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Dialing into Agricultural Innovation Via Mobile Phones: Experiences of Smallholder Cocoa Farmers in Sekyere South, Ghana

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ABSTRACT

Over the last two centuries, traditional methodologies for disseminating technologies to farmers have undergone significant evolution, paving the way for technology-based approaches. The study, therefore, investigated the use of mobile phones by smallholder cocoa farmers to access agricultural information. A survey design was employed, and a sample of 244 farmers was selected using a multi-stage sampling technique. Stata version 17 was used to analyse the data. The use of mobile phones by farmers for accessing agricultural information is relatively low. The most commonly accessed agricultural information via mobile phones includes cocoa market prices (26.63%), planting techniques (24.2%) and access to credit (24.18%). Cocoa farmers generally disagreed with using mobile phones for agricultural information, with mean indices of 2.46 for production, 2.50 for varieties, 2.28 for marketing, and 2.40 for practices. The binary probit model revealed that age (5%), years of education (5%), access to credit (10%), and years of farming experience (5%) significantly influence the use of mobile phones to access agricultural information. The cost of mobile phones is a primary challenge that farmers face in accessing agricultural information. Addressing these challenges will be instrumental in promoting the

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effective use of mobile phones for extension delivery, ultimately benefiting cocoa farmers and contributing to the development of the agricultural sector.

Keywords: Access, Agricultural Information, Cocoa farmers, Mobile Phone.

1. INTRODUCTION

With the introduction of modern technology, farmers' information needs are growing rapidly. Thus, farmers often find that their traditional knowledge, experience, and trial-and-error approach to making decisions for day-to-day activities are ineffective in changing conditions (Emeana *et al*., 2020; Rahman *et al*., 2020). The high cost of face-to-face interaction, crumbling extension services, and poor market information have paved the way for the use of modern information and communication technology (ICT), such as mobile phones, in disseminating agricultural information to targeted farmers (Rahman *et al*., 2020). According to Meera *et al*. (2004) and Caron (2020), the advent of new patterns of agricultural development has transformed old ways of delivering important agricultural information to clients. Meera *et al*. (2024) noted that, as the world becomes increasingly dynamic and complex, extension agents must look ahead and align themselves to capitalise on opportunities and address the challenges that arise. Therefore, to enhance their service delivery, extension agents should think creatively by continuously updating and expanding their information needs (Tsan *et al*., 2019).

The field of information and communication technology (ICT) has demonstrated its transformative potential by providing several avenues for disseminating knowledge and information (Aldosari *et al*., 2021). ICTs have become a prevalent trend for extension services, advocating communication technologies as the future of agricultural extension and offering cost-effective alternatives to face-to-face approaches (Tsan *et al*., 2019; Caron, 2020). For developing countries such as Ghana, where limited access to current farming knowledge hinders the adoption of modern agricultural technologies, this holds immense significance (Aker & Ksoll, 2016; Feng *et al*., 2021).

In the realm of information, technology serves as an intermediary. The proliferation of technology across various domains of human life has created the potential for the rapid and unimpeded acquisition of vast amounts of knowledge that undergo continuous updates, enhancements, and

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revisions (Kumar, 2021). Similarly, the use of mobile phone services in the agricultural industry facilitates the dissemination of information about market conditions, weather patterns, transportation logistics, and agricultural methodologies (Krell *et al*., 2021). This enables farmers to establish communication channels with pertinent authorities and departments (Khan, 2022).

The extensive integration of mobile phones has profoundly permeated various aspects of human life, encompassing domains such as education, commerce, trade, and agriculture (Krell *et al*., 2021). Mobile phones have emerged as the predominant mode of communication among various ICTs, with approximately 62.9% of the global population active users of this technology, equivalent to a staggering 4.68 billion individuals (Aldosari *et al*., 2021). The remarkable proliferation of mobile phones has transformed operational practices (Kassem *et al*., 2021) across industries and created new professional opportunities (Kumar, 2021), especially in agriculture (Balogun *et al*., 2022; Birner *et al*., 2021). According to Yao *et al*. (2022) and Khan *et al*. (2022), the use of mobile phones has demonstrated efficiency in cost savings, improved bargaining power, reduced barriers to market participation, and facilitated farmers' travel to better-paying markets (Abdul-Rahaman & Abdulai, 2022). Krell *et al*. (2021) argued that mobile phones have the potential to transform the lives of many smallholder farmers in a short time and at a low cost.

Mobile phones have empowered farmers within the agricultural sector, enabling communication across various levels, from local interactions to administrative matters such as trade, information dissemination, and the procurement of agricultural inputs (Kassem *et al*., 2021). They have reduced travel expenses and enhanced productivity in remote, rural regions (Krell *et al*., 2021). Mobile phones have proliferated in marginalised farming communities due to their adaptability, cost-effectiveness, and user-friendly features (Aker & Ksoll, 2016). Due to the diverse range of communication channels they offer, mobile phones have provided farmers with a novel means of making provisional judgements. Mobile phones can provide farmers with access to weather information, market prices, farming advice, improved decision-making, and reduced vulnerability to market fluctuations (Krell *et al*., 2021).

