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Dimensions of Accessibility and Use of Information Communication Technology Among Cocoa Farmers in Atwima Mponua District, Ghana

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Abstract

This research examined the drivers of accessibility and use of information communication technologies (ICTs) by cocoa farmers. A sample size of four hundred (400) cocoa farmers was selected using a multi-stage random sampling procedure. Data were analysed using

percentage, means, standard deviation, Kendall's coefficient of concordance and multiple linear regression model. The study revealed that mobile phones, radio and television are the most available ($\bar{x}$=4.99, 4.95 and 4.85 respectively), accessible ($\bar{x}$=4.97, 4.83 and 4.40 respectively) and utilised ($\bar{x}$=4.97, 4.81 and 4.30 respectively) ICT tools by cocoa farmers. There is a relatively high level of availability of ICT ($\bar{x}$=3.57), a moderate level of accessibility ($\bar{x}$=2.90) and low use ($\bar{x}$=2.19) of ICT tools. Cocoa farmers mainly used ICT tools to acquire information on their cocoa farm activities ($\bar{x}$=4.82). Gender, age, education and farmer-based organisation participation affected farmers' accessibility of ICT tools. Age, education and farm experience significantly affected farmers' use of ICT tools. The greatest challenge faced by cocoa farmers in accessing and using ICT tools is a lack of skills in operating the tools ($\bar{x}$ rank=2.24). Training on ICT use should be intensified by all relevant stakeholders to enable cocoa farmers to increase their use of ICT tools.

Introduction

The use of Information and Communication Technology (ICT) for agricultural activities may be a novel concept in developing nations, however, its impact on the reduction of poverty is progressively becoming more evident (Ekanem and Akpan, 2018). The agriculture industry can experience progress and advancement by utilising ICT proficiently. The agriculture industry has experienced significant enhancements in its efficiency and productivity of the value chain through the successful incorporation of ICT (Ayim et al., 2020).

The ICT transformation is the result of combining computer technology and communication technology. In today's era of information, ICT serves as a crucial tool for spreading knowledge between research and farming systems (Anand et al., 2020). According to El Bilali and Allahyari (2018), the adoption of ICT-based innovations can improve the quality of life in rural areas and empower small-scale farmers in developing nations by boosting their connectivity and enabling them to access accurate and up-to-date information on agriculture. As Anand et al., (2020) suggest, ICT is a crucial driver for economic growth, as it has the potential to significantly improve the delivery of social services and enhance the performance of government institutions.

According to Anand et al., (2020), ICT encompasses a diverse range of technologies, including traditional methods such as radio, television, and telephone, as well as modern advancements such as mobile devices, wireless, satellite technology multimedia, and the Internet. According to El Bilali and Allahyari (2018), the present developments in ICT, which involve technologies such as mobile phones, radio, computers, television, blockchain, cloud computing, big data analytics, Internet of Things (IoT), and artificial intelligence, can promote sustainability transitions in agriculture by improving efficiency and providing greater transparency and traceability. Kassahun et al., (2020) and Ahoa et al., (2020) suggest that big data analytics can provide predictive insights for farming operations, enable real-time decision-making and the optimisation of business processes. Additionally, Verdouw et al., (2019) and Koksal and Tekinerdogan (2019) noted that precision agriculture, which uses a combination of technologies including Geographic Information Systems (GIS), Global Positioning System (GPS), mobile computing, software and advanced information processing, can collect comprehensive data on production variability in both space and time.

Numerous advantages of implementing ICT in agriculture have been recorded in the literature. For instance, Ahabyoona et al., (2019) demonstrated the significant impact of ICT on agricultural development. Similarly, Goal and Gustira (2020) suggested that the use of ICTs can increase farmers' access to information on market trends, production inputs, and consumer demands, thereby improving the quality and quantity of their production. They also argued that ICTs can enhance farmers' performance by providing them with innovative tools such as seed-dispersing drones to assist them in carrying out their farming activities, resulting in effective and efficient agriculture. According to Shasani (2020), ICTs can fulfil the information needs of farmers by bridging the gap between traditional and modern knowledge. Similarly, Sajid and Ali (2018) suggested that the use of ICT is a valuable addition to modern innovative technologies as it has resulted in significant improvements in agricultural production through the dissemination of updated agricultural information. Despite the numerous benefits that ICTs offer to farmers, their use in enhancing farming activities is still limited (Fosu and Gruenen, 2020). This is explained by the Uses and Gratification Theory.

