2023

MAXIMIZING TECHNOLOGY ACCEPTANCE MODEL IN ACCESSING THE ATTITUDE OF RURAL FARMERS USING ICT TOOLS IN FARMING TO ENHANCE PRODUCTIVITY

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Abstract
The study was conducted using a multi-stage sampling technique involving simple random sampling, a probability sampling method, purposive sampling, and snowball sampling, which are non-probability methods. Two regions, namely, the Greater Accra and Eastern were purposively selected for the study. In the Greater Accra Region, Ada East District was selected while in the Eastern Region Asuogyaman District. In Greater Accra, the study was conducted in six farming villages namely: Big Ada, Dogo, Kasseh, Addokope, Korlekope, and Bedeku. In Eastern regions, the study was conducted in Asogyaman, where Tortibo, Sappor, Yenease, Adina Donor, and Ankyease. A snowball strategy was relied on in selecting small-scale farmers for the study. A total of 390 households, 130 from each district, were sampled randomly. The methodologies used for primary data were household surveys and Focus Group Discussion (FGD) while the instruments used were semi-structured pre-tested Interview Schedules and Checklist respectively. The study concludes that age has an effect on the attitude of small-scale farmers concerning their perceived use of ICT to improve their farming activities. The educational level of an individual plays a significant role in the acceptance and use of ICT.

Keywords
TAM, Rural farmers, ICT, Productivity, Farming, Perceived Usefulness.

Introduction and background

According to the World Bank (2018), ICT provides enormous opportunities for rural communities to increase productivity, improve food and nutrition safety, access markets, and find job possibilities. In addition, a study by Lucky and Achebe (2013) found that ICTs can make significant contributions to promoting agricultural development because they improve the effectiveness of market transactions and provide access to real-time information by enhancing farmers ' access to and pricing power through the use of Internet trading systems through web / mobile applications.

ICT in agriculture offers a series of solutions to some agricultural challenges. It is seen as a developing field focusing on the improvement of agricultural and rural development through enhanced information and communication processes. ICT in agriculture continues to progress in scope as new ICT applications continue to be harnessed in the agriculture sector. ICT in agriculture encompasses the conceptualization, design, development, evaluation, and application of innovative ways to use ICTs in the rural domain, with the main focus on agriculture. The provision of standards, norms, methodologies, and tools as well as the development of individual and institutional capacities, and policy support are all key components of ICT in agriculture.

ICT has the ability to provide possibilities for small-scale farmers to build networks between themselves to obtain market information and access other appropriate information (IFAD 2016). Mobile phones are becoming progressively significant sources of information for small-scale farmers, while other ICTs, such as radio, television, and, to some extent, computers are also sources of information for small-scale farmers (Oluwatayo 2014).

ICT services are used by small-scale farmers for different agricultural purposes. ICT has unleashed an incredible ability to enhance agriculture and has discovered a foothold even in impoverished small-scale farms. This is obvious from Angello's (2015) study, which discovered that ICT use was common among small-scale farmers in Tanzania, with more than 90% using cell phones on their farms which could promote virtual business possibilities.
Owing to the prospects of ICT in general and in the agricultural sector, in specific, the efficient use of ICT by small-scale farmers has become the focus of many countries around the globe. Global attention has been concentrated on finding alternatives to decrease poverty, particularly in developing nations such as Ghana in rural communities.

In a study by Arbuckle et al., (2013) they stated that attitudes can often be influential determinants of conduct in accepting ideas. According to Zheng et al., (2018), a favorable attitude toward ICT probably has a beneficial impact on the use of ICT, and an adverse attitude indicates otherwise. Policymakers have also identified that sometimes the way farmers adjust to agricultural policy reforms depends almost entirely on their attitudes and mindsets.

Using ICT needs a positive attitude on the part of the people as illustrated and confirmed by a number of previous studies (Raghuprasad, et al..,2016 & Amin et al., 2013). Attitude typically expresses either positive or negative views towards a person, location event, or case. One important requirement for ICT use is a positive attitude. The rural communities have a very positive attitude towards ICT based on what was done by Shiro (2008), and welcome any ICT project to be built in their areas. Yet their lack of ICT knowledge prevents them from frequently using ICT. Akpan, et al., (2011) stressed that if someone wants to form a positive attitude towards

ICT, frequent use and exposure to ICT have to be considered. As people use and expose themselves often to ICT, they will be informed that ICT is useful and beneficial to them, thereby creating a positive attitude towards ICT use.
Zhang and Aikman (2007) have indicated that behavioral intention may be a mediator on the role of attitude toward an object. In this case, relevant development agencies from government or private entities should recognize that a positive attitude towards a particular ICT would lead potential users, particularly the rural communities, to decide to accept or use the ICT. In addition, efforts should be made to recognize factors that may lead to a positive attitude toward use of ICT.