Typically, providing farm advisory services using traditional extension approaches necessitates a substantial deployment of extension agents (Yao *et al*., 2022). However, Peng (2022) indicated

that the current number of extension agents falls short of meeting the information needs of agricultural communities. This insufficiency contributes significantly to the communication gap between farmers and extension agents (Rahmiati *et al*., 2022). Furthermore, interventions aimed at delivering agricultural information to farmers through mobile phones have presented farmers with straightforward access to information. According to Khan *et al*. (2022), there is contention that communication technologies hold the key to the future of agricultural extension, rendering the traditional face-to-face extension system economically unviable. This argument is based on the potential of cellular phones to replace the need for in-person extension services. Therefore, we can argue that mobile phones can meet most of the basic needs of agricultural communities by enabling two-way communication between farmers and service providers (Mbunda & Kapinga, 2021).

The existing literature extensively explores various aspects of mobile phone usage among farmers, emphasising its significance in communication, market access, and agricultural growth (Krell *et al*., 2021; Yao *et al*., 2022; Kassem *et al*., 2021; Mapiye *et al*., 2021; Mapiye *et al*., 2025; Abdul-Rahman & Abdulai, 2022; Neha *et al*., 2018). According to Khan *et al*. (2022), the widespread use of mobile phones among farmers has emerged as a vital tool for communication, reducing transportation costs, and enhancing access to markets and information. Furthermore, several researchers have focused their efforts on examining the impact of mobile phone usage among farmers on agricultural growth progress (Birner *et al*., 2021; Khan *et al*., 2022; Balogun *et al*., 2022; Haruna *et al*., 2018; Krell *et al*., 2021; Mehta, 2013). A growing body of research has also examined the utilisation of mobile phones by agricultural officers (Idrisa *et al*., 2013). Other studies by Li *et al*. (2020) and Mbunda and Kapinga (2021) suggest that mobile phones have had a positive and significant impact on improving and modernising the agricultural industry. Naveed and Hassan (2021), Kitole *et al*. (2023), Emeana *et al*. (2020), Rahman *et al*. (2020), and Aparo *et al*. (2022) have all investigated the constraints that farmers face when using mobile phones to access information. Despite the complexity of the factors influencing mobile phone adoption and use (Feng *et al*., 2021; Rahmiati *et al*., 2022; Nyagango *et al*., 2023; Lee *et al*., 2018; Mbunda & Kapinga, 2021; Ma *et al*., 2018), these factors have received little attention. This leaves a gap in understanding the dynamics of mobile phone usage for accessing agricultural information. This gap underscores the need for further research to better comprehend the complex relationships between socioeconomic characteristics and mobile phone usage patterns in cocoa farming.

The study, therefore, aims to examine how smallholder cocoa farmers integrate mobile phones into their agricultural practices for innovation. Specifically, the study intended to examine the nature of agricultural information farmers access via their mobile phones, assess their perceptions of the use of mobile phones for accessing agricultural information, determine the socioeconomic factors that influence farmers' use of mobile phones for accessing agricultural information, and identify the challenges faced by cocoa farmers in using mobile phones for accessing agricultural information.

This research makes a novel contribution by pioneering an exploration of technology adoption patterns among smallholder cocoa farmers, with a particular emphasis on the use of mobile phones to access critical agricultural information. Through a nuanced analysis of socio-demographic factors, including age, education level, access to credit, and years of farming experience, the research reveals the underlying determinants shaping technology adoption in these communities. Additionally, our study breaks new ground by conducting a comprehensive assessment of farmers' perceptions across diverse categories, including production, varieties, marketing, and agricultural practices. By uncovering both the perceived benefits and challenges associated with mobile phone usage in agriculture, we offer a nuanced understanding of the digital landscape in rural farming contexts. Importantly, by pinpointing specific obstacles hindering the effective use of mobile technology, the study equips policymakers and stakeholders with actionable insights to develop targeted interventions and initiatives that aim to increase agricultural productivity and support smallholder cocoa farmers in Ghana. Thus, this research represents a significant step forward in the discourse on ICT adoption in agriculture, paving the way for tailored solutions to address the unique challenges faced by cocoa farmers in this region.

2. METHODOLOGY

2.1. Study Area

The Sekyere South District (formerly Afigya Sekyere District) is one of the 261 Metropolitan, Municipal, and District Assemblies (MMDAs) in Ghana, and forms part of the 43 MMDAs in the Ashanti Region, with its administrative capital located in Agona. The Sekyere South District, located in the northeastern part of the Ashanti Region, is 37 kilometres from Kumasi, along the Kumasi-Mampong trunk road. The district has a total land area of 416.8 square kilometres,

representing approximately 1.7 percent of the region's total land size of 24,389 square kilometres. It shares common borders with Ejura Sekyedumase Municipal to the north, Mampong Municipal and Sekyere East district to the east, Kwabre East Municipal to the south, and Offinso Municipality to the west. The population of the district according to the 2021 Population and Housing Census stands at 120,076 (SSDA, 2024).

