be estimated, X_1-X_{15} = Vector of explanatory independent variables;

Ui = error term.

It was also used to test for the strength of association between independent and dependent variables and differences between sub-groups.

3.9.1 Measurement of variables

The study considered two sets of variables - dependent and independent variables. These are briefly discussed below with an indication of how they were measured.

3.9.1.1 The dependent variables: Usage of ICTs and knowledge

The dependent variable was usage of ICTs. The technology (innovation), for this study was in reference to the following ICTs: Mobile phone, Radio, Television, Computer, the Internet and Email. Use of any one of the ICTs was coded as 1 or 0 otherwise. All the farmers had used at least one of the ICT tools.

3.9.1.2 Independent variables

The following independent variables were measured. These were identified as:

Age (X_1)

With age, a farmer was expected to accumulate more personal capital and therefore, show a greater likelihood of investing in innovations (Agwu and Chah, 2007). However, younger farmers may be more flexible and more likely to use and adopt new technologies (Abdullah & Abu Samah, 2013). Hill *et al*. (2008) found old age to be negatively associated with ICT usage. Age was measured in years. The a priori expectation for age was that younger people were likely to use more ICTs than older people. In this case farmers under forty years were more predisposed to use ICTs than those above forty years.

Sex (X_2)

The roles of the sexes had a traditional implication for farming in the northern region of Ghana. Since males own the land, they have more resources than women. It is likely that males are able to access and use ICT more than women. Traditionally in the north of Ghana, women are not yet fully emancipated and are expected to be at home, men have better and easier access to and more readily adopt technology (Tembo, 2008).

Education status (X_3)

It is postulated that organization with people who attained secondary schooling or higher education are more adaptable than otherwise (Coleman, 2000). The importance of education to technology adoption is demonstrated in a number of studies, which have produced evidence for skill bias in technological development

(Montealegre, 1999). Education can matter in at least two ways. For one, better-educated workers may have a comparative advantage with respect to learning and implementing new technologies. For another, technologies invented in advanced countries tend to be skill-complementary by design (Pohjola, 2003). It was assumed that the more educated the farmers, the more likely they were to adopt the use of ICTs in finding solutions to their farming and other problems. It was measured according to the level of formal education attained (1= no schooling; 2 =up to primary level; 3= Middle/ JHS, 4 = Secondary/Vocational/Commercial, 5= Tertiary Level). For ease in using the Probit model the variable was measured as a dummy. It was defined as no formal education (0) and formal education (1).

Head of Household (X_4)

The socio-economic characteristics of the head of household determined whether he/she would use ICTs (Mukoko, 2013). The head of household was expected to hold all the resources of the family including land. It was therefore expected that he/she had enough resources to indulge in technology use. The sample was categorised into those who are heads of households and those who are not and coded as a dummy variable.

Household size (X_5)

The larger the household size the bigger the responsibility and the less likely for the farmer to purchase and use ICTs (Sekebira *et al*, 2012). Mukoko (2013) writes the size of household has an effect on ICT adoption. Harindranath *et al*. (2008) stated

that family size was influential in using ICTs. Household size was measured by the number of individuals under the care of the farmer. It was also categorized into below five and above 5

Farming Experience (X_6)

Farmers with more years in farming (experience) were more likely to use the ICTs. Ayanwale and Adekunle (2008) posit that farming experience has an effect on ICT usage (Mukoko, 2013). Farming experience was coded in the number of years spent farming

Ownership of land (X_7)

Farmers who owned their lands were thought to have easier access to technology since they were not tied to paying for the land. Armstrong and Ghandi (2012) writes land ownership would allow great propensity to earn greater income to use for such purchases of ICT tools. It was coded as a dummy. 1=owns land and 0=otherwise

Annual income (X_8)

Increase in annual income was expected to have a positive impact on ICTs usage, as it was expected to increase the purchasing power of the farmer (Gamboa & Gutierrez, 2010). Donner (2007) found incomes to positively impact ICT use. Annual income was coded as the average amount of money earned in Ghana Cedis. 1 = more than 500 cedis, 0 = otherwise.

Training on ICTs received (X_9)

Adoption of ICTs was likely to be favoured by training received in ICT use (Yakubu, Abubakar, Atala & Abdulai., 2013). This was categorized into no training, received training, and coded as a dummy variable. Respondents answered 1 = Yes and 0 = NO

Marital status (X10)

Marital status was perceived to influence the adoption of ICTs since it meant that couples needed to stay in touch. Awoyemi (2015) found out that marital status had an effect on the adoption of technology. Marital status was coded as a dummy variable. Respondents answered 1= Married and 0 = otherwise

Maize production (X11)

This was considered as an important crop and therefore farmers who produced a lot of maize had the capacity to find ICTs useful for their marketing activities. Ayoola (2015) writes that it was useful for marketing activities in her work in North-Central Nigeria. It was coded as a dummy. Respondents answered 1 = Yes for cultivating maize and 0 = otherwise

Cultivation of rice (X12),

The cultivation of rice, a cereal was also considered as an important crop due mainly to the fact that it can be stored in anticipation of high prices. Farmers who cultivated rice therefore had the potential of getting resources to afford ICTs This is supported

by Adegbidi *et al*, (2012). This variable was coded as a dummy. Respondents indicated 1 = Yes for cultivating rice and 0 = otherwise

Groundnut cultivation (X13)

Groundnut cultivation is popular among farmers in the northern region of Ghana. Farmers are able to store it and sell when the market price rises. Therefore, farmers who farm groundnuts have the propensity to raise a lot of money. Through this it was felt that they had the ability to buy and use ICTs. Groundnut cultivation data was recoded as a dummy. Respondents answered 1 = Yes, for cultivating groundnut and 0 = otherwise.

Millet Cultivation (X14)

This was considered a very profitable crop since it is a popular crop and has many uses. As a result, farmers who cultivated the crop were more likely to use ICTs. Cultivation of the crop was re-coded as a dummy. Respondents answered 1 = Yes for cultivating millet and 0 = otherwise

Yam production (X15)

The cultivation of yam, a major staple in the northern region comes with many challenges and so farmers need a lot of information to derive maximum yields. It was felt farmers who cultivated Yam needed ICTs to enhance their yields. This is supported by Adewale & Ganiyu (2013), who wrote that yam farmers in Bulawaduro in Osun state used ICTs for information on production of yams. This was coded as a dummy, 1 = Yes for cultivating yam and 0 = Otherwise.