There are many factors that can be related to ICT usage attitude. In their research, Dorosh et al. (2010) specifically focused on six indicators that have the power to influence ICT use. The indicators are self-efficacy, perceived utility, perceived ease of use, subjective norm performance, and job relevance. A lot of existing scientific articles have demonstrated the effect of self-efficacy (D' Silva et al., 2010), perceived usefulness and perceived ease of use (Venkatesh and Morris, 2000), compatibility (AlGhaith et al., 2010), job relevance (Comfort et al., 2005 and Joseph and Andrew 2007) and subjective norm (Pee et al, 2010) on ICT usage. On the self-efficacy side, as D' Silva et al., (2010), and Pee et al., (2010) noticed, the subjective norm is a dominant factor for attitude toward ICT usage.

Perceived usefulness is key to creating a positive attitude towards the use of ICT. It creates a positive attitude toward ICT use when societies consider that ICT is useful (Silva et al., at 2010). Rogers (2003) noted that perceived usefulness has to be sustaining. To make ICT perceived to be useful, it must be low cost, have the ability to reach a wider market, and collect significant information in a short time. Connectivity was another consideration identified for having a positive relationship with attitude towards ICT use. Observations from previous research have confirmed this research, and the key reason is that people with higher ICT connectivity are likely to use more ICT, thereby creating a better and more positive attitude towards ICT use.

The general objective of this study is to find out the attitude of small-scale farmers towards the use of ICT in their farming activities. Specifically, the study would explore:

1. The effects of level of education and duration of farming on the attitude of small-scale farmers to the perceived ease of use of ICT.
2. The impact of age and gender of small-scale farmers on their attitudes toward the perceived use of ICT.
3. Assess the impact of small-scale farmers' attitudes toward ICT tools on farming outcomes

Technology Acceptance Model (TAM)
Davis (1989) introduced the Technology Acceptance Model (TAM) to research the factors impacting the adoption of information technology in institutions and the attitudes of individuals embracing information technology. This research is to be informed predominantly by Technology Acceptance Model (TAM). According to Lee, Kozar, & Larsen (2003) and Venkatesh & Davis (2000) TAM's success over the years is due to its convincing capacity in explaining technology acceptance among users of the technology products. Giovanis, Binioris, and Polychronopoulos (2012) stated in their study that TAM is the most utilized theoretical model in the area of technology adoption.

According to Davis (1989), perceived usefulness and ease of use are the two considerations that determine the adoption of the user and directly affect their attitude toward the use of technology. Lee et al. (2013) in their study regarded TAM to be among the most important and commonly used theories to explain the adoption of technology by an individual as it indicates two primary factors: perceived usefulness and perceived ease of use that collectively account for its usage.

These factors are specifically simple, easy to comprehend, and can be manipulated by system design and implementation (Taylor and Todd 1995).

Perceived usefulness is described as the extent to which an individual think that using a specific system would advance the efficiency of his or her work (Davis 1989). Venkatesh et al., (2000) also explained perceived usefulness as the degree to which a person believes that using a particular system or a technology will enhance his or her job performance. Venkatesh et al., (2000) provide proof that the most significant determinant of the mindset of an individual to use a new technology was perceived to be useful. In regard to the numerous variables affecting technology utilization, perceived usefulness is considered a prerequisite for technology acceptance and behavioural intent.

Perceived ease of use is described as the degree to which an individual think that the use of a specific system would be easy (Davis 1989). According to Tarhini et al., (2015) perceived ease of use is the extent to which consumers consider technology to be easy or free from effort. They are of the view that the more users think technology is easy to use the more positive their attitude to adopt the technology. Additionally, Davis, (1989); Verkantesh et al., (2003) views perceived ease of use as the magnitude to which a person believes that the particular use of a system would make his or her job easier. Perceived ease of use is believed to have a direct effect on the intention to use the technology (Barnett, Pearson, Pearson, & Kellermanns, 2015; Siregar, Wardaya Puspokusumo, & Rahayu, 2017). Perceived ease of use was expanded to the user's belief that using a specific technology would not create much work (Davis, 1989). Also Davis (1989) believed perceived ease of use influences in a significant way the attitude of an individual through two main mechanisms: self-efficacy and instrumentality. Self-efficacy is a concept developed by Bandura (2012) which explains that the more a system is easy to use, the greater should be the user's sense of efficacy. Moreover, a tool that is easy to use will make the user feel that he has a control over what he is doing. Efficacy is one of the main factors underlying intrinsic motivation and it is what illustrates here the direct link between perceived ease of use and attitude. Perceived ease of use can also contribute in an instrumental way in improving a person's performance. Because the user will have to deploy less effort with a tool that is easy to use, he will be able to spare efforts to accomplish other tasks. The views expressed by the above authors mean that the level of confidence of the authors is so high that the particular use of the system will be free of effort.

