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An Investigation into Barriers that Hinder the Effective Use of ICT in Farming by Small Scale Farmers in Asuogyaman District, Ghana.

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Abstract: *Mainstreaming information and communication technologies (ICTs) into the productive economic sectors has the potential of enhancing productivity of those sectors. In agriculture, there are emerging empirical evidence of how ICTs are helping farmers especially the small holder farmers to access agricultural resources to improve their economic activities. However, in developing countries, especially Africa the integration of ICTs into agriculture has not been effective due to a number of challenges. The study investigated the barriers that hinders the effective use of ICT in farming in Asuogyaman District in the Eastern Region of Ghana. Simple random, purposive and snowball sampling techniques were used in selecting 150 small scale farmers for the study. Semi structured questionnaire was used to collect primary data from the respondents. Data was analyzed using both descriptive and inferential statistical tools. The study revealed that majority of the small scale farmers have some level of education. The study also identified radio and mobile phones as the most common ICT tools used by small scale farmers. Three main barriers that hinders the effective usage of ICT namely attitudinal, accessibility and technical were identified by the study.*

Keywords: *ICT, effective, farming, livelihoods, Agricultural information*

1. INTRODUCTION

Agriculture is the backbone of the economy of developing countries. Hence, the growth of the agricultural sector is particularly important, as it constitutes the bulk of the national economy in terms of human and material resources. According to Stienen, Bruinsma & Neuman, (2007), agriculture is an important sector in most developing countries and majority of the rural population depend on it. In a study by Green et al., (2005) it was revealed that agriculture plays an important role in economic growth, food security, poverty reduction, livelihoods, rural development and the environment. In Ghana, agriculture is the mainstay of the economy where majority (70%) of the population living in the rural areas depend either directly or indirectly on it for their livelihood and survival. It is estimated that agriculture contributes about 25% to Ghana's Gross Domestic Product (GDP). Small holder agricultural activities predominate economic activities in rural Ghana and dependent on rainfall. According to Demiryurek et al., (2008) agricultural information is an important factor that interacts with other production factors. Productivity of these other factors, such as land, labor, capital and managerial ability, can be improved by relevant, reliable and useful information supplied by extension services, research institutions, and other agricultural organizations to helps farmers make better decisions. Agricultural information creates awareness among farmers about agricultural technologies adoption. Therefore, it is important for the existence of robust agricultural information system in every country especially the developing ones to support agricultural development.

In the contemporary era, the development of a strong agriculture requires the access and adoption of ICT tools which underline modern information system. Access depends on the provision of ICT infrastructure and content, while the adoption of the service is dependent on the value the individual

places on it. Development literature is fraught with good examples of the contributions of ICTs towards capability building of farmers in terms of access to agricultural resources and other critical information which have the potential of increasing the productivity of farmers. In effect, every farmer in Ghana and other developing countries should have unimpeded access and use of ICTs. This paper looks at the adoption and use of ICT tools by farmers in Asuogyaman District. Of particular interest to the paper is identifying barriers that hinder the effective use of ICT in farming by small scale farmers in the selected district.

2. ICT IN AGRICULTURAL DISCOURSE

In recent years, the increase in the use of ICTs in organizations has significantly changed the manner in which organizations operate and communicate. The achievement of agricultural development in the 21st century among others, depends on the effective use of ICTs. This includes the use of computers, internet, geographical information systems, mobile phones, as well as traditional media such as radio or TV.

ICT application in agriculture has become increasingly important due to its potential in improving agricultural productivity by serving as a pedestal to access vital agricultural information. This is very important due to the growing demand for higher quality products, which also offers opportunities for improving the livelihoods of rural communities. Realizing these opportunities require 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. In agriculture, an integrated ICT platform for knowledge and information sharing can help in strengthening the value chain and help the farmer gain by reducing transaction costs. The adoption of ICT tool such as mobile telephony by farmers and agricultural traders in Ghana has helped them reduce both their transportation and transaction costs.