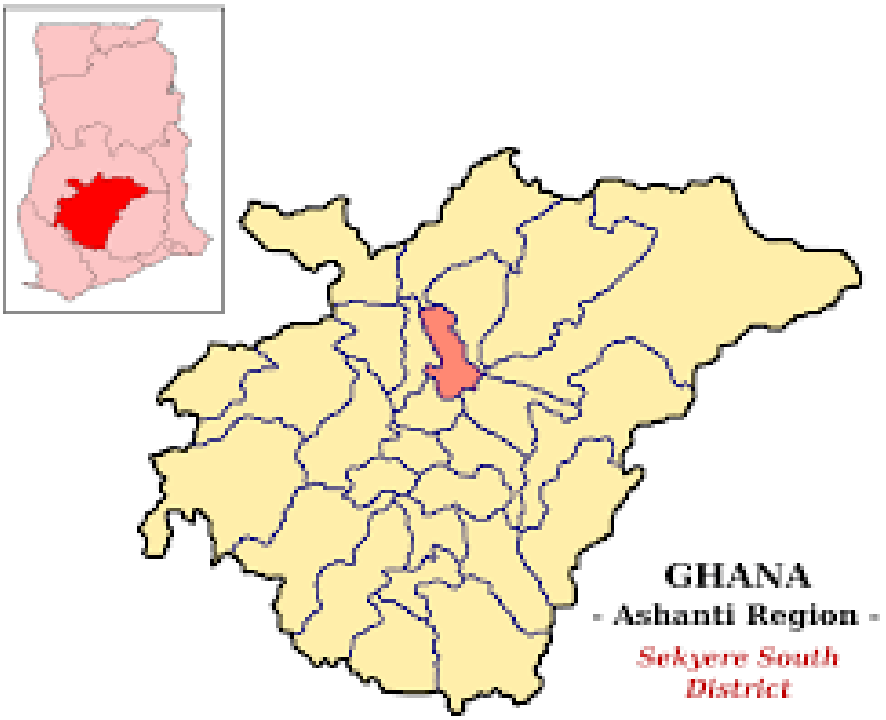


FIGURE 1: Map of Sekyere South District

2.2. Study Design

The study employed a cross-sectional research design. A cross-sectional research design is an approach where data is collected from a sample at a single point in time, offering a snapshot of their characteristics, behaviours, or attitudes without longitudinal tracking. Researchers select a representative sample and gather data through surveys, analysing it to identify patterns or relationships between variables. This design enables comparisons across different groups within the sample based on various factors, facilitating the exploration of associations or differences.

2.3. Study Population, Sample Size and Sampling Procedure

The study encompassed all cocoa farmers within the district, ensuring comprehensive coverage of the target population. The total population of registered cocoa farmers in the district from which the sampling frame was developed is 628. The sample size of 244 cocoa farmers was determined using Yamane's (1967) formula. This approach facilitated the selection of a representative subset of participants, allowing for meaningful insights into the perceptions, behaviours, and practices of cocoa farmers regarding the use of mobile phones for accessing agricultural information.

This study employed a multi-stage sampling approach, comprising several sequential steps, to ensure a representative selection of participants. Initially, the district was selected using a simple random sampling technique, where each district had an equal chance of being chosen. There are 15 cocoa districts in the Ashanti Region of Ghana. Subsequently, we selected four cocoa-growing communities (by ballot) out of approximately 20 (Jamasi, Wiamoase, Kona, and Boanim) using the same simple random sampling method, ensuring unbiased representation. Finally, we further sampled individual respondents from these selected communities using a simple random sampling procedure (balloting), giving each member of the community an equal chance of selection, thereby enhancing the overall representativeness of the study population. To develop the sampling frame, we obtained a comprehensive list of all registered cocoa farmers in each community. We then assigned a unique number to everyone in the sampling frame, thus assigning one (1) to 628. We wrote each unique identifier on a separate slip of paper, mixed them thoroughly, and drew the required number of slips. This multi-stage sampling approach aimed to systematically capture a diverse range of perspectives and experiences within the targeted population, facilitating robust analysis and interpretation of the research findings.

2.4. Research Instrument and Data Collection

Primary data collection was conducted through the administration of structured questionnaires designed to address the research objectives. The questionnaires were tailored to align closely with the specific aims of the study, ensuring that the data gathered could effectively address the research questions at hand. The questions posed in the questionnaires predominantly employed closed-ended formats to facilitate streamlined data collection and analysis. This included farmers' socio-demographic characteristics, access to mobile phones and usage patterns, types of agricultural information accessed (e.g., on production, improved varieties, marketing, and best practices), and

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the frequency and sources of such information. Additionally, data were collected on the perceived benefits, limitations, and challenges associated with using mobile phones for agricultural purposes. Respondents were also asked to rank barriers to mobile phone use, providing quantitative inputs for the analysis of constraints affecting mobile-based agricultural communication.

Researchers collected data directly from farmers while they were either at home or on their farms. This took a period of three weeks (March 2023). Two trained research assistants were engaged to assist with the data collection procedure. Questionnaires were designed in English but interpreted into the Akan language to aid quick understanding and response by the respondents. To enhance reliability, we implemented measures such as pilot testing with 20 respondents from Bepoase (within the Sekyere South District) to identify and address any ambiguities or issues with the questionnaire before full-scale data collection, thereby improving the reliability of the instruments. We ensured validity through aligning the research questions with the study objectives and using appropriate data collection instruments. We designed structured questionnaires to capture relevant variables and concepts related to the research objectives, thereby enhancing content validity.