Table 3.2: Measurement of Independent Variables and Their a priori Expectations

Study variable	Explanation	Expected sign
Age (X_1)	Measured in years.0 = <40, 1= >40	+
Gender (X_2)	Sex of respondent – Male = 0, Female = 1	+
Education level (X_3)	Measured in years of access to formal education.0 = No formal Education, 1 = formal education.	+
Head of household (X_4)	Whether respondent is/not head of household No= 0, Yes= 1 head of household	-
Size of household (X_5)	Dependents was dichotomized into 0= <5 1= > 5	+
Farming experience (X_6)	No. of Years farmed. 0 =<5 years, 1= > 5 years	+
Ownership of Land (X_7)	Ownership of land 1= Yes 0= No	+
Average income (X_8)	Measured in Ghana cedis. 0=<500Ghs, 1= >500	-
Received ICT training (X_9)	Whether respondent has received ICT training, No = 0 Yes=1	+
Marital status (X_{10})	Marital status, Single = 0 Married = 1	+/-
Maize cultivation (X_{11})	Crop grown by farmers – No maize =0 Maize =1	+/-
Rice Cultivation (X_{12})	Crop grown by farmers – No rice =0 Rice =1	+/-
Groundnut cultivation (X_{13})	Crop grown by farmers – No groundnut =0 Groundnut =1	+/-
Millet cultivation (X_{14})	Crop grown by farmers – No millet =0 Millet =1	+/-
Yam cultivation (X_{15})	Crop grown by farmers – No yam =0 Yam =1	+/-

CHAPTER FOUR
4.0 RESULTS AND DISCUSSION

4.1 Introduction

This section contains the findings and discussion of the study based on statistical analyses in the form of frequencies, percentages etc. and presented in tables or figures where appropriate. This section relates the findings to available literature where appropriate. Specifically, the chapter covers the socio-economic characteristics and how it affects ICT usage based on the findings of the study.

4.2 Socio-Demographic Characteristics of Respondents

Table 4.1 below indicates that the majority of farmers, 37.1% were in the age range of 31-40 years, followed by those aged below 31 years (35.2%). This indicates that the farmers under 40 years constituted an active group in agricultural activities.

Table 4.1: Age, Sex and marital status of farmers

Variable	Frequency	Percentage
Age (years)		
Below 31	74	35.2
31-40	78	37.1
41-50	23	11
Above 50	35	16.7
Total	210	100
Sex		
Male	105	50
Female	105	50
Total	210	100
Marital status		
Married	165	78.6
Single	36	17.1
Widowed	9	4.3
Total	210	100

Source: Survey Data, 2015

This finding is supported by Lohento & Ajilore, (2015) who wrote that 35% of youth in Africa are in Agriculture. It also agrees with ILO, (2013) that there are 364 million youths in agriculture in Africa. The results also indicated that 78.0% of the respondents were married with 17.0% being single. Respondent with number of children 1 to 5 constituted the majority at 56.7% (Table 4.1).

To appreciate the associations within some of the variables, some cross tabulations were run in SSPS, Below are a few of them using ICTs and some demographics.

4.2.1 Age

The results of a cross tabulation between age and the use of ICT are presented in table 4.2 below. It is clear from table 4.2 that, those respondents who were 40 years and below used more of the ICTs (71%) compared to those above 41 years (29%). In the use of the use of ICTs, the respondents below 40 years were in the majority in the use of mobile phones, (36.7%), Radio (18.6%), Television (5.2%). This is supported by Abu Samah & Abdullah (2013) who wrote that younger farmers may be more flexible and more likely to use and adopt new technologies. The implication is that the younger the farmer the greater probability of using ICT. Since older people were less inclined to using ICTs, a deliberate attempt needed to be made to get them interested and involved in using ICTs particularly for farming purposes. The implication is that there is the need for extension to increase education on the popular ICTs to older farmers. However, the result of the study runs contrary to the study of Rice & Katz, (2003) who found out that Mobile phone usage, does not

seem to be influenced to the same extent by age; rather it is associated with characteristics of work (full-time, part-time), income, education, and marital status.

Table 4.2: Age and ICT use cross tabulation

ICT use	Age of respondents				Total %
	Below 30	31-40	41-50	51+	
Mobile Phones	18.6	18.1	4.8	5.2	46.7
Computers	3.8	1.9	1.0	0	6.7
Radio	8.6	10	5.7	8.1%	32.4
Television	1.4	3.8	1.4	1.9	8.5
Internet	1.9%	1.4%	0.5%	0%	3.8
Email	0.0%	1.4	0.5	0%	1.9
	34.3	**36.7**	**13.8**	**15.2**	**100**

Source: Survey Data, 2015

4.2.2 Sex (Gender)

From table 4.3 below, males used Mobile phones (24.3%) more than women (22.4%) did. Males were in the majority in using Television (4.7%) and the Internet (2.9%). The women were found to use the radio (18.5%) more than the men did. This result, however, is indicative of the fact that more males are using more ICT tools than the females.

Table 4.3 Sex and ICT use cross tabulation

ICT use	Gender		Total
	Male	Female	
Mobile Phones	24.3%	22.4%	46.7%
Computers	2.9%	3.8%	6.7%
Radio	13.8%	18.5%	32.3%
Television	4.7%	3.9%	8.6%
Internet	2.9%	0.9	3.8%
Email	1.4%	0.5%	1.9%
	50%	**50%**	**100%**

Source: Survey Data, 2015

4.2.3 Formal Educational Status of Respondents

The results revealed that a majority (62.0%) of the respondents had no formal education. Only 5% had attended a tertiary institution like the Polytechnic, College or University (Figure 4.2).