Throughout Africa, ICTs have become increasingly integrated into the dissemination of information to farmers. For decades' traditional forms of ICTs have become more prevalent in advisory service provision. Radio and TV programmes feature agricultural information. Rural telecentres provide information on education, agricultural and health issues and equip rural citizens with skills on how to use computers and provide basic literacy. Many Ministries of Agriculture have attempted to integrate ICTs into the delivery of information and have established district information centers to provide agricultural information. NGOs and research organizations such as Agro Minset Organization and Agricultural and Rural Development Association (ARA) have also attempted to facilitate technology transfer in the agricultural sector in Ghana. Mukhebi (2003) is of the view that agriculture is also being transformed by ICTs.

Increasingly, ICTs spur the development of innovative programmes and research in the agricultural sector. Farmers worldwide are using ICTs to obtain market information, to bypass intermediaries and to obtain better prices for their products. Timely access to market information via communication networks also helps farmers make judicious decisions about what crops to plant and where to sell their produce and buy inputs. For example, in Ghana an ICT-based agricultural market information service (MIS) was introduced by the private sector Busy Lab through its TradeNet (now Esoko) platform. Esoko, a mobile and web-enabled repository of current market prices and a platform through which buyers and sellers interact in Ghana. According to a study conducted by H a l e w o o d and Surya (2012) farmer's revenue has increase by 10% since they started using the platform in northern Ghana. These real time market dynamics help farmers deal with external demand directly, hence capturing more of the products' value. Additionally, ICTs empower farmers, rationalize supply chains and improve productivity. ICTs also facilitate research and development, and information sharing on agricultural farm extension technologies and approaches (such as the development of effective seed technologies), particularly those that can work to enhance food security and subsistence.

ICTs can also assist in utilization of information that warns fisher folk of storms at sea or facilitates the prevention or treatment of crop or animal disease. According to Darkwa (2002, cited by Kaddu 2011), ICTs disseminate generic non-customized information, such as agricultural practices, weather forecasts, and contact information. This type of information enables farmers to get prepared on time. They are able to decide when to plant, the type of crops that do well with which soils and the like.

Most governments all over the world realize the importance of real-time information and thus innovative mechanisms to deliver information to farmers are being developed. Although investment in agricultural sector-based ICT initiatives is low, with private-sector intervention, a number of such initiatives are being developed and implemented in various Asian countries, and more specifically in India. The new initiatives in the use of ICT include community radio, SMS and voice-based cellular telephony, information through tele-centers, internet kiosks, village knowledge centers, multipurpose community centers etc. These new ICT initiatives are transforming the traditional agricultural extension system, but the mobile- and internet-based information delivery models have to be complementary to conventional extension services (Mittal et al., 2010).

These new ICT models still lack appropriate network linkages with research institutes and other knowledge banks which are a possible source of appropriate content for the customized, timely information that is necessary for the smooth flow of information to farmers to help them to mitigate risk. There are a number of studies that have demonstrated the use of ICT in disseminating knowledge and technology to farmers, but there are concerns about the limited understanding of the impact of this intervention on the behavior of farmers, and its capacity to act as an enabler of technology adoption (Ali and Kumar, 2010; Aker 2010).

In a study by Hassan et al., (2011) it was found out that ICT plays an important role to expose rural community to development. Other factors like language, traditional constraints and political will to ensure adequate ICT infrastructure in the agriculture communities have been found to impact on the effectiveness of adoption of ICT by agribusiness (Aleke et al., 2011). A good example is the use of mobile money through M-Pesa in Kenya, where studies have shown that households with access to mobile money are better able to manage negative livelihood shocks such as job losses, death of livestock, or problems with harvests(Aker and Mbiti, 2010; Sen and Choudhary,2011). Insurance, credit and savings services are alsobeing developed based on the mature mobile money systems in Africa. For example, Kilimo Salama is amicro-insurance product that uses M-Pesa to provide payouts to small scale farmers where crops fail. In the second year of its operation in 2011, 12,000 farmers were insured, and 10% of these received payouts of up to50% of their insured inputs (Sen and Choudhary, 2011),hence having an impact on agricultural growth and people's livelihoods.