2.5. Ethical Considerations

We implemented several measures to uphold ethical principles to the best of our ability. We provided participants with clear and comprehensive information about the study's purpose, their voluntary participation, and the use of their data. We obtained informed written consent from all participants before including them in the survey. There is no possibility of linking the data collected to specific individuals. We provided ample time for participants to provide their questionnaire responses, free from any form of pressure or coercion. We did not provide any financial incentives. We instructed participants to omit any uncomfortable questions and advised them to approach the questionnaire with careful consideration. Crucially, we did not include any inquiries or tasks that could result in bodily injury or induce psychological anguish, such as stress, anxiety, or depression, among the participants. Ultimately, we affirm that we are the authentic creators of this work. In light of these considerations, we present the findings of this study with transparency and integrity, acknowledging the limitations and expressing a commitment to upholding ethical principles in our research.

2.6. Data Analysis

We employed descriptive statistical methods, including frequency and percentage analysis, to examine farmers' responses regarding their demographics and access to information via mobile phones. By presenting farmers with a diverse array of agricultural information topics and asking them to indicate which ones they accessed through mobile phones, we aimed to capture a nuanced understanding of the specific types of information used by farmers in their decision-making processes (Aregaw *et al*., 2023).

To assess the perception of cocoa farmers regarding the use of mobile phones for accessing agricultural information, we employed a structured measurement approach using a five-point Likert scale. This scale, ranging from "strongly disagree" to "strongly agree," enabled farmers to express their level of agreement or disagreement with statements about the utility of mobile phone-based access to agricultural information. By offering a continuum of response options, from "strongly disagree" to "strongly agree," the Likert scale facilitated a nuanced understanding of farmers' attitudes and viewpoints regarding this technology-driven information dissemination paradigm. This methodological choice enabled us to capture the spectrum of opinions among cocoa farmers, providing valuable insights into their perceptions and preferences regarding the use of mobile phones for accessing agricultural information.

We employed the binary probit model to determine the socioeconomic factors influencing farmers' use of mobile phones to access agricultural information. We selected this model due to the dichotomous nature of the dependent variable, where a value of one (1) signified farmers who accessed agricultural information through mobile phones, and a value of zero (0) indicated those who did not. While useful for analysing binary outcome variables, the probit model has the limitation of assuming a normally distributed error term, which may not always align with real-world data distributions. Furthermore, interpreting the coefficients can be complex because they represent changes in the latent variable rather than direct changes in the outcome probability. It is also sensitive to outliers and influential data points, which can distort the estimation (Srimaneekarn *et al*., 2022). The technique allowed us to analyse the relationship between various socioeconomic factors and the likelihood of farmers using mobile phones to access agricultural information. The binary probit model helped determine the likelihood that farmers would use their phones to access

agricultural information, based on factors such as gender, age, marital status, farm size, education level, and other socioeconomic characteristics. This was achieved by comparing the binary outcome variable (whether farmers use or do not use phones to access agricultural information) to a set of predictor variables that identified those factors.

The study operationalised the dependent variable, which represents the use of mobile phones for accessing agricultural information, as a binary outcome, with a value of 1 indicating "yes" (use) and a value of 0 indicating "no" (not use). To determine the average usage pattern, the responses for each type of agricultural information accessed via mobile phones were aggregated, resulting in a cumulative score. We then averaged this cumulative score across all respondents to determine a mean cut-off point. We calculated the mean cut-off point in this case as the sum of the responses (e.g., 9 for "yes" and 0 for "no"), yielding a total of 9. We divided this total by 2 to arrive at a mean value of 4.5. We established a threshold based on this mean value, classifying responses below 4.5 as "not use" (0) and those above 4.5 as "use" (1). This re-categorisation enabled the grouping of respondents' mobile phone use into two categories, allowing for more in-depth research into the factors that affect usage patterns (Nyagango *et al*., 2023). We selected a range of predictor variables, including both continuous and discrete factors, to calculate the expected values of the outcome variable. Previous studies, such as Krell *et al*. (2021), Spencer *et al*. (2022), and Zheng and Ma (2023), influenced the selection of these variables.

The equation is represented as; $P_i = F(Z_i) = F(x+\beta X_i) = \frac{1}{1+e^{-Z_i}} = \frac{1}{1+e^{-(x+\beta X_i)}}$

where e represents the base of natural logarithms, Pi is the probability that an individual farmer would decide to use a mobile phone for accessing agricultural information (0-No, 1-Yes), given Xi, where Xi is the set of explanatory variables that influence the use of the mobile phones (Table 1), and β is the coefficients of the explanatory variables.

We identified the challenges faced by cocoa farmers by using mobile phones to access agricultural information using Kendall's coefficient of concordance. Kendall's Coefficient of Concordance is a statistical measure used to assess the level of agreement or concordance among multiple observers or raters when ranking or rating a set of items or variables. Farmers were asked to rank the identified challenges in order of severity, from one (1) (most severe) to nine (9) (least severe).