McKechnie et al. (2006) demonstrate that the perceived ease of use was a significant determinant of perceived usefulness. In addition, TAM indicates that perceived usefulness is affected by perceived ease of use because the easier the system is, the more helpful it can be. According to Venkatesh and Davis (2000); Saghafi et al. (2017), a positive relationship was found between perceived ease of use and perceived usefulness. Behavioral intention explicated how the intention to use a technology system for making decisions, along with the effort required to employ the technology and the accuracy of the resulting decisions (Sun & Teng, 2017). Users' behavior toward a technology system is perceived as ease of use and usefulness that participate in predicting the role of the technology. Ardiansah et al. (2019) also found perceived usefulness to be a potent mediator for the relationship between perceived ease of use and purchase intentions. There is an accumulated extensive finding that perceived ease of use is significantly linked to intention and its impact on perceived usefulness. Although beyond the issues of the present extension of TAM, other research has begun to model the antecedents of perceived ease of use (Arora & Sahney, 2018). Through empirical research, it has also been tested many times and the methods used in the model have proved to be of high quality and have yielded statistically consistent results.

In this research, perceived usefulness and perceived ease of use of ICT tools and services are expected to have a direct impact on farmers' attitudes. In addition, it is suggested that the perceived ease of use not only predicts attitudes but is also an antecedent of perceived usefulness (Davis et al., 1989). Farmers' trust in ICT will be improved if the information on agriculture is readily available to them. As is the case with TAM, the attitude towards the use of ICT may have an uninterrupted effect on the intention to use information. Combined, perceived usefulness and perceived ease of use determine the attitude of a person toward using technology. Ultimately, with the combined influence of Perceived Usefulness and attitude, behavioral intention influences actual usage as shown in Figure 1.

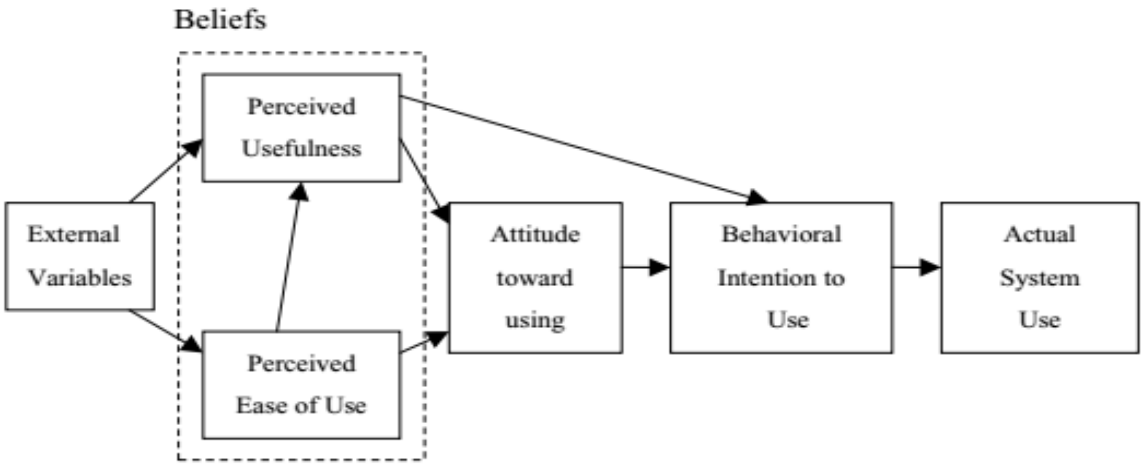

Figure1. Technology Acceptance Model (TAM) (Davis, 1989)

Davis (1989) original TAM, has undergone a variety of refinements by many writers attempting to discover the latent factors that underlie perceived usefulness and ease of use of technology. Venkatesh et al; (2003), in TAM 2, showed that the perceived usefulness and ease of use were influenced by social influence (subjective norm, voluntary picture) and behavioral procedures (work significance, output quality, outcome demonstrability). McFarland and Hamilton (2006) believe that six contextual factors (previous knowledge, fear of computers, system quality, task structure and administrative support) influence perceived usefulness and perceived ease of use of technology.

The processes of social influence relate to subjective norm, voluntariness, and image, while cognitive instrumental processes refer to job significance, quality of performance, demonstrability of result, and perceived ease of use. With the exception of TAM, by implementing models from TRA and TPB, Venkatesh and Davis (2000) introduced subjective norm as an additional construct. Subjective norm has clear relationships with perceived value and purpose of use.

The user experience regulates its relationship with perceived usefulness while the user experience and voluntariness of use reduce its relationship with the intent of use. Extending TAM to TAM2 by adding some constructs from older theories to perceived usefulness and perceived ease of use according to some users would boost the model's presence of experience administrator, for example, would demonstrate the rise in the level of user experience of technology over time, and this will trigger a tangible change in their acceptance of technology.

Much research has been done on TAM and its acceptance and validation. Research showed that TAM offers input on two factors: (1) utility and (2) user-friendliness. Yet, it does not provide

input on certain factors that may improve adoption such as convergence, versatility, information completeness, and information currency.