In a paper by Fafchamps and Minten's (2011) they estimated the benefit of information on markets and weather conditions being delivered to farmers through short text messages (SMS) over mobile phones. They used the case of the service provider, Reuters Market Light (RML), in Maharashtra, India. The study found that farmers use this information for decision making, but found no statistically significant effect of the intervention on the price received by farmers or on the reduction in crop wastage due to climatic factors. The study concluded this from a controlled, randomized experiment in 100 villages of Maharashtra. These results are contrary to other literature on these issues, which show a potential impact on price realization and reduction of wastage (Jensen, 2007; Abrahim, 2007; Aker, 2008; Mittal et al., 2010; Goyal, 2010). However, none of these studies have done a rigorous quantitative analysis to evaluate the impact. In a study by Fafchamps and Minten (2011) which had Maharashtra, a developed state, as its study area, found that the services provided by RML did not have much of an impact. It is worth examining the relevance and utility of the introduction of mobile phone information services in regions that have a lesser degree of information asymmetry and consequently stand to gain less from modern ICT.

3. METHODOLOGY

For this study, a multi-stage sampling procedure involving simple random, purposive and snow ball sampling techniques were used in selecting respondents for the study. In the first stage the district was selected using simple random sampling. The study was conducted in the Asuogyaman District in the Eastern Region of Ghana. The District shares boundary with A fram Plains South District to the north and Upper and Lower Manya Districts to the south and west respectively. Majority of the people in the district are engaged in agriculture and related trades. There are three (3) prominent types of agricultural activities in the district. These are livestock rearing, food and cash cropping. However, most of the farming activities in the district are focused on the production of food crops. Three communities in the district namely Tortibo, Gyakiti and Ankyease, were purposely selected for the

study. These communities were selected based on Ghana Statistical Service (2010) Population and Housing Census Report which mentioned these communities as the main farming areas in the district. Snowball sampling technique was used to select 50 respondents from each community. Data were obtained primarily using questionnaire. Items such as the socio-economic characteristics of the respondents and types of ICT owned by farmers were contained in the questionnaire.

4. Analysis of Results and Discussions

This section presents and discusses the key findings of the study.

4.1. Socio-economic characteristics of the respondents

The socio-economic characteristics of the respondents discussed includes age, gender, marital status, educational level and duration of farming. The age of the farmers selected for the study was the first socio-economic characteristic of the respondents to be explored. The result is shown in the Table 1.

Table1: *Age of respondents.*

Age	Frequency	%
20-30 Years	75	50
31-40 years	34	23
41-50 Years	9	6
51-60 Years	19	13
above 60 Years	13	9

Source: Field Study 2017

The results from Table 1 shows that majority (50%) are between 20 to 30 years, while only 9% are above 60 years. This imply that majority of the youth in the study area are engaged in farming. Gender of the respondents was also explored. The result is shown in the Figure 1.

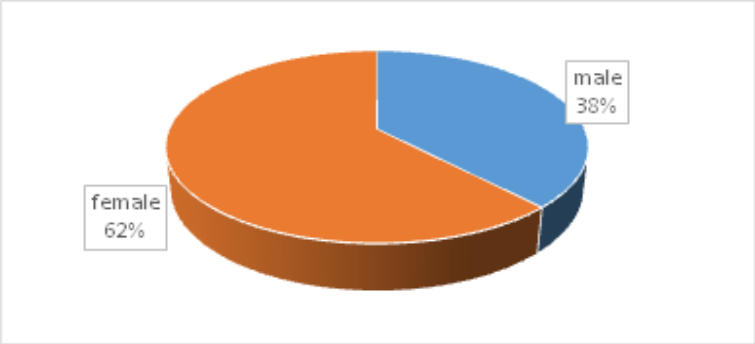

Figure1: *Gender of Respondents*

Source: Field Study 2017

The majority (62%) of the respondents were females and this confirms Ghana Statistical Service (2010) population census analytical report for the Asuogyaman district which identified females as the dominant actors in agriculture.