The Uses and Gratification Theory (UGT) suggests that farmers are capable of recognising their own needs and choosing media i.e., ICT tool that is best suited to meet those needs. It explains why farmers may choose to adopt or avoid the use of ICTs, and also provides insights into the reasons behind their choice of specific ICTs (Ray et al., 2019). This theory is focused on individual media consumers, such as farmers, and how they select and use media i.e., ICTs (Moon et al., 2022). UGT is particularly useful in identifying the psychological needs that drive ICTs selection and the reasons why farmers choose a particular ICT tool to meet their specific needs (Menon and Meghana, 2021). Farmers are intentional in their selection of ICTs, choosing them for specific reasons and actively utilising them to create expectations and obtain gratification (Moon, 2020). Users, in general, are typically motivated to use ICT tools that provide the greatest entertainment value (Kirova and Vo Thanh, 2019).

Despite the various perspectives covered by the existing literature on ICT use in extension delivery (Ifeanyi-obi et al., 2023; Henri-Ukoha, 2020; Nwaiwu et al., 2019; Rengaraj and Shibu, 2022; Onyeneke et al., 2019; Chimanga and Kanja, 2020; Ekeanya et al., 2018), the drivers (dimensions) of accessibility and use of ICTs by Ghanaian cocoa farmers are less studied.

The cocoa industry is a significant contributor to Ghana's economy, with cocoa farmers playing crucial roles in sustaining the sector. Despite the increasing availability of ICT tools in the agricultural sector, there remains limited access and use among cocoa farmers in Ghana. This lack of accessibility and use poses a significant hindrance to the potential benefits that ICT tools can provide for cocoa farmers. Therefore, the objective of this study is to explore the dimensions of accessibility and use of ICT tools among cocoa farmers in the Atwima Mponua District of the Ashanti Region of Ghana. Specifically, this study aims to examine the perceptions of cocoa farmers on the availability, accessibility, and use of ICT tools in cocoa farming, identify the factors that influence the accessibility and use of ICT tools, and determine the constraints to the use of ICT tools in cocoa farming. By understanding the factors that influence the adoption and use of ICT among cocoa farmers, policymakers and stakeholders can develop appropriate strategies to increase accessibility and enhance the use of ICT

tools by cocoa farmers, ultimately improving their livelihoods and contributing to the growth of the cocoa industry.

Methodology

The study employed a quantitative research method and a cross-sectional survey research design. It was carried out in the Atwima Mponua District of the Ashanti Region. The population of Atwima Mponua Cocoa District is estimated to be 119,180 (GSS, 2010). The Yamane (1973) formula was used to determine the sample size. The formula is as follows: $n = N/[1+N(0.05^2)]$, where; n is the sample size, (0.05^2) is the error margin of error, and N is the sampling frame. n=12,322/[1+(12,322 x 0.0025)], n=12,322/38.5. Therefore, n=385.08. The calculated sample size of 385 was increased to 400 to reduce errors due to sampling. The multi-stage sampling technique was adopted to select the 400 respondents. In the first stage, simple random sampling was used in selecting the district. In the second stage, ten (10) operational areas were randomly selected from the 32 operational areas. In the third stage, 40 farmers were randomly selected from each community. Primary data were elicited using a well-structured questionnaire. Data were analysed using inferential statistics (i.e., multiple linear regression and Kendall's Coefficient of Concordance) and descriptive statistics (i.e., frequencies, percentages, means and standard deviations).

In the study, the list of ICT tools and operationalisation of "availability, accessibility and use" were generated from Folitse et al., (2019) and Anand et al., (2020). Availability of ICT is farmers' perception of the physical presence of the communication equipment. ICT accessibility is farmers' perception of the existence of the right conditions for use in getting information. Use is the experience or adoption of the ICT tools.

A Likert scale; 1=strongly disagree, 2=disagree, 3=neutral, 4=agree and 5=strongly agree was used to calculate the availability and accessibility of ICT tools while a Likert scale; 1=never, 2=rarely, 3= sometimes, 4=often and 5=always was used to calculate the use of ICT tools. A multiple linear regression model was used to determine the socioeconomic factors that influence accessibility and use of ICT by the respondents aided by IBM SPSS Statistical Software tool version 20. The regression model used in the study is depicted as follows;

$$Y = \alpha + \beta_i X_i \quad (1)$$

where Y represents the two dependent variables (ICT accessibility and use score) and varies from 1 to 5. Two separate regression analyses were conducted, with the ICT accessibility and use score serving as the dependent variable in each model. X_{is} are the independent factors that influence ICT access to or use of ICT by farmers and β_s are the coefficients of the explanatory variables. The explanatory variables included gender, age, marital status, household size, religion, education, farm size, FBO participation, farm age and farm experience.