3. RESULTS AND DISCUSSION

3.1. Socio-Demographic Characteristics of Farmers

TABLE 1: Socio-Demographic Characteristics of Farmers

Variables	Measurement	A-prior Expectation	Frequency	Percent
Sex				
Female	Dummy: 1-Male, 0-Female	+/-	98	40.2
Male			146	59.8
Religion				
Christian	Dummy: 1-Christian, 0-Others	+/-	223	91.4
Muslim			21	8.6
Marital status				
Married	Dummy: 1-Married, 0-Others	+/-	172	70.5
Divorced	(Divorced, single, widowed)		17	7.0
Single			20	8.2
Widowed			35	14.3
Age				
20-30	Continuous: years	+	10	4.1
31-40			25	10.2
41-50			41	16.8
51 above			168	68.9
Level of education				
Junior High School	Continuous: years	+	103	42.2
None			82	33.6
Primary			46	18.9
Senior High School			8	3.3
Tertiary			5	2.0
Land ownership type				
Family land		+/-	112	45.9

Hired	Dummy: 1-Own, 0-Others		12	4.9
Leased land	(Family, hired, lease)		6	2.5
Own			114	46.7
Farm size				
0.5-2	Continuous: acres	+/-	22	9.0
3-5			100	41.0
5-10			91	37.3
Above 11			31	12.7
Access to credit				
No	Dummy: 1-Yes, 0-No	+/-	235	96.3
Yes			9	3.7
Years of Farming				
1-3	Continuous: years	+/-	16	6.6
4-6			18	7.4
7-10			50	20.5
Above 11			160	65.6
Household size				
1-3	Continuous: number of persons	+/-	49	20.1
4-6	living in a house		120	49.2
7-10			61	25.0
Above 10			14	5.7
Membership of cooperative				
No	Dummy: 1-Yes, 0-No	+/-	12	4.9
Yes			232	95.1
Ownership of mobile phone				
No	Dummy: 1-Yes, 0-No	+/-	39	16.0
Yes			205	84.0

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In Table 1, approximately 59.8% of the respondents were males, indicating a predominance of male farmers among the respondents. This gender distribution highlights the male-dominated nature of the cocoa farming communities within the study area (Alao *et al*., 2020). The majority (68.9%) of respondents were aged 51 and above, indicating that older individuals primarily engage in cocoa farming, which may impact the adoption of new agricultural practices and technologies (Adebayo *et al*., 2021). The religious composition of the respondents revealed that an overwhelming majority (91.4%) identified as Christians, while 8.6% identified as Muslims. Marital status revealed that a significant portion (70.5%) of the cocoa farmers were married. This high percentage of married farmers indicates that these individuals may have significant family responsibilities, which could affect their ability to allocate resources and time to their farming activities (Pierotti *et al*., 2022).

The respondents' education levels varied, with approximately 42.2% having completed junior high school. This relatively low level of education may influence their ability to access and use agricultural information and innovations. Most (46.7%) of the farmers owned their farming lands, providing them with more control over their farming practices and potential investments in land improvements. In terms of farm size, most (41%) of the sampled farmers owned between three (3) and five (5) acres of land. This relatively small farm size could limit economies of scale and the potential for mechanisation. Access to credit was severely limited, with 96.3% of farmers reporting that they had no credit. This lack of financial resources can hinder their ability to invest in the necessary inputs and technologies to improve productivity (Alao *et al*., 2020).

The data also indicated that most respondents (65%) had been farming for more than 11 years, demonstrating a high level of experience in cocoa farming. However, long-term farming without adequate access to modern techniques and resources might not lead to significant productivity improvements (Sabasi *et al*., 2021). The respondents' household size revealed that about 49.2% had between four (4) and six (6) members. Larger households may have both positive and negative effects on farming, providing more labour but also increasing consumption needs (Pierotti *et al*., 2022). The majority (95.1%) of respondents were members of agricultural groups. Membership in these groups can facilitate access to shared resources, information, and support networks, potentially enhancing farming practices and outcomes. Additionally, 84.0% of the farmers owned

mobile phones, which could be a crucial tool for accessing agricultural information, market prices, communication with other farmers, and extension services (Jones *et al*., 2023).

3.2. Types of Agricultural Information Farmers Access through Mobile Phone

TABLE 2: Types of Agricultural Information Farmers Access through Mobile Phones (n=244)

Variables	Access through a mobile phone
New improved varieties	22.5
Weather information	20.9
New farming methods and practices	23.0
Diseases and pest control	22.1
Fertiliser application	22.1
Planting techniques	24.2
Government input subsidies	20.9
Cocoa market prices	26.63
Access to credit	24.18

Table 2 shows farmers in Sekyere South District who use mobile phones to access a variety of agricultural information. This indicates that a substantial percentage of farmers are not utilising their mobile phones to access essential agricultural information. Recent research suggests that although farmers have a high rate of mobile phone ownership, they do not extensively use it for agricultural purposes. Although more than 90% of farmers in Pakistan possess mobile phones, a significant number of them fail to efficiently utilise these devices for accessing agricultural information (Khan *et al*., 2012; Chhachhar *et al*., 2016).

Only 22.5% of respondents reported having access to information about new, improved varieties of cocoa. This suggests a potential gap in knowledge dissemination in this area, given the less frequent use of mobile phones as a source of information on new crop varieties. Only 20.9% of the respondents reported having access to weather information, while 79.1% reported lacking this information. Similarly, Aparo *et al*. (2022) and Chhachhar and Memon (2019) asserted that farmers have limited access to weather information.