Additionally, the educational level of the respondents was explored. The result is indicated in the

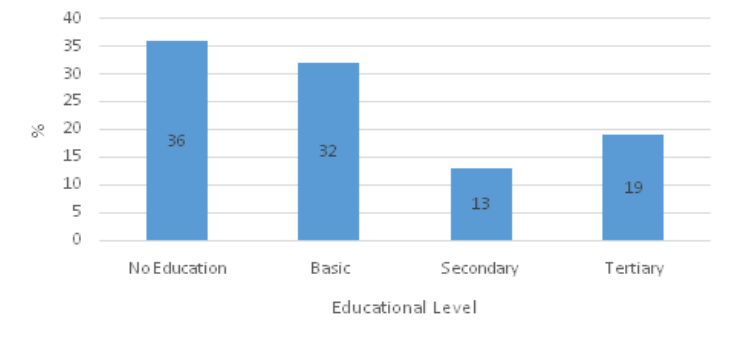

Figure2. *Educational Level Respondents*

Source: Field Study 2017

The analysis revealed that 36% of the respondents had no formal education with the rest having various levels of education. Interestingly, 45% of the sample had gone beyond basic education with 19% with tertiary education. Generally, the sample is literate and this should have a positive effect on the adoption and use of modern technologies.

Furthermore, the duration of farming was also explored and the result indicated in the Table 2.

Table2: *Duration of Farming*

Duration	**Frequency**	**%**
1-5 years	4	3
5-10years	10	7
10-15years	54	36
15-20years	66	44
Above 20 years	16	10

Source: Field Study 2017

The analysis revealed that cumulatively an overwhelming majority (90%) have been into farming for more than 10 years. The result means that farmers in the study area have some appreciable level of experience in farming.

4.2. Types of ICT owned by farmers

Respondents were asked to indicate the type ICTs they owned. Table 3 shows their responses.

Table3. *ICT tools owned by respondents (N=150)*

	Responses	
ICTs tools	**Frequency**	**%**
Computers	8	5
Internet	1	0.7
Email	1	0.7
Geographic Information systems (GlS)	0	0
Personal digital assistant (PDA)	0	0
Telephone/Fax	2	1
Mobile phone	140	93
Television	137	91
Video	102	68
Radio	139	93

Source: Field Study 2017

In terms of ICT ownership, overwhelming majority (93%) had mobile phones, 91% have television, 68% had access to video and 93% radio. Only, eight representing 5% had access to computers and 1% to fixed line telephone, less than 1% had access to emails and internet. This confirm an earlier finding by Chilimo (2008) who reported that most farmers owned radio and cell phones in four rural districts of Tanzania. The ownership of mobile phones has become very important to agricultural development. As a result, mobile applications have been developed to provide important technical information to the farmer. Therefore, the high level of ownership of mobile phones

4.3. Level of ICT usage by farmers

A Likert scale of 1= Never, 2= Sometimes and 3= Frequently was used to measure the level of ICT usage by small scale farmers. The results are shown in the table 4.

Table4. *Level of ICT usage (N=150)*

	Responses		
ICTs tools	**Never**	**Sometimes**	**Frequently**
Computers	100	0	0
Internet	100	0	0
Email	100	0	0
GlS	100	0	0
PDA	100	0	0
Telephone/Fax	100	0	0
Mobile phone	38	9	53
Television	78	11	11
Video	96	1	3
Radio	34	9	57

Source: Field Study 2017

As indicated in the table it can be seen that mobile phone, television, video and radio were the only ICT tools that were used by respondents. Mobile (53%) and radio (57%) were the most were the most frequently used ICT tools. This confirms an earlier study by Chilimo (2008) who reported that most farmers used radio and cell phones frequently in four rural districts of Tanzania. Radio was more likely to have high use due to low cost, use of local languages, as well as being an appropriate tool that fulfills farmers' needs. Akullo *et al.*, (2007) in their study found out that radio programmes were the major ICT channel used by farmers to acquire agricultural IK in Uganda. The findings also showed that mobile phones were becoming an important communication medium mainly due to high ownership in the surveyed district.

5. FACTOR ANALYSIS

Factor analysis was used to analyzed statements regarding barriers that hinders the effective use of ICTs in farming. According Malhotra (1996) factor analysis is a statistical procedure used to identify a small number of factors that can be used to represent relationship among set of interrelated variables. Factor analysis was therefore used to identify the barriers that hinder the effective use of ICT to improve farming.

The statements are defined below.