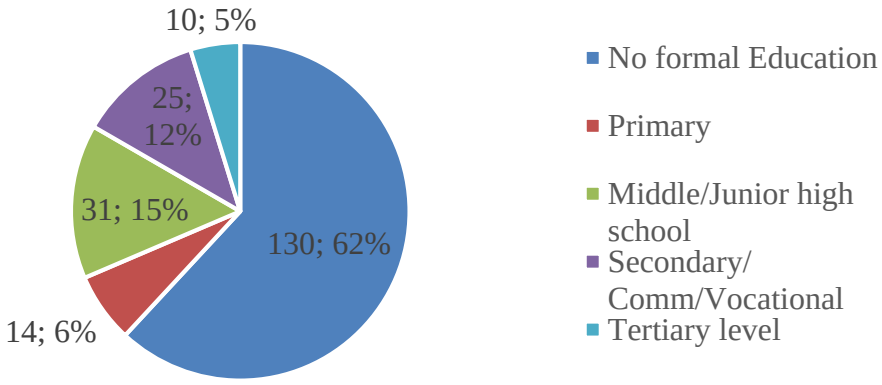


Figure 4.2: Educational level of farmers **Source: Survey Data, 2015**

4.2.3 Formal Educational Status

The results in table 4.4 is a cross tabulation between educational status and ICT usage. It shows that those who have less than 8 years of formal education were in the majority in the use of ICT tools, Mobile phones, Radio and Television. (68.2%). Ideally, it is the expectation that only those with higher levels of education will be more inclined to use ICT tools (Okello *et al*, 2014), but this is not the case in this study. Of course, the number of respondents with no formal education was very high at 62%. Only 38% had gone through some form of formal education. This implies that the socio-cultural context is receptive to innovation and so ease of use of the technology apart from formal education may have accounted for the results of this study.

Table 4.4 Educational Status and ICT usage cross tabulation

ICT use	No formal %	Primary %	Mid/JHS %	Secondary %	Tertiary %	Total %
Mobile Phones	30.1	3.2	8.6	3.7	1	47
Computers	0	0	1.4	2.4	0.5	4.3
Radio	24.9	0.9	3.8	3.7	1.4	33.7
Television	7	2.4	1.4	0.5	0%	12.7
Internet	0	0	0.9	1.4	1.7	2.3
Email	0	0	0	0.0	0.0%	0
Total	**62%**	**6.5%**	**15.1%**	**11.7%**	**4.7%**	**100**

Source: Survey Data, 2015

4.2.4 Marital status

Table 4.5 below indicates that married respondents were in the majority of over 78.6%. The results further indicate that married farmers were more disposed towards using ICTs in terms of the Mobile phones, 40%, radio, 22.9% and television 7.6%. This may be because married people need to stay in touch and communicate more. This is supported by *Awoyemi* (2015) who found that marital status, was positively related to the use of Information Communication Technology. Another study by Olumuyiwa & Kayode (2016) indicated that 86% of married farmers used ICTs.

Table 4.5 Marital status and ICT use cross tabulation

ICT use	Marital status		Total %
	Married	Single	
Mobile Phones	40%	6.6%	46.6
Computers	3.3%	3.3%	6.6
Radio	22.9%	8.6%	31.5
Television	7.6%	1%	8.6
Internet	2.4%	1.4%	3.8
Email	2.4%	0.5%	2.9
	78.6%	**21.4%**	**100**

Source: Survey Data, 2015

4.2.5 Household Size of Respondents

The results in Figure 4.1 below, indicates that 50.0% (105) of households with 6 to 10 members were in the majority. The least household size was below five members

(18.1%). Above 10 members were 31.9%. The finding agrees with Armstrong (2012) who wrote that rural households in Ratnagiri District in India had more than 5 members. It is further corroborated by Olumuyiwa & Kayode (2016), that the mean household size in their study on ICT usage and household food security status of maize farmers in Ondo state was 6.

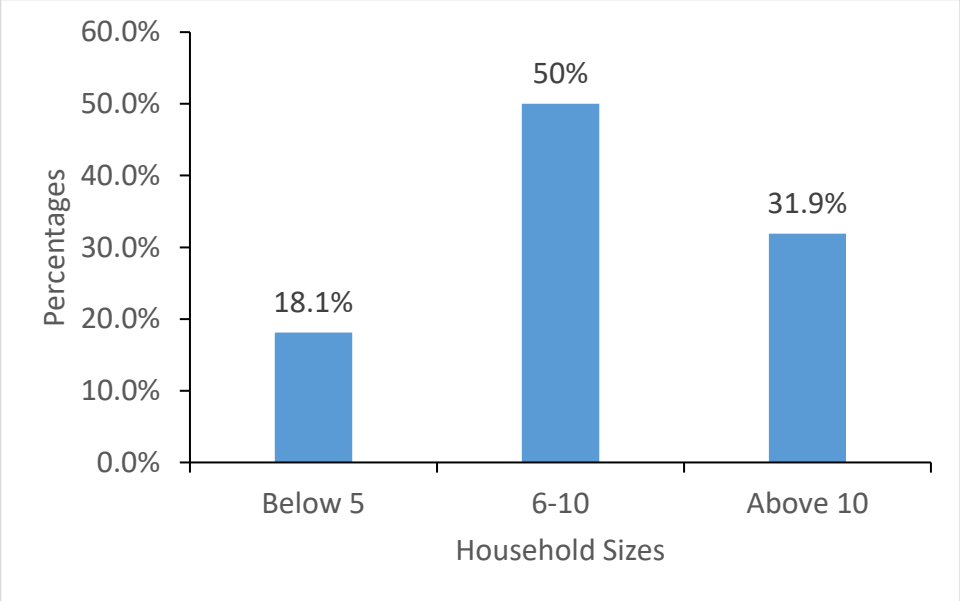


Figure 4.1 Household sizes Source: Survey Data, 2015

4.2.6 Other Socio-economic Characteristics of Respondents

The results in Table 4.6 show that majority of the respondents (55.7%) had farm sizes ranging from 2-5 acres. The least group was below one acre, which constituted 1.9%. According to the results, 33.0% were household heads with the majority (67%) as members of households. Furthermore, 57.0% of the respondents owned land. Less than half (43%) were tenants or had leased land from the landowners. On farming experience, 39% indicated they had farmed for 5 years and below but 30% and 31% had farmed for 6-10 years and above 10 years respectively.