About 23.0% of respondents have access to information on new farming methods and practices. This indicates that although a quarter of farmers use mobile phones to learn about modern farming techniques, the majority still lack this information, suggesting a need for increased outreach and education (Nyaplue, 2015). About 22.1% of respondents reported having access to information on diseases and pest control, while 77.9% reported not having access to this information through the phone. Rahmiati *et al*. (2022) demonstrated that in India, farmers tend to prefer seeking guidance from government agents overusing their mobile phones.

Similar to pest control, 22.1% of respondents have access to information on fertiliser applications. Only 24.2% of respondents have access to information on planting techniques. Approximately 20.9% of respondents reported having access to information on government input subsidies via their phone. Government subsidies can have a significant impact on farmers' operational costs, and the low access rate suggests a need for improved communication about available subsidies (Voica, 2022; Thapa *et al*., 2023).

Information on cocoa market prices is the most accessed category, with 26.63% of respondents reporting availability. This reflects a critical market information gap, which is essential for making informed economic decisions regarding cocoa sales. Knowing market prices helps them make strategic decisions about when to sell, and access to credit is essential for investing in their farms. The use of mobiles for these purposes underscores their role in economically empowering farmers. The increased use of market information also signifies its efficacy in agricultural practices (Tang *et al*., 2015). Only 24.18% of respondents reported having access to credit-related information. Credit is critical for financing agricultural inputs and operations, and the significant majority lack access, indicating a need for more effective credit information dissemination.

3.3. Perception of Cocoa Farmers Towards Mobile Phone Usage for Accessing Agricultural Information

TABLE 3: Perception of Cocoa Farmers Towards Mobile Phone Usage for Accessing Agricultural Information (n=244)

Statements	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Mean	Std. Dev.

	F (%)	F (%)	F (%)	F (%)	F (%)		
Production (Mean Index=2.46)							
Availability of cocoa farm implements.	113 (46.3)	58 (23.8)	6 (2.5)	16 (6.6)	51 (20.9)	2.31	1.593
Increasing my yield.	74 (30.3)	81 (33.2)	20 (8.2)	24 (9.8)	45 (18.4)	2.52	1.472
Improvement in the nutrient status of my soil.	75 (30.7)	76 (31.1)	22 (9.0)	24 (9.8)	47 (19.3)	2.55	1.490
Varieties (Mean Index=2.50)							
Information on new varieties of seeds.	80 (32.8)	77 (31.6)	18 (7.4)	24 (9.8)	45 (18.4)	2.49	1.489
Information on good varieties of cocoa beans seedlings.	76 (31.1)	85 (34.8)	14 (5.7)	20 (8.2)	49 (20.1)	2.51	1.500
Marketing (Mean Index=2.28)							
Packaging of my produce.	130 (53.3)	39 (16.0)	4 (1.6)	20 (8.2)	51 (20.9)	2.27	1.641
Contact potential buyers.	125 (51.2)	48 (19.7)	12 (4.9)	22 (9.0)	37 (15.2)	2.17	1.505
Prices of cocoa commodities.	107 (43.9)	50 (20.5)	18 (7.4)	20 (8.2)	49 (20.1)	2.40	1.580
Agricultural Practices (Mean Index=2.40)							
Control diseases and pest on my cocoa farm.	83 (34.0)	74 (30.3)	18 (7.4)	20 (8.2)	49 (20.1)	2.51	1.540

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Information on irrigation system.	145 (59.4)	33 (13.5)	10 (4.1)	18 (7.4)	38 (15.6)	2.06	1.528
Information on fertiliser application.	71 (29.1)	85 (34.8)	18 (7.4)	24 (9.8)	46 (18.9)	2.54	1.471
Information about pruning.	79 (32.4)	81 (33.2)	16 (6.6)	20 (8.2)	46 (18.9)	2.47	1.489

NB: Strongly disagree=1.00-1.49; Disagree=1.50-2.49; Neutral=2.50-3.49; Agree=3.50-4.49; Strongly agree=4.49-5.00

Table 3 provides insights into the perceptions of cocoa farmers across various categories: production, varieties, marketing, and agricultural practices. The mean index for the production category (2.46) indicates disagreement among cocoa farmers about the usefulness of mobile phones in obtaining information about production practices. This implies that most cocoa farmers do not perceive mobile phones as particularly useful tools for accessing information related to their production. Farmers may have limited access to relevant production information via mobile phones, either due to technological barriers such as poor network coverage or limited internet connectivity, or a lack of tailored content available through mobile platforms (Nyaplue, 2015; Erlangga *et al*., 2023). Additionally, farmers' preferences for traditional sources of agricultural knowledge, such as extension services or face-to-face interactions with agricultural experts, may influence their perceptions of the utility of mobile phones for production-related information (Jones *et al*., 2023). Furthermore, the discrepancy in perceived usefulness could stem from varying levels of familiarity or comfort with mobile technology among cocoa farmers. Those who are less adept at using mobile phones or who have limited exposure to digital tools may be less inclined to view them as effective means of accessing production information compared to those who are more technologically savvy (Abdulai *et al*., 2023).

The slightly higher mean index for the varieties category (2.50) indicates a relatively neutral perception among cocoa farmers about the usefulness of mobile phones in accessing information about new and improved varieties. This neutral perception could stem from the fact that farmers perceive mobile phones as potentially useful for accessing information on new cocoa varieties.