Kendall's Coefficient of Concordance (W) was also used to measure the degree of agreement among the respondents in rankings of the perceived uses of ICT and constraints. When there are more than two judges, this statistic is used to measure the extent to which all judges agree. It measures the degree of agreement on a zero-to-one scale. The coefficient of concordance (W) has a positive value ranging between zero (0) and one (1). It is one (1) in the situation where the ranks assigned by respondents are the same and zero (0) when there is a maximum disagreement among the respondents (Silvério et al., 2020).

Results and Discussion

Availability, Accessibility and Use of ICT Among Cocoa Farmers

Table 1 shows that the ICT tool most available to them was mobile phones (M= 4.99; SD=0.49). This is followed by radio (M= 4.95; SD=0.85) and television (M= 4.85; SD=0.09). This means the three most available ICT tools in the district are mobile phones, radio and television. A perception index of 3.57 for the availability of ICT shows the cocoa farmers agreed that the ICT tools are available to them. The implication is that ICT tools are relatively highly available to farmers. However, Anand et al., (2020) argued that ICT tools are moderately available to farmers.

Access to information technology is one of the important dimensions of farmer empowerment. Farmers were asked about their accessibility to various ICT tools in their communities. Accessibility was indicated in the following order: mobile phones (M= 4.97; SD=0.45), radio (M= 4.83; SD=0.61) and television (M= 4.40; SD=0.49). This means that mobile phones, radio and television are the ICT tools farmers can easily access. Similar results were obtained from different studies by Anand et al., (2020), Panda et al., (2019) and Khalak et al., (2018). A perception index of 2.90 for accessibility of ICT shows that the cocoa farmers were neutral. The implication is that there is a relatively moderate level of accessibility to ICT tools. The findings agree with Anand et al., (2020) that ICT tools are moderately accessible to farmers. In contrast to the findings of this study, Khalak et al., (2018) found that the access to ICTs among rural farmers is normally low. In addition, Khan et al., (2022) indicated that farmers lack full access to ICT and they have very low knowledge of useful information necessary to improve agricultural production.

Use was indicated in the following order: mobile phones (M= 4.97; SD=0.45), radio (M= 4.81; SD=0.46) and television (M= 4.30; SD=0.19). This implies that mobile phones, radio and television are the most used ICT tools. According to Hasan et al., (2019), farmers are slowly becoming more aware of the use of smartphones. Research conducted by Ayim et al., (2020), Ekeanya et al., (2018), and Anand et al., (2020) indicated that televisions, mobile phones, and radios are the most commonly used ICT tools in the agricultural sector. Particularly for mobile phones, the biggest motivation for farmers' use of the mobile phone in their production was its potential to ensure easy and faster access to information that is pertinent to their respective problems, money-saving, assurance of getting the receiver, flexibility and faster access to other stakeholders/services (Folitse et al., 2019 and Anand et al., 2020). Farmers benefit from the radio as it provides them with important and timely updates on weather forecasts, market prices for commodities, and other relevant information without having to travel to research centers. Meanwhile, television programmes that focus on identifying problems and controlling pests in crops, as well as providing agricultural information and precautions, are widely regarded as helpful by farmers. Generally, the use of ICT tools among cocoa farmers is low as attested by the mean score of 2.19. According to Khan et al., (2022), farmers are not using ICT to access agricultural information.

Table 1: Availability, accessibility and use of ICT among cocoa farmers

ICT tools	Availability		Accessibility		Use	
	Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**
Mobile phones	4.99	0.49	4.97	0.45	4.97	0.45
Radio	4.95	0.85	4.83	0.61	4.81	0.46
Television	4.85	0.09	4.40	0.49	4.30	0.16
Social media	3.12	0.49	2.04	0.24	1.40	0.40
Extension bulletin	4.18	0.38	3.66	0.48	2.38	0.02
Internet	4.35	0.81	2.43	0.62	1.18	0.11
Desktop Computer	2.91	0.50	2.02	0.76	0.37	0.18
Digital Camera	1.87	0.48	1.70	0.46	0.30	0.09
Projector	0.93	0.49	0.09	0.02	0.07	0.03
Perception Index	M=3.57; SD=0.51		M=2.90; SD=0.46		M=2.19; SD=0.21	