Table 4.6: Other socio-economic characteristics of farmers

Variable	Frequency	Percentage
Farm size (acres)		
Below 1 acre	4	1.9
1	37	17.6
2-5	117	55.7
Above 5	52	24.8
Household headship status		
Head of household	69	32.9
Non head of household	141	67.1
Total	210	100
Land ownership		
Own Land	91	43.3
Does not own land	119	56.7
Total	210	100
Farming experience		
1-5 years	82	39
6-10	63	30
More than 10 years	65	31
Total		100

Source: Survey Data, 2015

4.3 ICT tools which are currently in use among farmers

From the results in Table 4.3 below, the following ICT tools are available among crop farmers in the study areas; Computers, Mobile phones, Internet, Radio, Television and email. The results indicate that mobile phones are the highest (36.0%) with radio at 33% and TV at 20%. The others are computers, internet and email at 7.1%, 3.3% and 1.4% respectively. The study indicated that almost

everybody is aware of ICTs in the areas covered. The implication of ICT awareness is that many of the rural farmers could access important information through Radio, Television and Mobile Phones, which hitherto had to be gained by travelling longer distances. In addition, farmers could use some of the existing ICT information dissemination services like VOTO and Farm Radio, which had arrived, in the study area.

Table 4.7: Available ICT tools among crop farmers

ICT Tools	Frequency (n)	Percentage (%)
Computer	15	7.1
Mobile Phone	75	35.7
Internet	7	3.3
Radio	69	32.8
Television	41	19.5
Email	3	1.4
Total	**210**	**100**

Source: Survey Data, 2015

4.3.1 Popular ICT tools among farmers

From the results in Table 4.8 below, the mobile phone remains the single most popular and most used ICT tool in the northern region with 48.5%. This is followed by radio (34.9%) and television (13.9%). This finding runs contrary to earlier research done by Adegbidi *et al*. (2012) where the radio was the most popular. The interest in radio persists since about 35.0% of the respondents possessed it in the communities covered. About 14.0% had televisions with a paltry 2.0% having computers. Similarly, Okoedo-Okojie and Omoregbee, (2012) indicated that apart

from Radio, the Mobile Phone (GSM) was the highest used ICT tool. The use of the computer, email and internet were very low. In another study by Hassan *et al*., (2008), the television, mobile phone, telephone and the radio were the popular tools. This study agrees with the findings of Henri-Okoha, Chikezie & Osuji (2012) who reported that farmers in Ukwa West in Abia state used the mobile phones, radio and television. The study also supported the finding by Aboh (2008) and Falola and Adewumi (2011) that mobile phone is another ICT tool embraced by farmers for receiving and sending information. The implication of this finding is that, since the three ICT tools; mobile phone, radio and television are popular among smallholder farmers in terms of usage, they could be factored into policy formulation to enhance services to crop farmers in the northern region. This results again tally with the findings of Owen (2008) in his USAID ICT4D program report where he asserted that over 50.0% of the world population have access to, or uses a mobile phone and only 5.0% of the world's population have access to or uses broadband Internet.

Mobile phone was regarded as the most widely used ICT tool for marketing of produce. They are used to communicate efficiently with intermediaries in the markets and to prevent them from cheating the farmers. With the help of the mobile phones, farmers are able to keep track of prevailing market prices of commodities in other markets thus helping them in determining the prices of their produce. This is also in line with the findings of Hielig (2003), Oyeyinka, and Bello (2013).

Table 4.8: Popular ICT tools

ICT tool use	Percentage (%)
Mobile phone	48.5
Computer	1.9
Radio	34.9
Television	13.9
Email	0.8
Total	**100**

Source: Survey Data 2015.

The results indicate that, 39.0% of the respondents rated radio and the mobile phone to be at par, as the most convenient ICT tools. This is followed by television. The computer and email users were 2.1% and 0.3% respectively (Table 4.9).

Table 4.9: Convenient ICT tools

ICT tool	Percentage (%)
Mobile Phones	39.2
Radio	39.2
Computer	2.1
Email	0.3
Television	19.2
Total	**100**

Source: Survey Data 2015

4.4 The socio-economic factors affecting the usage of ICT tools among the farmers

Table 4.10 presents the socio-economic determinants of farmers' usage of ICT tools. The Probit regression model was used in the determination of the influence

of each of the factors on the use of ICT tools. The dependent variable was ICT usage by the farmers.

Table 4.10: Factors influencing farmers use of ICT tools by Probit Regression Analysis

Variable	Regression coefficient	Standard error	Z	P>IzI	95% CI	
					Lower	Upper
Age (X_1)	0.7521*	0.23831	3.16	0.002	0.28503	1.21918
Gender (X_2)	0.3513	0.28745	1.22	0.222	-0.2121	0.91469
Education level (X_3)	-0.3890	0.26619	-1.46	0.144	-0.9107	0.13276
Head of household (X_4)	-0.8662*	0.31299	-2.77	0.006	-1.4796	-0.2527
Size of family (X_5)	-0.0145	0.22066	-0.07	0.947	-0.447	0.41796
Farming experience (X_6)	0.7150*	0.24614	2.90	0.004	0.23258	1.19742
Ownership of Land (X_7)	0.0680	0.27382	0.25	0.804	-0.4687	0.60463
Average income (X_8)	-0.7758	0.40431	-1.92	0.055	-1.5683	0.0166
Received ICT training (X_9)	1.3676*	0.29707	4.60	0.000	0.78537	1.94986
Marital status (X_{10})	0.2119	0.27101	0.78	0.434	-0.3193	0.74305
Maize production (X_{11})	-0.2140	0.26392	-0.81	0.417	-0.7313	0.30328
Rice production (X_{12})	0.1221	0.22903	0.53	0.594	-0.3268	0.57104
Groundnut production (X_{13})	0.3225	0.25007	1.29	0.197	-0.1676	0.81264
Millet production (X_{14})	0.3582	0.32623	1.10	0.272	-0.2812	0.99765
Yam production (X_{15})	0.6395*	0.28336	2.26	0.024	0.08415	1.19491
Constant	-2.0251	0.50709	-3.99	0.00	-3.019	-1.0313
LR = 65.54 (*p=0.000)*		Pseudo R^2=0.2352				

*, ** and *** means significant at 10%, 5% and 1% respectively

The results of the estimation in table 4.10 show that the probit model has a LR of 65.54. This value is statistically significant at the 5 percent alpha level as shown by

the p-value of 0.000. This means that all the variables in the probit model are together, statistically significant. The Pseudo R^2 also indicates that just 23.52 percent of the variation in default probability is explained by the independent variables.