TAM and TAM2 furthermore do not explain how beliefs affect behavior. After analyzing the main constructs of both models and the associations between these constructs, some of the results of these studies indicate that associations were statistically significant, suggesting that TAM and its extension were strong models, while others suggested that they were contrary to findings. Through observing the cultural aspect, TAM and TAM2 cannot predict user behavior within the community in the same way.

From its original model, TAM has evolved over time and proved to be a helpful theoretical model to help people comprehend and clarify their behavior in the adoption and deployment of technology. Legris, Ingham, and Collerette, (2003) in their study recognized a weakness of TAM to be the exclusion of external variables. It has also been criticized by (Taylor and Todd, 1995) for its simplicity which reduces the comprehensive understanding of behaviour intention.

Technology Acceptance Model is one of the most popular theories that is used widely to explain the usage of technology. So many studies have been conducted which has led to changes in the originally proposed model. A new model called the combined TAM-TPB model which integrated the Technology acceptance model and theory of planned behavior was proposed by Taylor and Todd (1995). Venkatesh et al. (2003) in a study proposed the Unified Theory of Acceptance and Use of Technology (UTAUT) Model.

The various studies conducted by researchers have tried to modify the TAM by adding new variables to it. Agarwal and Prasad (1998) modified TAM by adding the construct of compatibility in the Technology Acceptance Model. Moon and Kim (2001) have added a new variable playfulness factor to study the acceptance of the World Wide Web. Lim (2000) proposed to modify TAM by adding variables like experience, self-efficacy, perceived risk, and social influence. Another study done by Agarwal and Karahanna added cognitive absorption, playfulness, and self-efficacy to the TAM model. Chau (1996) in a study reviewed TAM by including two types of perceived usefulness: near term and long term. Van der Heijden (2000) after analyzing the individual acceptance and usage of the website added two new constructs to TAM: perceived entertainment value and perceived presentation attractiveness. Chau and Hu (2002) combined the factor of peer Influence with Technology Acceptance Model.

According to a study by Franco and Roldan (2005) the relationship between perceived usefulness and behavioral intention was strong among goal directed users. Chau and Hu (2001) compared three models: Technology Acceptance Model (TAM), the Theory of Planned Behavior (TPB), and a decomposed TPB model that is potentially adequate in the targeted healthcare professional setting in Hong Kong. The results indicated that TAM was superior to TPB in explaining the physicians' intention to use telemedicine technology. The study conducted by Sun and Zhang (2003) found voluntariness can be a factor in determining the behavioral intention to use.

The theory described and examined here discussed the attitudes of individuals and their ability to accept the adoption of new technology based on certain constructs and variables. The emphasis of this theory was on the psychological and behavioral perspectives of technology users.

Despite the widespread use of TAM, a meta-analysis of TAM studies has found many shortcomings. Analysis of 101 published papers by Lee, Kozar, and Larsen (2003) found that most papers relied on one study, adopted low-validity steps, and did not consider whether the use was voluntary or not. The second most frequently cited limitation of the studies is the propensity

to analyze at a single point of time only one information system with a homogeneous group of subjects on one task, thereby increasing the generalization issue of any single study. The majority of the studies with lower variance explanations did not consider external variables other than original TAM variables. Other suggested limitations of TAM studies included single measurement scales, relatively short exposure to the technology before testing, and self-selection biases of the subjects. Irrespective of the credit given to TAM for its ability to explain the intention of users to use technology, Dishaw and Strong (2015) indicated that further research is necessary in order to increase the external validity of the TAM. This was supported by the current meta-evaluation of the TAM literature which recognized a weakness of TAM to be the exclusion of external variables (Legris, Ingham & Collerette, 2003). In addition, it has been criticized for its simplicity which reduces the comprehensive understanding of behavior intention (Taylor and Todd, 1995).

Problem statement

The primary aim of using ICTs tools in Agric farming is for storing, processing, and disseminating information and communication, which includes common communication tools like computers, mobile phones, and the internet (Balaji, Meera, & Dixit, 2007). According to Birke and Knierim (2020), such tools now link rural people and farming activities with the necessary information to promote the diffusion of agricultural technology. However, Far and Rezaei-Moghaddam (2018) claim that a positive attitude impacts the precision of agricultural technologies and contributes to increasing income and productivity. In contemporary times, rural farmers are using ICT tools in farming to enhance productivity. For instance, evidence from Shiro (2008) disclosed that rural communities have a very positive attitude toward ICT and they welcome any ICT project to be developed in their areas. However, their lack of ICT knowledge prohibits them from using ICT frequently. According to Khan et. al., (2022), 55% of rural wheat farmers are using Mobile Internet Technology to boost productivity. Although rural farmers are gradually adopting the use of ICT tools in rural farming, Steinke et al., (2020) argue that farmers' use of ICT-based apps, on the other hand, has frequently suffered as a result of their low educational and economic position. Moreover, rural farmers may be unwilling to use ICT-based services due to their technological incapability and habits, which may discourage extension workers from utilizing various ICTs. This has been the contention that in a developing country like Ghana, where there is a gigantic deficit with regard to agriculture productivity, it does not make sense that the government and stakeholders continue to invest in ICTs to promote digitization and socio-economic development, hence, cannot be effectively used by rural farmers to boost production. In this regard, preliminary investigations preceding this study revealed some areas that still pose a challenge to rural farmers in using ICTs tools for productivity. Therefore, this study investigated the contributions of the technology acceptance model in accessing the attitude of rural farmers using ICT tools in farming to enhance productivity.