X_1 - Lack of the institutional ICT policy

X_2 - Inadequate personnel with adequate ICT skills

X_3 - Service is not available

X_4 - Financial constraints

X_5 - Poor knowledge sharing culture in the local community

X_6 - Lack of training in the use of ICTs

X_7 - High illiteracy rate among farmers

X_8 - Lack of awareness about ICTs

X_9 - Poor ICT infrastructure

X_{10} - Lack of cheap technology

X_{11} - Lack of local contents in local Languages

X_{12} - Low production

X_{13} - Lack of electricity

X_{14} - Unable to access information using ICT

X_{15} - Low number of agricultural TV and radio programmes

X_{16} -Unfavorable radio broadcasting time

X_{17} - No control over the programme during access

X_{18} - Knowledge of opportunities that ICTs provide

X_{19} - Negative attitude of people to change

X_{20} - Poor benefits in using ICT

X_{21} - Fear that things will go wrong in using ICT

X_{22} - Lack of adequate time for training on ICT facilities

X_{23} - Complexity in using ICT

X_{24} - General lack of awareness of the importance of ICT in agriculture

The levels of agreement or disagreement on these variables described above were measured using the following Likert scale disagree --- 1, neutral --- 2 and agree --- 3

In order to obtained the final factor solution that would adequately explain the correlations among the original variables a rotated component matrix was obtained using Equamax with Kaiser Normalization method. Three components were obtained by the rotated component matrix. This means that three factors would be used to indicate the barriers that hinder the effective use of ICT to improve farming. The result of rotated component matrix using Equamax with Kaiser Normalization method is shown in the table 5.

Table5: *Rotated Component Matrix*

Variables	Component		
	1	2	3
X_1	**.625**	-.055	.430
X_2	**.625**	.332	.448
X_3	.123	-.066	**.875**
X_4	.479	.390	.599
X_5	.393	.533	.359
X_6	**.692**	.356	.327
X_7	.276	.375	**.755**
X_8	.195	.428	**.745**
X_9	.213	.503	**.627**
X_{10}	.340	**.640**	.493
X_{11}	.217	.599	.452
X_{12}	.213	**.742**	-.194
X_{13}	.479	**.650**	.320
X_{14}	.140	**.782**	.367
X_{15}	.237	**.741**	.414
X_{16}	.487	**.629**	.417
X_{17}	.521	.556	.388
X_{18}	**.836**	.372	.164
X_{19}	**.862**	.332	.148
X_{20}	**.814**	.382	.213
X_{21}	**.880**	.278	.167
X_{22}	**.770**	.253	.366
X_{23}	**.629**	.306	.493
X_{24}	.425	.404	**.630**

Source: Field study 2017

The results of the factor analysis clearly clustered related items together. It can be seen from the table above that the first factor is highly loaded on nine variables. These variable are:

X_1 - Lack of the institutional ICT policy, X_2 (Inadequate personnel with adequate ICT skills) X_6 (Lack of training in the use of ICTs), X_{18} (Knowledge of opportunities that ICTs provide), X_{19} (Negative attitude of people to change), X_{20} (Poor benefits in using ICT) , X_{21} (Fear that things will go wrong in using ICT) X_{22} (Lack of adequate time for training on ICT facilities) X_{23} (Complexity in using ICT).These items are related to attitude of small scale farmers towards the use of ICT in farming. Therefore, the first barrier identify by the study can be referred to as attitudinal factors.

Attitude, according to Horne(1985) represents the mental and neural state of readiness, organized through experience. It influences an individual's response to all objects and situations. According to Kenneth and Liquat (2006); Simpson (2005) and Loh et al., *(*2009) the use of ICT requires positive attitude from the actors. Attitude portrays either positive or negative views towards a person, place, thing or event. A positive attitude is an important requirement for ICT usage. In the study by Shiro (2008) rural communities that have very positive attitude towards ICT welcome any ICT project to be developed in their areas.

Further, education, age and gender also contribute to attitudinal posture of users of technologies. Education plays an important part in the adoption and use of ICT services, ICTs services are knowledge intensive and therefore some level of literacy is required to ensure effective utilization of the technology (Frempong 2008). Therefore, education becomes a hindrance to small farmers in rural communities. In this study, most of the respondents have attained various levels of education and therefore should be more predisposed to use ICT. However, most of them complained about of lack of adequate time for training on ICT facilities and Complexity in using ICT. This is evident in the type of ICT services (mobile telephone, radio, TV) adopted by the majority of the respondents, while more knowledge-intensive ones such as internet, computers and email among others were owned by very few respondents.