4.4.1 Age and ICT use

Age significantly increased farmers usage of ICT tools by 75.21% (CI 0.28503 – 1.21918 with p=0.002). The implication is that the younger the farmer the greater probability of using ICT. Since older people were not using ICTs, a deliberate attempt needed to be made to get them interested and involved in using ICTs, particularly for farming purposes. The implication is that there is the need for extension to increase education on the popular ICTs to older farmers.

4.4.2 Household headship status and ICT use

Interestingly, farmers who were household heads significantly (*p=0.006*) reduced their usage of ICT tools by 86.62% (CI -1.4796 - -0.2527). This implies that, a household head with limited resources, may want to spend on essential items like food, school fees, hospital bills etc. instead of using it on ICT tools. The finding is similar to one by Mukoko (2012) where the level of income of the household head had an effect on ICT use. In their study, lower incomes affected ability of household heads to acquire ICTs.

4.4.3 Farming experience and ICT use

Farmers with more years in farming (experience) were more likely to use the ICTs. Ayanwale and Adekunle (2008) posit that farming experience has an effect on ICT usage. In this study, farming experience among the farmers was identified to significantly increase usage of ICT tools by 71.50% (CI 0.23258 – 1.19742) with the *p-value* of 0.004 (Table 4.10). Mukoko (2013) made a similar observation.

4.4.4 ICT training received and ICT use

Farmers who had received ICT training were found to increase significantly their usage of ICT tools. (p=0.000) by 136.76% (CI 0.78537 – 1.94986). Yakubu *et al.* (2013), supports this finding. They wrote that adoption of ICTs was likely to be favoured by training received in ICT use.

4.4.5 Gender and ICT use

Gender did not affect farmers' usage of ICT tools significantly. However, it showed an increased by 35.13% (CI -0.2121 – 0.91469) in Table 4.6. This means that more men were using ICTs than women were. The finding that gender has an effect on ICT usage support the literature available. Deen-Swarrey, Gilward & Morel (2012), writes, "Women with similar income, education and employment status are as likely as men to own a mobile phone. But, as women generally have less access to employment, education and other factors, which increases the likelihood of ownership, access to mobile phones is clearly not equal between men and women". Gender and technology studies have found that men and women adopt and use technology differently (Gefen and Straub, 1997; Venkatesh & Morris, 2000).

Venkatesh and Morris (2000b) further posit that men's decision to use technology are more strongly influenced by their perception of usefulness, while women's decisions are based more on perceptions of the technology's ease of use. Deen-Swarray, Gilward & Morell, (2012) write that "women generally have less access to ICTs than men and this increases as the technologies and services become more sophisticated and expensive, requiring greater levels of income and education to access and operate". On the contrary, Hassan *et al*. (2012) in their study in Malaysia, said there was a trend showing that female farmers were more likely to use no tools than men.

4.4.6 Educational Status and ICT use

Education improves human resources, and the skills gained through it are likely to impact on the ability of the enterprises to adopt advanced technologies including ICTs. However, in this study education level of farmers was not significant in the use of ICT tools, 38.90% (CI -.09107 – 0.13276) at (*p=0.144*). This was expected, as majority of the farmers had no formal education. This result corroborates that of Galloway and Mochrie (2005); Simeunović and Russo (2010) who found that education was an important aspect in adoption and use of ICTs. Adegbidi et al. (2012), Sekebira et al. (2012), and Tembo (2010) agree that, the number of years spent in school greatly affected the use of ICTs made similar observation. The researchers mentioned agree that literacy was a determinant in the choice and use of ICTs.

4.4.7 Household size and ICT use

Similarly, Household size of farmers affected their usage of ICT tools by 1.45% with the *p-value* of 0.974. The larger the household size the bigger the responsibility and the less likely for the farmer to purchase and use ICTs (Sekebira, 2012). Mukoko (2013) writes the size of household has an effect on ICT adoption. Harindranath *et al*. (2008) stated that family size was influential in using ICTs..

4.4.8 Land ownership and ICT use

Farmers' ownership of land had and influence on their usage of ICT tools by 6.80% (CI -0.4687 – 0.60463) with *p-value* of 0.804 (Table 4.10). This result supports the findings of Armstrong and Ghandi (2012) that land ownership would allow for great propensity to earn greater income to use for such purchases of ICT tools.

4.4.9 Annual income and ICT use

Increase in annual income was expected to have a positive impact on ICTs usage, as it was expected to increase the purchasing power of the farmer (Gamboa & Gutierrez, 2010). Donner (2007) found incomes to positively impact ICT use. However, in this study, annual income of farmers was not significant in the choice and use of ICT tools with 77.58% (CI -1.5683 – 0.0166) with *p-value* of 0.055 (Table 4.10).

4.4.10 Marital status and ICT use

Marital status of farmers influenced their usage of ICT tools insignificantly (*p=0.434*) by 21.19% (CI -0.3193 – 0.74305). This means that other factors account for their use of ICTs. This is because married people need to stay in touch and communicate more. Awoyemi, (2015) support this finding. He indicated that the farmer‘s marital status (married) was positive and significant (p=0.05) which implied that being married increases the probability of using ICT by 3.9%. However, Henri-Ukoha *et al* (2012) were of the opinion that marital status was not significant in their study on ICT usage among livestock farmers in Abia, Local Government area in Nigeria. According to Rice and Katz (2003), marital status has an influence on the adoption and use of ICTs. Neves *et al*., (2012) also indicated that marital status was significant in the use of ICTs and new technologies in their study.

4.4.11 Type of crop produced and ICT use

Among the crops grown by farmers (maize, rice, groundnut, millet and yam), only yam significantly influenced one’s use of ICT tools by 63.95% (CI 0.08415 – 1.19491) with *p-value* of 0.024. Maize cultivation did not influence the farmers’ usage of ICT tools since the result showed a reduction by 21.40% (CI -.7313 – 0.30328) with *p-value* of 0.417 (Table 4.10). Rice, groundnut and millet production increased farmers’ ICT usage by 12.21% (CI -0.3268 – 0.57104), 32.25% (CI -0.1676 – 0.81264) and 35.82% (CI -0.2812 – 0.99765). This study agrees with findings of Adewale and Ganiyu (2013) that yam farmers in Boluwaduro Local

Government of Osun State, Nigeria were aware and used ICTs for information on production and distribution of yams.