Brief literature review

The use of Information and Communication Technology (ICT) in a variety of industries increased labour efficiency and production. Agriculture, like other economically important sectors, is now seeing widespread use of ICT in all aspects. According to Daum (2020), it has become one of the most important tools used by farmers to manage different information connected to input parameters such as water, labour, among others. ICT applications in agriculture are becoming more widespread throughout the world, which is assisting in the transformation of the industry's business and quality. The use of ICT in agricultural activities is growing in popularity across the world, and it is revolutionizing the sector's operations.

A positive attitude is an important requirement for ICT usage. Based on what has been completed by Shiro (2008), the rural communities have a very positive attitude towards ICT and they

welcome any ICT project to be developed in their areas. However, their lack of ICT knowledge prohibits them from using ICT frequently. Dixon (2009) has stressed that frequent usage and exposure to ICT must be considered if someone wants to form a positive attitude toward ICT. When people frequently use and expose 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 of the role of attitude toward an object on behavioral intention. In this case, related development, government agencies, or private companies should understand that a positive attitude toward ICT would lead potential users, especially the rural communities to decide to accept or use the ICT. Besides, efforts should be put into identifying factors that can contribute to a positive attitude toward ICT usage. So, to ensure the effectiveness of ICT, the rural community especially their leaders must have a positive attitude towards ICT usage.

Agricultural Extension in the current scenario of a rapidly changing world has been recognized as an essential mechanism for delivering knowledge (information) and advice as an input into modern farming (Jones, 1997). Present-day agriculture and Bangladeshi farming community are facing a multitude of problems to maximize crop productivity. In spite of successful research on new agricultural practices related to crop cultivation, the majority of farmers are not getting upper bound yield due to several reasons. One of the reasons is expert/scientific advice regarding crop cultivation is not reaching the farming community in a timely manner. Farmers need expert advice well on time to make them more productive and competitive. This, extension agency plays a major role in bridging this gap to make available the latest technologies at the doorstep of the farmers.

Most smallholder farming systems are much less productive and profitable than they could be. The reasons include a lack of access to inputs and credit, and the inability to bear risks. Another major contribution is the information and skills gap that constrains the adoption of available technologies and management practices or reduces their technical efficiency when adopted (World Bank, 2007). Farming is becoming a more time-critical and information-intense business. A push towards higher productivity will require an information-based decision-making agricultural system. Farmers must get information at the right time and place (De Silva and Ratnadiwakara, 2008). It is increasingly recognized that ICT is necessary for accessing required information and knowledge (Richardson 1997; Chapman et al. 2004; Anandajayasekeram et al. 2008; Mcnamara 2009; Aker 2010). ICT with agriculture helps in the dissemination of gathered information to the farmers, mostly living in rural areas, to use in their routine work (World Summit on the Information Society, Geneva 2003). In a country like Bangladesh, farms are extremely small, cultivation is dependent on the uncertainties of variable rainfall and average output is generally low. Value addition in agriculture requires technological, institutional, and price incentive changes designed to raise the productivity of small farms (Todaro, 2000). Imperfect information and high transaction costs can constitute major impediments to the agricultural marketing process (Dao, 2004). The information helps the poor to avail of opportunities and also reduces their vulnerability (Kiplang' et. al., 1999).

Recent developments in information and communications technology (ICT) offer a great opportunity to facilitate the flow of information and technology services delivery, especially to rural farmers (Maningas, 2006). It is comprehensible that on the one hand agriculture is becoming highly science-driven and knowledge-intensive, but on the other hand, the existing public extension system has become less effective, more time-consuming, and costly and fails to meet the expectations of those involved in agricultural production (Mruthunjaya & Adhiguru, 2005). The role of public agricultural extension services has traditionally been to provide an important link between agricultural research and farming communities, especially for technology transfer

in support of agricultural and rural development (FAO, 2004). Several authors (Anderson and Feder, 2004; Anandajayasekeram et al., 2008; Aker, 2010) posited that public agricultural extension service over the years has been working via different approaches, methodologies, and programs to ensure farmer's adoption of improved technologies with little success. The extensive use of modern information technology needs to be promoted for communication between researchers, extension workers, and farmers to transfer technologies and information in a cost-effective manner. Moreover, at present, the ratio of the farm families to the extension agent is 1000:1, which is really very less (NAEP, 1996). ICT has many potential applications in agricultural extension (Zijp, 1994), most especially in accessing required information and knowledge (Richardson, 1997; Chapman et al., 2004; Mcnamara, 2009).