Gender is also a contributory factor to technology adoption. The technology acceptance model (TAM) argues that the acceptance to use a technology is influenced by two factors namely; perceived ease of use and perceived usefulness. Arguing along that lines, Ilie (2005) indicates that men's use of technologies are influenced by their perception of usefulness while women by the ease of use. In a study by Frempong et al (2013) on the patronage of public ICT centres, the results showed that few women patronized internet cafes because they found them very inconvenient and insecure. Therefore, the gender has effect on the use and non- use of ICT.

Also age has implication on technology adoption. According to Rogers (1983) age is an important determinant factor in the adoption of a technology. Older people are more conservative to use technologies such as ICTs, while young people are rather curious to explore the potential of new technologies. With the younger people engaged in agriculture, the likelihood of they exploring the potential of ICTs is great. However, this is not the case in this study. The use of mobile telephones, TV and radio among others were high among the farmers but the use of computers, internet and email were very low. This raises the issue of affordability and access which potentially have constricted the use of the more knowledge-intensive ICT services.

The second factor is highly loaded on the variables: X_{10} (Lack of cheap technology), X_{12} (Low production), X_{13} (Lack of electricity), X_{14} (Unable to access information using ICT) , X_{15} (Low number of agricultural TV and radio programmes) and X_{16} (Unfavorable radio broadcasting time).

These items are related to access to ICT by small scale farmers. It can therefore be said that the second barrier that hinders ICT usage by small scale farmers is accessibility factors.

Information technology in Ghana has come a long way, but despite its existence, there seems to be limited access and utilization of these technologies. Access is a major factor in the use of a

technology. In a study by Shah (2009) he reported that, access to broad band internet services is substantially low in rural areas and poor urban neighborhoods of many developing countries than in the metropolitan urban. A study conducted by Yildrim (2007) in education found out that access to technological resources is one of the effective ways to teachers' pedagogical use of ICT in teaching.

The third and final factor is highly loaded on the variables: X_3 (Service is not available), X_7 (High illiteracy rate among farmers), X_8 (Lack of awareness about ICTs) and X_9 (Poor ICT infrastructure) and X_{24} (General lack of awareness of the importance of ICT in agriculture).These variables are related to technical. Therefore, the third barrier identified by the study can be referred to as technical factors. This confirm in a study conducted by Musa N. S et al (2014) where it was revealed that there is statistically significant relationship between technical challenges and the adoption of ICT. Also Bowora and Chazovachii (2010) revealed that the respondents in the informal sector bracket lacked the knowledge and exposure to ICTs other than cell phones, radios and televisions.

So from the factor analysis it becomes evident that small scale farmers are confronted with attitudinal, accessibility and technical barriers in using ICT in their farming activities.

6. CONCLUSIONS

The study investigates the barriers that hinders the effective use of ICT in farming by Small Scale farmers. In this study age, gender, educational level and the duration of farming constitute the socioeconomic characteristics of respondents. Findings show that majority of respondents in the study area are between 20- 30 years and this should facilitate the adoption of ICTs by the farmers, since age is one of the underlining factors for technology adoption. However, it was found that the adoption of less knowledge-intensive ICT services was prevalent.

It was also found out that majority of the respondents are able to read and write, however less knowledge intensive ICT services such as, radio, television and mobile phones were the most common ICT tool used by respondents. . The study also found out three factors that hinder ICT usage by respondents. These factors are classified as attitudinal, accessibility and technical factors.

Based on the findings of this research work, it can be concluded that radio and television, followed by mobile phone were the most common ICT tool used by small scale farmers in the Asuogyaman district. The study also indicated three main barriers the hinders the effective use of ICT in farming by Small Scale farmers. These barriers are classified as: Attitudinal, Accessibility and Technical level barriers. The study therefore recommends that concerned stakeholders, partners and policymakers at different levels should make attempt to address these barriers that hinders the use of ICT among farmers. These facts should be taken as an input for policy formation of ICT in agriculture and rural development in particular and for its usability among farmer for improved productivity.

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