4.5 Information accessed by farmers through mobile phone

Table 4.11 provides the results for the information farmers used mobile phone to access. About sixty-eight percent of the farmers indicated they obtain information on agriculture and other activities from their relatives by the use of mobile phones, followed by 24.7% who used it for information on prices of farm inputs and produce. This was followed by 23.3% of the farmers who reported to use ICT tool (mobile phone) to do mobile money by sending or receiving and 19.5% of them also indicated to use ICT tools to order for seed. The remaining 12.8%, 10.9% and 5.7% use ICT tools for ordering pesticides, markets and sales, respectively.

Table 4.11: Usefulness of mobile phone for farmers

Specific Use Mobile Phone	Frequency	%
Ordering of seed	41	19.5
Ordering pesticides	27	12.8
Information on prices	52	24.7
Markets	23	10.9
Information from relatives	142	67.7
Sales	12	5.7
Mobile Money	49	23.3

Source: Survey Data, 2015 (* Multiple response)

From table 4.11 above, it is clear that farmers used mobile phone for their farming and non-farming activities. This corroborates other findings in Africa and elsewhere. In Tanzania, Furuholt and Matotay (2011) found that mobile phones

affected all stages of farming cycle, including land preparations, harvesting and post-harvest. Overall, farmers felt that mobile phone had helped to raise incomes by improving their ability to deal with risks and take advantage of income opportunities.

In Uganda, Martin and Abbott (2011) also concluded that farmers used their phones for a range of farming activities, especially to coordinate access to agricultural inputs such as training, seeds or pesticides (87% of farmers), accessing market information (70%), requesting agricultural emergency assistance (57%), monitoring financial transactions (54%) and consulting with experts for advice (52%).

A study in Peru by Beuermann (2011) observed that the introduction of mobile pay phones in selected Peruvian villages had raised agricultural profitability by 19.5% by increasing the value that farmers received for each kilogram of agricultural production by 16% and reducing agricultural costs by 23.7%. The study outlined possible mechanisms through which ICT access could increase profitability (e.g. reduced search costs to find the best market, better bargaining power due to knowledge of prices, access to weather information), but did not assess how these mechanisms played out in the Peruvian context.

Several assessments conclude that ICT tools had reduced search times and costs (Bayes, Von Braum & Akhter , 1999; Jagun, Heeks & Whalley, 2007; Overå, 2006; Beuermann, 2011) as well as information asymmetries (Overå, 2006). In the case of *Village Pay Phones* in Bangladesh, for instance, such cost reductions had benefited the poor in particular, resulting for example in better access to and prices of outputs and inputs, and a more stable supply of fertilisers and fuel (Bayes *et al*.,

1999). A study in Nigeria also found out, however, that mobile phones had not necessarily improved the quality of information, but rather its completeness (Jagun *et al*., 2007).

4.6 Constraints to ICT use by the smallholder farmers

Table 4.12 below indicates the constraints of ICT usage among the smallholder farmers. The constraints identified were high cost of ICTs (35.1%), high cost of recharge credit in the case of mobile phones (30.0%). Nenna (2015) in assessing ICTs among farmers in Anambra State, Nigeria also reported high cost of ICT facilities as a key constraint against the use of ICT tools among the farmers.

Table 4.12: Constraints to ICT usage among the farmers

Constraints	Percentage (%)
High cost of ICT	35.1
Lack of electricity	10.6
High cost of recharge credit	29.9
Distance to recharge centres	4.1
Language	20.4
Total	**100.0**

Source: Survey Data, 2015.

Others constraints identified were language (20.4%), lack of electricity (10.6%) and distances to centres to recharge their phones (4.0%). These constraints serve as obstacles that prevent the farmers from taking maximum advantage of the ICT tools. They again do not ensure the effective use of the tools by the farmers. Resolving

these constraints will help in not only increasing access but also help in alleviating the sufferings of farmers.

Olaniyi (2013) identified similar constraints in assessing utilization of ICTs among poultry farmers in Nigeria. He mentioned poor power supply, inadequate access to ICTs, high cost of ICTs infrastructure, lack of physical access to some of the ICT facilities and poor network connectivity. The findings of this study are also in line with Greenberg (2005) who states that high cost of communication gadgets and lack of skills are the major barriers to wide use of internet-based communication.

The research findings of various researchers revealed that inconsistent power supply and low network connectivity are the major constraints in the use of ICTs among farmers (Chilimo, 2008; Ajani & Agwu, 2012; Sharma, Kaur & Gill, 2012; Shankaraiah & Swamy, 2012; Oyeyinka & Bello, 2013). For instance, the use of mobile phones depends entirely on availability of mobile phone infrastructure and power for recharging batteries (Mtega and Msungu, 2013). Further, limited television viewing in rural areas is due to limited power supply (Kerr *et al*., 2007). Poor electrification in villages has always been a common problem, which has restricted development in different aspects of life. In-fact, the low level of electricity coverage has also been found to inhibit the expansion of ICT services to rural areas (UNDP, 2012). Other constraints identified include long distance to maintain and repair ICT tools (Asian Development Bank, 2004) and high cost of hardware and software (Agwu *et al*., 2008; Oyeyinka and Bello, 2013). As reported by Syiem and Raj (2015) farmers in Meghalaya State of North-East India also lamented the high cost of repairing of ICTs for mobile phones and television sets. This, however,

deterred them from using ICTs from time to time when the electronic item is often damaged. Some of the farmers had difficulties in understanding the English language. This is because most mobile phones use English language menus.

CHAPTER FIVE

5.0 SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary of findings

The emergence of the Information Communication Technologies has been hailed as a revolution following the Agricultural and industrial revolutions. The use of telecommunication has reduced the drudgery of doing many things economically, socially and technologically leading to the breakdown of various barriers.