The use of ICT is an important pillar of agriculture extension and in the current scenario of a rapidly changing world, has been recognized as an essential mechanism for delivering knowledge (information) and advice as an input for modern farming (Jones, 1997). ICT covers any product that will store, retrieve, manipulate, transmit, or receive information electronically in a digital form. For example, personal computers, digital television, email, and mobile, among others. As ICT's diffusion started to grow in many developing countries, the application of ICT to agricultural and rural development began to receive the attention of researchers and policymakers. A number of studies have suggested that ICT could play an important role in agricultural development. Lio and Liu (2006) found that a microwave-radio telephone system installed in the remote region of Tumaca, Columbia, along with community access points resulted in better trade and market opportunities. James (2004) reported that rural telephone and community radio services initiated in India and Sri Lanka had received a positive response from farmer communities. Bayes (2001) has argued that the Village Phone Program (VPP) of Grameen Bank of Bangladesh can convert telephones into production goods by lowering transaction costs. Attitude is seen as an evaluative disposition based upon cognitions, affective reactions, behavioral intention, and past behaviors and it provides the response of someone who likes or dislikes something (Shih, 2004; Luarn & Lin, 2004). Shiro (2008) for example, through his research, has proved that rural communities possess positive attitudes towards ICT and they welcome any ICT project to be built in their areas. However, Shiro (2008) also found that their lack of ICT knowledge reduces their ICT usage. Here, an attempt has been made to analyze the reaction and to know the level of knowledge of the farmers towards ICT as a source of reliable and timely information about best production practices, processing, marketing, input and output prices, and financial risk-covering institutions. The favorable attitude of farmers towards ICT as an effective and efficient information support tool would lead to stronger conviction and efficient extension program planning in changing rural environments. Hence, the focus of this study was on the attitude of the farmers towards the ICT-based agricultural system, their present level of knowledge on ICT-based agriculture, and the present situation with regard to education, duration, age in Greater Accra Region, Ada East District, and the Eastern Region.

Methodology

The study was conducted using a multi-stage sampling technique involving simple random sampling, a probability sampling method, purposive sampling, and snowball sampling, which are non-probability methods. Two regions, namely, the Greater Accra and Eastern were purposively selected for the study. The second stage was the selection of the districts. The districts were also chosen by simple random sampling. From the District to group level a multistage sampling approach was used for the study. In the Greater Accra Region, Ada East District was selected while in the Eastern Region Asuogyaman District. In Greater Accra, the study was conducted in six farming villages namely: Big Ada, Dogo, Kasseh, Addokope, Korlekope, and Bedeku. In Eastern regions, the study was conducted in Asogyaman, where Tortibo, Sappor, Yenease, Adina

Donor, and Ankyease. A snowball strategy was relied on in selecting small-scale farmers for the study. The Snowball technique relies on previously identified group members to identify other members of the population. For this study, the researcher contacted the heads of farmers' associations in the selected communities. The contact persons knew the farmers well in the context of agricultural knowledge and experience. The contact farmer then referred the research assistants to other farmers. This method continued until the desired sample units were obtained. A total of 390 households, 130 from each district, were sampled randomly. The methodologies used for primary data were household surveys and Focus Group Discussion (FGD) while the instruments used were semi-structured pre-tested Interview Schedules and Checklist respectively.

The mixed members ranging from 10-12 were selected with vigorous discussion with the major stakeholders for focused group discussion. A total of six Focused Group Discussions (FGDs), two from each district were conducted before and after the household survey to verify data and get ideas about the study area. Secondary data was gathered from published articles, journals, and other publications. The acquired data were analyzed using descriptive statistics and suitable scaling techniques once they had been cleaned and managed properly. Knowledge of ICT tools was assessed using a yes/no scale for the various types of ICT tools and agricultural machinery used in paddy farming. Simultaneously, a five-point rating system for both perception and attitudes on the numerous assertions questioned was devised. The respondents' perceptions and satisfaction with ICT tools and agricultural machinery used in paddy farming were then ranked using index values.

Given that the population for the study was heterogeneous with regard to the subjects understudied, sampling was employed. The baseline supposition was the conception that the rural farmers would not be understated. Straits and Singleton (2010:155) indicate that several approaches can be followed in determining sample size. For smaller populations, for example, researchers can use a census, emulate similar studies' sample sizes, and apply mathematical formulas, among other things. These techniques have both advantages and flaws. A mathematical calculation was applied in this study to arrive at the sample size for the entire population. The sample equation was imitative of the equation used by Sekran and Bougie (2010), for a population of 75,000 people, a sample of 382 will be acceptable and for a population of 1,000,000 a sample of 384 is appropriate. Therefore, for the present study, based on the projected population size of 2,000,000 a minimum sample size of 400 will be representative of the population and the findings of the present study sample can be safely generalized to the population.