Source: Field survey, 2022

Reasons for ICT Use

Based on the uses and gratification theory, the cocoa farmers were asked about the reasons for their use of the ICT tools (Table 2). A mean score of the different uses shows the majority of cocoa farmers use ICT to acquire information on their cocoa farming activities; cognitive need (M=4.82; SD=0.01). This was followed by "strengthen contacts with friends and family"; and social integrative needs (M=4.50; SD=0.05). The least was "releasing tension"; tension release need (M=2.34; SD=0.18). The implication is that farmers' use of ICT tools is mainly to acquire information on their cocoa farm activities. Panda et al., (2019) found similar results as the present study, where farmers use ICT for information acquisition, communication, and marketing. Additionally, Ekanem and Akpan (2018) suggest that ICT can facilitate the exchange of information and interaction between researchers, extension workers, and farmers, thereby providing various benefits. Kendall's W of 0.52 gives an indication there is a 52% agreement in the ranking of perception of uses of ICTs among cocoa farmers.

Table 2: Reasons for the use of ICT

Perception of uses of ICT	Mean (Max = 5)	SD
For acquisition of information on cocoa farm activities (cognitive need)	4.82	0.01
To strengthen contacts with friends and family (social integrative need)	4.50	0.05
For pleasure and aesthetic experience (affective need)	3.35	0.03
For strengthening my credibility, confidence and status in society (personal integrative need)	3.14	0.09
For releasing tension (tension release need)	2.34	0.18

Source: Field survey, 2022

N=400; Kendall's W=0.52; Chi-Square=834.20; Df=4; Asymp. Sig.=0.00

Determinants of Accessibility to ICTs by Cocoa Farmers

From Table 3, the R^2 shows that 81% of the changes in the dependent variable (accessibility) are explained by the independent variables. The coefficient for the gender of cocoa farmers in the study area concerning accessibility to ICT tools is negative and significant at 5%. This suggests that gender has a statistically significant but negative effect on the accessibility to ICT tools by cocoa farmers. The implication is women farmers are likely to have more access to ICT tools than men. It is always expected that men will have more access to ICT tools than women, however, this study shows otherwise.

The coefficient for the age of cocoa farmers in the study area concerning accessibility to ICT tools is negative and significant at 5%. This implies that ICT tools are less likely to be accessible to older cocoa farmers than young farmers. It is expected young cocoa farmers will have the capacity to access more of these ICT tools since they are more energetic and more ICT inclined than the older generation. The current system of education in formal schools where students are taught basic ICTs could also be a reason for this situation. According to Hasan et al., (2019), older individuals are less likely to use ICT, which serves as a hindrance to the adoption of ICT. The finding agrees with Khalak et al., (2018) that age is an important determinant of respondents' likelihood of having access to ICTs.

The coefficient for the education of cocoa farmers concerning accessibility to ICT tools is positive and significant at 5%. This implies that a cocoa farmer who is more educated will be more likely to have access to ICT tools as compared to their counterparts who are less educated. According to Hasan et al., (2019), farmers with low levels of education are less likely to use ICT. This is so because education enhances the ability to use ICTs. Again, a study by Khalak et al., (2018) revealed that educational status is an important determinant of respondents' access to ICTs.

The coefficient for FBO participation of cocoa farmers in the study area concerning accessibility to ICT tools is positive and significant at 5%. This implies a cocoa farmer who is a member of an FBO will more likely get access to ICT tools as compared to their counterparts who are not part of any FBO. Membership in farmers' associations also increases the likelihood of accessing and using ICT sources of information (Khalak et al., 2018).

Table 3: Determinants of accessibility to ICTs by cocoa farmers

	Unstandardised Coefficients		Standardised Coefficients	
Variables	**B**	**Std. Error**	**Beta**	**T**
(Constant)	4.15	0.05		92.29
Gender	-0.04	0.02	-0.17	-2.35*
Age	-0.00	0.00	-0.14	-2.92*
Marital status	0.02	0.01	0.10	1.92
Household size	-0.00	0.00	-0.04	-0.72
Religion	-0.01	0.01	-0.04	-0.56
Education	0.00	0.01	0.02	0.46*
Farm size	-0.00	0.00	-0.06	-0.99
FBO participation	0.04	0.02	-0.11	-2.23*
Farm age	0.00	0.00	0.04	0.64
Farm experience	0.00	0.00	0.02	0.23

Source: Field survey, 2022. R=0.29; R^2=0.81; Adjusted R^2=0.57; Std. Error=10.74

Determinants of Use of ICTs by Cocoa Farmers

From Table 4, the R^2 shows that 55% of the changes in the dependent variable (use) are explained by the independent variables. The coefficient for the age of cocoa farmers in the study area concerning the use of ICT tools is negative and statistically significant at 5%. This implies young cocoa farmers will be more likely to use ICT tools as compared to their counterparts who are old. Young cocoa farmers may be more comfortable with technology, having grown up in a more digitally connected world. They may be more familiar with computers, smartphones, and other digital devices, which would make them more comfortable with using ICT tools. The result agrees with studies by Nyamboka et al., (2019) who found the age of the respondents influenced the use of mobile phones (ICT tool) as sources of market information.