Indeed, the use and adoption of ICTs has facilitated easy gathering, packaging and dissemination of information in ways, which were not possible earlier. It has helped to bridge the gap between the north and south and has facilitated rapid advancement in health delivery, business and industry. These advancements have also occurred in the area of agriculture and facilitated the sharing of information in application of farming tools, knowledge of the weather, incidence and control of pests, information on new varieties of crops and their cultivation methods. It has provided farmers with the ability to forecast weather patterns, access information on markets and pricing of crops. Not the least is the provision of information on credits and links to resources and support for farming from extension officers in other domains leading to the improvement of yields and lives of farmers, particularly in rural communities.

The role of Information and Communication Technologies (ICT) to support agricultural production systems has been investigated by many government agencies and university research departments and has been proved to play a vital

role in the transfer of technology and to share the modern agriculture practices with the farmers. However, many of these farmers are not completely utilizing the full potential of the ICT.

This study set out to investigate whether crop farmers in the northern region of Ghana were aware of the ICTs, which ones were available, which socio-economic factors, if any, were affecting the use of the tools and whether the use is affecting their yields.

Cross sectional data were collected from 210 selected farmers from seven districts of the Northern region using multi-stage sampling. The data were analyzed using SPSS. Descriptive statistics were used to characterize farmers, the popular ICT tools available and the constraints that the farmers face in the use of the ICT tools, while Probit regression was used to determine the socio-economic factors that influenced the farmer's use of ICTs.

The results show that almost all the farmers are aware of the benefits of ICTs. Below is a summary of the main findings according to the objectives

Objective 1. sought to describe the Socio-economic characteristics of crop farmers. The results revealed that majority of respondents, 37.1% were aged between 31-40 years, followed by 35.2% who were below 30 years. Together 73% of the respondents were under 40 year. Most of the respondents 78.6% were married. Seventy-eight (78.6%) had no formal education. Half (50%), of the respondents had households of 6-10 members. Sixty-seven (67%) were household

heads, 56.7% did not own their land while 39% had between 1-5 years of farming experience.

Objective 2 was meant to identify the ICT tools, which are currently in use in the Northern Region. The findings were that ICT tools which are currently available among farmers in the northern region include; mobiles phones (36%), radios (33%) TVs (20%), Computers (7%) Internet use (3.3%) and email (1.4%)

Objective 3 assessed the socio-economic factors affecting the usage of ICT tools. It was found out that age was significant in the use of ICT tools by 75.21% (CI 0.28503-1.21918 at p=0.0002). Younger farmers were more predisposed to using ICTS than older farmers. Farmers with more years in farming used more ICT tools. In fact, experienced farmer's usage of ICTs increased by 71.50% (CI 0.23258-1.19742) at p=0.004. In addition, Farmers who had received training were found to increase their ICT tool usage significantly (p=0.000) by 136.76% (CI 0.78537-1.94986). Crop farmers who were heads of households were not inclined to using ICT tools by 86.62% (CI -1.4796 - -0.2527. In addition, farmers with large household sizes were not keen on using ICT tools by 1.45% with the p-value of 0.974. Farmers' who owned more land were likely to increase their usage of ICT tools by 6.80% (CI -0.4687 – 0.60463) with p-value of 0.804. In this study, low annual income of farmers affected their usage of ICT tools by 77.58% (CI -1.5683 – 0.0166) with p-value of 0.055. Marital status of farmers had a positive influence on their use of ICT tools (p=0.434) by 21.19% (CI -0.3193 – 0.74305).

The cultivation of certain crops by farmers (maize, rice, groundnut, millet and yam) influenced their use of ICTs. Farmers who cultivated yams significantly used ICT tools than other farmers, 63.95% (CI 0.08415 – 1.19491) with p-value of 0.024. Farmers who cultivated Maize were less likely to use ICT tools by 21.40% (CI -.7313 – 0.30328) with p-value of 0.417 (Table 4.10). Rice, groundnut and millet production increased farmers' ICT usage by 12.21% (CI -0.3268 – 0.57104), 32.25% (CI -0.1676 – 0.81264) and 35.82% (CI -0.2812 – 0.99765).

Objective 4 sought to determine the kinds of information being accessed with the ICT tools. The results indicated that about sixty eight percent (68%) of the farmers obtained information on agriculture and other activities from their relatives by the use of mobile phones, followed by 24.7% who used their ICT tools for information on prices of farm inputs and produce. This was followed by 23.3% of the farmers who reported to use ICT tool (mobile phone) to do mobile money by sending or receiving and 19.5% of them also indicated using ICT tools to order for seed. The remaining 12.8%, 10.9% and 5.7% use ICT tools for ordering pesticides, markets and sales, respectively.

Objective 5 identified the constraints to ICT usage by the crop farmers. The constraints identified were high cost of ICTs (35.1%), high cost of recharge credit in the case of mobile phones (30.0%). Others constraints identified were language (20.4%), lack of electricity (10.6%) and distances to centres to recharge their phones (4.0%)

5.2 Conclusions

From the findings of the study the following conclusions are drawn:

Age, head of household, farming experience, ICT training received and the cultivation of yam were the main socio-economic predictors of ICT use among crop farmers in the Northern Region.

The most popular ICT tools used among crop farmers were the mobile phone, radio and television. Among these, the mobile phone was increasingly the ICT tool of choice among farmers.

Furthermore, farmers were aware of and were using ICT tools for various services including access to information on prices, information from their relatives, markets, seeds and mobile money transfers.

The constraints militating against the use of ICTs are high costs of ICT, high cost of recharge credit and language. It was quite clear from the study that many of the respondents preferred having local languages on the ICT appliances or getting information to reach them in the language they understand.

The results of this this study show that there is an immense opportunity to enhance the sharing of agricultural information that farmers receives from government officers, fellow farmers and relatives

5.3 Recommendations

Based on the conclusions of this study, the following recommendations are made:

1. The Ministry of Food and Agriculture should take advantage of the immense opportunity of the popularity of mobile phones to enhance the sharing of important agricultural services and information to rural areas.
2. Government should collaborate with the private sector ICT service providers like VOTO and ESOKO to carry services by mobile phone.
3. Farmers should be trained in their local languages to use Voice SMS for quick access to market information and emergency services
4. Policy makers should target the youth who are crop farmers with programs and ICT applications that will help them to improve their livelihoods

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APPENDIX

Sample of questionnaire

This questionnaire is seeking to find out how Information Communication Technology (ICT) tools are being used by rural farmers in the Northern region. I shall be grateful if you could take a little part of your time to contribute to the information seeking process on ICT usage. Thank you.