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However, they may also harbour doubts or uncertainties about the reliability or comprehensiveness of such information when delivered through digital channels. Additionally, farmers' experiences with mobile-based agricultural extension services or the quality of content available through mobile platforms may vary, leading to mixed perceptions among respondents (Abdul-Rahman & Abdulai, 2022).

The mean index of 2.28 in the marketing category, which is slightly lower than the scores in the previous categories, suggests that cocoa farmers disagreed regarding the usefulness of mobile phones for marketing purposes. Farmers may perceive limitations in the ability of mobile phones to effectively support their marketing efforts. This could include concerns about the reliability of mobile networks, access to relevant market information, or the ability to engage in direct marketing activities using digital platforms (Nyagango *et al*., 2023). This could stem from challenges or barriers they face in using mobile phones for marketing purposes (Lee *et al*., 2018). These may include limited access to mobile-based marketing platforms or services, inadequate training or technical support for leveraging mobile technology in marketing strategies, or a lack of awareness about the potential benefits of digital marketing tools (Idrisa *et al*., 2013).

The category of agricultural practices, with a mean index of 2.40, indicates that cocoa farmers disagreed on the effectiveness of mobile phones in providing information about agricultural practices. Although farmers may recognise the potential benefits of using mobile phones to access agricultural information, they may also harbour doubts about the reliability or accuracy of the information available through mobile channels, particularly in comparison to traditional extension services or expert advice (Nyaplue, 2015).

3.4. Socioeconomic Factors that Influence Cocoa Farmers' Use of Mobile Phones for Accessing Agricultural Information

TABLE 4: Socioeconomic Factors that Influence Cocoa Farmers' Use of Mobile Phones for Agricultural Information

Variables	Co-efficient (Std. Error)	Marginal effects
Sex	-0.0366	0.964
	(0.500)	(0.482)

Marital status	-1.312	0.269
	(0.861)	(0.232)
Age	1.502	4.491
	-3.265**	0.0382**
Years of education	0.698**	2.010**
	(0.290)	(0.584)
Farm size	0.222	1.249
	(0.256)	(0.32)
Access to credit	1.278*	3.591*
	(0.741)	(2.661)
Years of farming	0.822**	2.274**
	(0.399)	(0.908)
Religion	-0.606	0.546
	(0.554)	(0.302)
Household size	0.331	1.393
	(0.242)	(0.337)
FBO Membership	0.412	1.51
	(0.984)	(1.486)
Phone Ownership	0.194	1.215
	(0.627)	(0.761)
Constant	-5.486**	0.00414**
Number of obs. = 239; LR chi^2 (17) = 67.49; Prob > chi^2 = 0.000; Pseudo R^2 = 0.239		

NB: *** p<0.01, ** p<0.05, * p<0.1

Table 4 presents the various factors that contribute to the use of mobile phones for accessing agricultural information. We found statistical significance in the following factors: age, years of education, access to credit, and years of farming. The significant and negative correlation with mobile phone usage at a 5% significance level indicates that younger cocoa farmers are more inclined to use mobile phones for accessing agricultural information. This finding aligns with Nyagango *et al*.'s (2023) research, which also revealed a positive association between age and the

use of mobile phones for agricultural marketing information among farmers. Specifically, the study highlighted that younger farmers exhibit a greater propensity for such use compared to their older counterparts.

The significant and positive association between education and mobile phone usage at a 5% significance level suggests that cocoa farmers with more years of formal education are more inclined to use mobile phones for accessing agricultural information. The level of education of smallholder farmers serves as a crucial socio-demographic factor influencing their use of mobile phones for accessing agricultural information. This finding aligns with the research of Krell *et al*. (2021) and Khan *et al*. (2022), which identified a significant link between individuals' educational attainment and their use of mobile phones for obtaining agricultural marketing information. Rahman *et al*. (2020) observed that farmers with limited literacy skills were less likely to employ mobile phones to access agricultural marketing information.

The significant and positive relationship between access to credit and mobile phone usage, at a 10% significance level, indicates that cocoa farmers with access to credit are more likely to use mobile phones for agricultural information. Access to credit can facilitate the acquisition of mobile phones or subscriptions to access agricultural data, thus enhancing their use of mobile phones for accessing agricultural information. Moreover, the positive and significant relationship between years of farming experience and mobile phone usage at a 5% significance level suggests that cocoa farmers with more experience in cocoa farming are more likely to use mobile phones to access agricultural information. This observation is consistent with the notion that older individuals are typically the primary users of mobile phones for agricultural information (Krell *et al*., 2021). According to Aldosari *et al*. (2019), farmers with extensive farming experience may be hesitant to adopt mobile phone technologies for accessing agricultural information.

The coefficient for years of farming, which is 0.822, suggests a positive relationship between the duration of farming experience and the likelihood of using mobile phones for accessing agricultural information among cocoa farmers. This implies that as farmers gain more experience in cocoa cultivation over time, they are increasingly inclined to use mobile phones as tools for obtaining relevant agricultural information. This finding aligns with the notion that farmers with

longer tenure in the profession may develop a deeper understanding of the importance of being informed about evolving agricultural practices, market trends, and pest management strategies to optimise their productivity and profitability. As they accumulate practical knowledge and encounter various challenges and opportunities in their farming endeavours, experienced farmers may recognise the value of leveraging mobile technology as a convenient and accessible means of accessing timely and relevant agricultural information (Aldosari *et al*., 2019).