The minimum sample size, n, can also be statistically calculated for the analysis, provided the sample proportion, which is the unbiased population proportion estimator p, the confidence level on the error margin, d as

$$n \geq \frac{(Z_{\frac{\alpha}{2}})^2}{4d^2}$$

In the study, we estimated a sample yielded an error margin of less than 5% within a 95% confidence. Therefore, the minimum sample for the study was obtained as

$$n \geq \frac{1.96^2}{4(0.05^2)}$$

$$n \geq 384$$

Hence a minimum sample of 384 will be adequate for the purpose of the study. Consequently, 1080 questions were sent out, and after putting in all the required effort to feedback, only 985 responded.

Ethical considerations

In this study, participation was voluntary, and the participants were informed that they would remain anonymous and that confidentiality would be maintained. The researchers got permission to conduct the study from the office of the Association of rural farmers. Furthermore, ethics clearance was obtained from the Centre for Graduate Studies Open University Malaysia/Accra Institute of Technology. The researchers undertook this study from a heterogenous background of participants. These practices brought a measure of inconvenience to the researchers. However, participants took part take in the study of their own free will. Before the actual administration of the questionnaires and interviews, the researchers explained the purpose of the study to all participants.

Results and discussion

The results are discussed according to the study's objectives. The table below (Table 1) summarizes the demographic characteristics of respondents who participated in the study. The study indicated that the females were in the majority of 59% and 41% of the respondents were males. Also, 24% of the respondents were between 20-30 years, 25% between 31-40 years, and 22% between 41-50 years. Cumulatively the majority of respondents were below 50 years and formed 71% of the sample. This means that the majority of the respondents fall within the active working group.

From the data, the majority (42%) of the respondents had basic education, 34% had no formal education, 17% had secondary education and only 7% had tertiary education**.** In effect, 66% of the sample had various levels of education with a considerable number with basic education.

On the duration of farming 81 out of 985 respondents representing 8% have been into farming between 1-5 years, 19% for between 5-10 years, 12% have been into farming for between 11-15 years, and 14% have been into farming for between 6-20 years. However, those over 20 years dominate and the indication is that the majority of the respondents are skillful in farming.

Table 1 *Demographic Characteristics (N=985)*

Socio-Economic Profile		Frequency	Percentage (%)
Gender	Male	402	41
	Female	583	59
Age (years)	20-30	239	24
	31-40	246	25
	41-50	217	22
	51-60 years	142	15
	above 60 years	141	14
Educational Level	No formal education	334	34
	Basic education/Middle School	413	42
	Secondary	169	17
	Tertiary	68	7
Duration of farming	1-5 years	81	8
	5-10 years	183	19
	11-15 years	118	12
	16-20 years	137	14
	Above 20 years	466	47

The effect of education and duration of farming on the attitude of small-scale farmers to the perceived ease of use of ICT.

This part of the research questions aimed at determining the influence of farmers' education and duration of farming on the use of ICTs. In this regard, Factorial Anova test was carried out in order to answer the research question. The findings indicate the impact of the educational level and duration of farming on the attitude of small-scale farmers to the use of ICT as stated in Table 2. As indicated, Table 2 is a 2 X 2 factorial analysis of variance that tested the main effect of educational level and the duration of farming on the expectation of small-scale farmers regarding the use of ICT to improve farming. Results from the study as shown indicates that the main effect of educational level on the use of ICT to improve farming with Type III Sum of Squares = 17.008, degree of freedom (df) = 3, Mean Square = 5.67, F-statistic = 5.06 and p-value =0.002 ($p<0.05$) is statistically significant. Additionally, the main effect of the duration of farming with Type III Sum of Squares = 51.302, degree of freedom (df) = 4, Mean Square = 12.83, F-statistic = 11.44, and p-value = 0.00 ($p<0.05$) is also statistically significant. The interaction between educational level and duration of farming as seen from table 2 Type III Sum of Squares = 147.983, degree of freedom (df) = 11, Mean Square = 13.45, F-statistic = 11.99 and p-value = 0.00 ($p<0.05$) is statistically related to the use of ICT to improve farming.

Table 2: Factorial Anova

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power
Corrected Model	283.388	18	15.74	14.04	0	.207	252.77	1.000
Intercept	1701.293	1	1701.29	1517.47	0	.611	1517.47	1.000
Educational level	17.008	3	5.67	5.06	.002	.015	15.17	.919
Duration of farming	51.302	4	12.83	11.44	0	.045	45.76	1.000
Educational level * Duration of farming	147.983	11	13.45	11.99	0	.120	131.99	1.000
Error	1083.018	966	1.12					
Total	8631.000	985						
Corrected Total	1366.406	984						

The Impact of Age and Gender of small-scale farmers on their attitudes toward their perceived use of ICT.