Section 1 DEMOGRAPHICS (Please tick as appropriate)

1. How old are you? [1] 30 and below [2] 31 - 40 [3] 41 - 50 [4] 51 and above
2. Gender: tick as appropriate [1] (Male) [2] (Female)
3. Marital status : [1] Married ( ) [2] Single ( ) [3] Widowed ( )
4. Number of children [1] (1-5) [2](6-10) [3] (above 10)
5. Number of members of your household [1] (below 5) [2] (above 5-10) [3] (above 10)
6. What is your education level?

   [1] No formal schooling [2] Primary level [3] Middle/JHS [4] Secondary/Vocational/Commercial [5] Tertiary level
7. What is the size of your farm? [1] Below one acre [2] one acre [3] 2-5 acres [4] Above 5 acres.
8. What crops do you cultivate? [1] Maize [2] rice [3] groundnuts [4] millet [5] yams [6] other please

   specify……
9. Are you the head of the household? [1] Yes [2] No
10. Do you own your land?

[1] Yes [2] No If No

Specify……

Section 2: Knowledge of ICT

Q10.Which ICT tools do you know about? (Please select as many as possible)

[1] Computer
[2] Mobile phone
[3] Internet
[4] Radio
[5] Television
[6] Email
[7] Other Please
specify…….

Q11. Which ICT tool do you have? (Select as many as possible)

[1] Mobile Phone
[2] Computer
[3] Radio]
[4] Television
[5] Other please
specify……..

Q12. If you have a mobile phone, which mobile operator do you use?

[1] Vodafone
[2] Tigo
[3] MTN
[4] Airtel
[5] Glo
[6] None

Q13. How do you pay for your connection?

[1] Prepaid
[2] Contract
[3] None

Section 2: ICT awareness and usage

Q14. Do you know how to use the following ICTs? Please tick the appropriate options

[1]Mobile phone
[2]Computers
[3]Internet
[4]Email
[5]Radio
[6]Television
[7]Other please
specify……..

Q15. Did you receive any formal training to use any of the ICT in Question 14?
[1] Yes
[2] No

Q16.1 If yes, who trained you?
[1] A friend
[2] Officers from SARI
[3] Extension Officer
[4] Other (specify) .....

Q17. Do you use ICT to support your farming activities?
[1] Yes
[2] No

Q18. Do you know how to access Internet on your own?
[1] Yes
[2] No

Q19. How do you use the ICT tool you have?
[1] Personal
[2] Farming/Business
[3] None

Q20. How many hours do you spend using your ICT tool per week?
Assign
[1] 0 - 3 hours,
[2] 4 -6 hours,
[3] 7+ hours
[4] Not sure

Q21. What do you use your ICT tool for? Please tick the appropriate options
[1] Input Ordering
[2] Pesticides ordering
[3] Information on Prices

[4] Marketing
[5] Sales
[6] New crops or method
[7] Information from relatives

Q22. Which of the following ICTs are convenient to use? *Tick the appropriate options*
[1] Mobile phone
[2] Computer
[3] Internet
[4] Email
[5] Television
[6] Radio
[7] Others Please specify……

Q23
How do you get information about innovations in Agriculture? *Select your options*
[1]By mobile phone from farmers
[2]From radio
[3]From television
[4]Extension officers
[5]Word of mouth from friends
[6] Other – please specify……..

Q24
What energy source do you use for your ICT tool?
[1] Electricity at home
[2] Car battery
[3] Solar power
[4] Other please specify

Q25
In the case of a mobile phone, how much do you spend a week to recharge the credit?
[1] 2 GHs
[2] 5 GHs
[3] 10 GHs
[4] More than 10 GHs
[5] Other please specify

Section 3: Benefits of ICT
Q26. The use of ICTs helps me to increase my income
[1] Strongly agree
[2] Agree
[3] Neutral

[4] Disagree
[5] Strongly disagree

Q27. ICT promotes access to credit
[1] Strongly agree
[2] Agree
[3] Neutral
[4] Disagree
[5] Strongly disagree

Q28. The use of ICT saves time
[1] Strongly agree
[2] Agree
[3] Neutral
[4] Disagree
[5] Strongly disagree

Q29. The use of ICT in agriculture leads to improved productivity
[1] Strongly agree
[2] Agree
[3] Neutral
[4] Disagree
[5] Strongly disagree

Q30. Does ICT help to increase your income?
[1] Yes
[2] No

Q31. Will ICT would be more effective if local language is used?
[1] Strongly agree
[2] Agree
[3] Neutral
[4] Disagree
[5] Strongly disagree

Section 4: Challenges

Q32. What are the major problems that you face when using ICT in general? *Tick the options, which apply to you*
[1] Language and content limitations
[2] Poor network and reception
[3] Time consuming
[4] Expensive to use

[5] Electricity
[6] Other
(specify).....

Q33. What are the constraints that limit you from using ICTs? *Please tick as many options as possible*
[1] High cost of ICT
[2] Lack of electricity
[3] High cost of recharge credit
[4] Distance to centres to recharge
[5] Language
[5] Other (specify) .....

Q34. Which local language would you prefer in ICT related information?
[1] Dagbanli
[2] Hausa
[3] English
[4] Other (specify).....

Q35. Which ICT do you need as a farmer to improve your work?
[1] Radio
[2] Mobile phones
[3] Televisions
[4] Other (specify).....

Q36. For how many years have you been farming?
[1] 1-5
[2] 6-10
[3] More than 10 years
[4] Dot know

Q37. What is your average income per year from farming?
[1] Less than 500 GHs
[2] 500-1000 GHs
[3] 1000 GHs +

Q38. Do you have any permanent off-farm income?
[1] Yes
[2] No

Q39. What is your average off-farm income per month?
[1] Less than GHs200
[2] GHs200 – GH500

[3] GHs 500 +

Q40. Is it important to educate your children about ICT?
[1] Yes
[2] No

THANK YOU FOR YOUR COOPERATION. MAY GOD BLESS YOU!