The coefficient for farm experience of cocoa farmers in the study area concerning the use of ICT tools is negative and statistically significant at 5%. This implies a less experienced cocoa farmer will be more likely to utilise ICT tools as compared to their counterparts who are more experienced. Less experienced cocoa farmers may be more open to learning and adopting new technologies. They may also be more receptive to training and education programmes that teach them how to use ICT tools effectively. On the other hand, more experienced cocoa farmers may have a deeper understanding of the specific challenges and opportunities in their farming environment. In agreement, Nyamboka et al., (2019) asserted farming experience significantly reduces the probability of using ICT as a source of market information.

The coefficient for the educational level of cocoa farmers in the study area concerning the use of ICT tools is positive and statistically significant at 5%. This implies a cocoa farmer who is more educated will be more likely to use ICT tools asset compared to those who are less educated. A more educated cocoa farmer would likely have more exposure to technology and would be more likely to understand how to use it. The level of education has a positive effect on the likelihood of using ICT tools to acquire market information (Nyamboka et al., 2019).

Table 4: Determinants of use of ICTs by cocoa farmers

	Unstandardised Coefficients		Standardised Coefficients	
Variables	**B**	**Std. Error**	**Beta**	**T**
(Constant)	3.41	0.07		49.78
Gender	0.00	0.00	0.07	1.43
Age	-0.12	0.03	0.34	4.60*
Marital status	-0.00	0.01	-0.00	-0.08
Household size	0.00	0.01	-0.04	-0.79
Religion	0.05	0.02	-0.18	-2.41
Education	0.00	0.01	-0.21	-0.16*
Farm size	0.00	0.00	0.03	0.53
FBO participation	0.03	0.02	-0.07	-1.40
Farm age	0.00	0.00	-0.06	-1.07
Farm experience	-0.01	0.00	0.19	1.42*

Source: Field survey, 2022

R=0.28; R^2=0.79; Adjusted R^2=0.55; Std. Error=16.33

Challenges Faced by Cocoa Farmers in the Use of ICT

Table 5 shows the results on the constraints faced by cocoa farmers in the access to and use of ICT tools. The greatest challenge (1st) faced by cocoa farmers in the district concerning the use of ICT tools is the lack of skills in operating the tools. This is followed by the high cost of ICT gadgets (2nd) and lack of local content (3rd). The least constraint (7th) was faulty gadgets. Several studies including Hasan et al., (2019), Khalak et al., (2018), Panda et al., (2019), Kacharo (2020), Ekanem and Akpan (2018), and Byamukama et al., (2020) have identified various challenges hindering the effective use of ICT facilities in agriculture, such as high costs, lack of operational knowledge, language barriers, unstable power supply, expensive maintenance, poor network and reception, and slow internet bandwidth speed. A Kendall's W of 0.59 gives an indication there is a 59% agreement in the ranking of constraints among the cocoa farmers.

Table 5: Challenges faced by farmers in the use of ICT

Challenges	Mean Ranks	Rankings
Lack of skills in operating the tools	2.24	1st
High cost of ICTs gadgets	2.57	2nd
Lack of local content	3.21	3rd
Loss of signals from source during usage	3.26	4th
High cost of repairs	4.22	5th
Intermittent power outages	6.24	6th
Faulty gadgets	6.27	7th

Source: field survey, 2022

N=400; Kendall's W=0.59; Chi-Square=1421.50; df=6; Asymp. Sig.=0.00

Conclusion and Recommendations

The study shows that factors such as gender, age, education and FBO participation have a statistically significant effect on the accessibility of ICT tools. Factors such as age, education and farm experience significantly affected farmers' use of ICT tools. The greatest challenge faced by farmers accessibility and use of ICT tools by cocoa farmers in Ghana is a lack of skills in operating the ICT tools.

Training should be intensified by all relevant stakeholders to enable cocoa farmers to increase their use of ICT tools. This is to address the challenge of lack of skills in operating the tools. This can be done by providing hands-on training and support to farmers. Finally, there should be a focus on increasing the accessibility of ICT tools, particularly for female farmers who may face additional barriers to accessing ICT tools.

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