3.5. Challenges Faced by Cocoa Farmers in the Use of Mobile Phones for Accessing Information

TABLE 5: Challenges Faced by Cocoa Farmers in the Use of Mobile Phones for Accessing Information (n=244)

Challenges in using a mobile phone	Mean	Ranking
Cost of a mobile phone	2.16	1st
Cost of mobile data	3.08	2nd
Incomplete information	4.31	3rd
Unreliable mobile network	4.50	4th
Language barrier	4.57	5th
Digital literacy level	4.73	6th
Breaking up of sound	5.64	7th
Weak signal strength	7.46	8th
Frequent service interruptions	8.54	9th
N=244; Kendall's W[a]=0.530; Chi-Square=1034.458; df=8; Asymp. Sig.=0.00		

The application of Kendall's W coefficient (0.53) and chi-square statistics confirms a moderate level of consensus among respondents regarding the ranked challenges associated with mobile phone use in agriculture (Table 5). This level of agreement enhances the credibility of the rankings and underscores the importance of the identified issues within the context of agricultural communication.

Foremost among these challenges is the cost of mobile phones, which was ranked as the primary barrier. This highlights the financial burden of acquiring and maintaining a mobile device, which

remains a significant obstacle for many farmers (Erlangga *et al*., 2023). The cost of mobile data follows as the second major concern, reflecting the recurring expense of data packages. Even after obtaining a mobile phone, the affordability of data continues to limit farmers' ability to access information effectively (Wyche & Steinfield, 2016).

Incomplete information ranks third, highlighting the inadequacy of relevant, timely, and comprehensive agricultural content available on mobile platforms. This limits the usefulness of mobile phones as tools for informed decision-making and productivity enhancement (Erlangga *et al*., 2023). Addressing this may involve tailoring content to farmers' needs, integrating extension services into digital platforms, and ensuring the timely dissemination of locally relevant information. The fourth-ranked challenge, unreliable network coverage, highlights infrastructural limitations that hinder consistent communication. This calls for investment in mobile infrastructure—such as expanding coverage and enhancing reliability—to improve connectivity, especially in rural and remote areas (Mittal & Mehar, 2016).

The language barrier, ranking fifth, underscores the need for agricultural information to be delivered in local languages to facilitate effective communication and inclusivity. Closely following are concerns about digital literacy, breaking up of sound, and weak signal strength, which reveal usability and technological barriers that affect the effectiveness of mobile communication tools. Lastly, frequent service interruptions point to broader issues of network stability and service reliability in rural Ghana. These findings collectively emphasise the need for holistic interventions that combine technological, infrastructural, and educational strategies to enhance the role of mobile phones in agricultural development (Idrisa *et al*., 2013).

4. CONCLUSION

Despite the widespread availability and use of mobile phones for various activities, their usage among cocoa farmers for accessing cocoa market prices and credit-related information is relatively low, implying that mobile phones are not yet a critical tool for economic decision-making in cocoa farming, suggesting a reactive rather than proactive approach to farm management. The low usage of mobile phones for accessing agricultural information highlights a significant gap in knowledge transfer and the adoption of innovative farming techniques. Cocoa farmers' perceptions of the

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usefulness of mobile phones for accessing agricultural information vary widely, with many holding neutral views or disagreeing. Socio-demographic factors such as age, education level, access to credit, and years of farming experience significantly influence the likelihood of cocoa farmers using mobile phones to access agricultural information. Several key challenges hinder the effective use of mobile phones among cocoa farmers, including the cost of mobile phones and data, incomplete or unreliable information, poor mobile network coverage, language barriers, and issues related to digital literacy.

Based on the study's conclusions, we offer the following recommendations: The Ghana Cocoa Board could develop policies and initiatives to improve cocoa farmers' access to affordable mobile phones and data packages. There could be partnerships established between government agencies, telecommunications companies, and agricultural extension services to expand mobile network coverage in rural areas and ensure reliable connectivity for farmers. The launch of agricultural information campaigns that specifically target farmers, emphasising the advantages of mobile phone use for accessing valuable information, could be helpful. Technology organisations can also create user-friendly mobile applications and services tailored to the specific agricultural needs of farmers. These should include features for accessing information on crop varieties, weather forecasts, pest control, and other relevant topics. Content provided through mobile phones must be in local languages to overcome language barriers and make the information more accessible and understandable for all farmers.

We suggest two key areas for further study: conducting longitudinal studies to track changes in mobile phone usage over time among cocoa farmers, which will help identify trends, long-term impacts, and the sustainability of mobile phone adoption for agricultural purposes. Secondly, investigate the direct impact of mobile phone usage on agricultural productivity, income, and the livelihoods of farmers.

The reliance on self-reported data, as a limitation, can introduce bias, as respondents might overestimate or underestimate their mobile phone usage or other behaviours. The scope of mobile phone usage is limited. We did not explore in detail other potentially beneficial uses of mobile phones. The findings, as a cross-sectional study, provide a snapshot in time and do not account for

changes in mobile phone usage or other variables that may occur over time. The study did not fully account for external factors that could influence mobile phone usage, such as government policies, the presence of agricultural extension services, or the availability of mobile phone training programmes.

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