The study also aimed to ascertain the impact of age and gender of small-scale farmers on their attitudes toward the perceived use of ICT. The result of the factorial analysis tested the perceived expectation of small-scale farmers regarding the use of ICT to improve farming based on their gender and age.

The results from the Factorial Anova analysis in Table 3 indicate the effect of age and gender on the attitude of small-scale farmers regarding the use of ICT to improve their farming activities is statistically significant $F(1,975) = 3.621$, $P<0.05$, Partial Eta Squared=0.04. Also, the main effect of age is statistically significant $F(4,975) = 15.088$, $P<0.05$, Partial Eta Squared=0. 058. The interaction between gender and age is also statistically significant $F(4,975) = 2.803$, $P<0.05$, Partial Eta Squared=0.011. The findings of this study indicate that the predictor variable sex (male) has a statistical influence on the their usage of ICT.

Table 3: Factorial Anova

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power
Corrected Model	102.605	9	11.401	8.795	.000	.075	79.158	1.000
Intercept	6719.489	1	6719.489	5183.964	.000	.842	5183.964	1.000
Gender	4.694	1	4.694	3.621	.007	.004	3.621	.477
Age	78.227	4	19.557	15.088	.000	.058	60.351	1.000
Gender * Age	14.533	4	3.633	2.803	.025	.011	11.212	.769
Error	1263.801	975	1.296					
Total	8631.000	985						
Corrected Total	1366.406	984						

The impact of small-scale farmers' attitudes toward ICT tools on farming

The attitude of rural farmers towards ICT usage was measured using a five (5) point Likert scale ranging from 1=Strongly Disagree, 2=Disagree, 3=Neutral, 4=Agree, and 5=Strongly Agree. Respondents were given twenty (20) attitudinal statements and were asked to use the Likert scale given to measure the statements. There were 19 attitudinal statements that the study used to describe the attitudes of respondents. Table 4 summarized the results. From the table, it can be seen that 'potentially saves time' was ranked the first attitudinal statement with a mean rank of 11.85. This is followed by 'can use ICT to obtain information on rainfall pattern ($\bar{X} = 11.50$). The least ranked attitudinal statement is **'**too much information from ICT makes the information less useful', with a mean rank of 6.59.

Table 4: Attitude toward the use of ICT

Attitudinal Statements	Mean Rank	Rank order
Potentially saves time	11.85	1st
Can use ICT to obtain information on rainfall pattern	11.50	2nd
ICT will increase my technical knowledge of modern farming	11.30	3rd
ICT will enhance the quality of extension activities	11.22	4th
Can use ICTs to share indigenous knowledge (IK) on farming activities?	11.06	5th
ICT is a useful tool for farming	11.01	6th
Can use ICTs to acquire indigenous knowledge (IK) on farming activities	10.88	7th
ICT can help facilitate loan/credit facility	10.64	8th
Can use ICT to control weeds in farm	10.94	9th
ICT can help improve soil fertility	10.05	10th
Can use ICT to obtain Market information	10.01	11th
ICT tools are too expensive	9.99	12th
ICT can be used for crop storage	9.50	13th
Can use ICT to detect crop disease or pest problem	9.36	14th
ICT can be used for crop processing	8.99	15th
ICT can be used for crop harvesting	8.90	16th
Can use ICT for the planting of crops	8.57	17th
Information through ICT does not need other published sources	7.64	18th
Too much information from ICT makes the information less useful	6.59	19th

Conclusions and recommendations

The study concludes that age has an effect on attitude of small-scale farmers concerning their perceived use of ICT to improve their farming activities. The educational level of an individual

plays a significant role in the acceptance and use of ICT. The majority of respondents in the study area have some level of education. The findings of this research show that education has a strong association with the use of ICT. In other words, the research discovered that education had an influence on ICT usage. Education, therefore, places a barrier on ICT usage by illiterate small-scale farmers in rural communities. Gender is a factor that contributes to the acceptance of technology. The outcomes of this research are in accordance with existing literature on sex differences in the use and access of ICT. Also, a larger percentage of small-scale farmers in the research area are below 60 years. On education, the study shows that there were more educated small-scale farmers in the study area than illiterates. The research revealed that age and educational level had an important influence on the level of ICT usage by small-scale farmers. Educational level, duration of farming, and age also have an influence on the perceived ease of use and perceived usefulness of ICT to improve their farming activities. Ultimately, the research found that the level of education, age, and duration of farming influences the attitude of small-scale farmers toward the use of technology in farming.

The study recommends that future study concerns the replication of the study in other parts of Ghana. Given that the study was carried out in 3 out of 254 districts/municipalities in Ghana the research needed to be replicated in other districts/municipalities to help assess the generalization of the results.

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