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Challenges to the Adoption of Mobile-Based Agricultural Extension Communication among Farmers in South-East Nigeria

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Abstract

The increasing use of mobile technologies has created opportunities for expanding agricultural extension communication and improving farmers' access to timely agricultural information. However, the potential of mobile-based extension communication may be constrained by technological, economic and user-related challenges. This study examined the challenges associated with farmers' adoption of mobile-based agricultural extension communication in South-East Nigeria. Specifically, it identified the mobile-based platforms used by farmers and examined infrastructural, economic and communication-related challenges associated with their adoption and use. The study adopted a descriptive survey design and collected data from 381 farmers across Anambra, Enugu, Ebonyi, Imo and Abia States. Data were collected using a structured questionnaire with a reliability coefficient of 0.82. Data were analysed using frequencies, percentages and mean scores, while qualitative responses were used to provide contextual explanations of the quantitative findings. The findings showed that farmers employed multiple mobile-based platforms for agricultural extension communication, with WhatsApp, SMS and Facebook emerging as the principal platforms. The major challenges identified were the cost of mobile data, frequent service breakdown and inadequate technical support. Other technology-access and communication-related factors were reported by some farmers but did not emerge as general barriers under the study's decision criterion. The study concludes that effective adoption of mobile-based agricultural extension communication depends not only on the availability of mobile platforms but also on affordable connectivity, reliable services and adequate user support. It recommends a multi-platform and farmer-centred extension approach, improved reliability of mobile services, affordable agricultural connectivity and continuous digital-literacy support, while maintaining complementary face-to-face extension services.

Keywords: mobile-based agricultural extension; agricultural communication; mobile platforms; farmers; adoption; digital agriculture; South-East Nigeria

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Introduction

Agriculture remains an important sector of the Nigerian economy, providing food, employment, income and raw materials for households and agro-allied industries. For farmers to make appropriate production and marketing decisions, however, access to agricultural resources alone is insufficient. Farmers require timely and relevant information on improved production practices, pest and disease management, weather conditions, farm inputs, markets and other agricultural innovations. Agricultural extension has traditionally provided an important mechanism for connecting farmers with such knowledge and innovations. Anderson and Feder (2004) describe agricultural extension as an important institutional mechanism for transmitting knowledge and information to farmers and supporting improved agricultural decision-making.

The effectiveness of agricultural extension communication depends considerably on the ability of extension systems to reach farmers when and where information is required. Conventional extension approaches, particularly face-to-face interaction, provide opportunities for demonstration, clarification and interpersonal engagement, but their reach can be constrained by geographical distance, transportation difficulties, limited extension personnel and inadequate institutional resources. These limitations have increased interest in communication technologies capable of complementing conventional extension systems and extending the reach of agricultural advisory services.

The expansion of mobile communication technologies has created new possibilities in this regard. Mobile phones can facilitate communication between farmers and extension personnel through voice calls, SMS and internet-enabled platforms such as WhatsApp and Facebook. Such platforms can provide channels for disseminating information on farming practices, weather conditions, pest and disease management, markets and other agricultural matters. Aker and Mbiti (2010) argue that mobile technologies can reduce information and communication barriers, particularly in contexts where conventional communication infrastructure is limited. In agricultural settings, mobile-enabled advisory services can therefore complement physical extension visits by allowing farmers to access information and communicate with extension personnel without necessarily waiting for face-to-face contact.

The potential of mobile technologies in agricultural extension has been documented in different developing-country contexts. Fabregas et al. (2019a), for example, demonstrate the value of agricultural information delivered through digital channels, particularly where information is locally relevant and available

when farmers need it. Similarly, Ayim, Kassahun, Addison & Tekinerdogan, (2022), in their review of ICT adoption in African agriculture, found that mobile and other ICT innovations have considerable potential for improving access to agricultural information, although adoption is influenced by infrastructural, economic, institutional and user-related factors.

The potential of mobile-based agricultural extension should therefore not be confused with actual or sustained adoption. A mobile platform may be available without being accessible to all farmers. Likewise, ownership of a mobile phone does not necessarily imply that the farmer can afford regular data services, possesses an appropriate internet-enabled device, has adequate digital skills or can obtain useful responses from agricultural extension personnel. Mobile-based agricultural extension is consequently situated within a broader digital-access environment in which affordability, connectivity, device ownership, user competence and the quality of information interact to determine the extent to which farmers can benefit from digital communication.

The Nigerian context illustrates these difficulties. Studies of mobile and ICT use in Nigerian agriculture have identified constraints including the cost of devices and communication services, inadequate network coverage, limited ICT literacy and insufficient awareness of relevant applications. For instance, Obayelu, Afolami, Folorunso, Adebayo & Ashimolowo (2022) found that mobile-based ICT use among agricultural value-chain operators in South-West Nigeria was associated with socio-economic and awareness factors, while high costs, network limitations and inadequate ICT literacy constituted barriers to effective use. Similarly, Abdullahi, Oladele, & Akinyemi, (2021) identified the cost of mobile phones and airtime, network connectivity, electricity supply and difficulties associated with mobile applications among the constraints affecting farmers' use of mobile applications for agricultural information.

The economic dimension of digital agricultural communication is particularly important. Mobile-based extension services increasingly depend on data-enabled devices and internet connectivity, making the cost of data a potential determinant of sustained use. This is especially relevant for farmers whose income may be seasonal and whose expenditure decisions are influenced by competing household and farm needs. Thus, even when farmers recognise the usefulness of mobile agricultural communication, the recurrent cost of accessing the service may discourage regular engagement.

Infrastructure presents another challenge. Reliable mobile communication depends on network availability and service stability, while internet-enabled devices also require regular access to electricity for charging. Poor network coverage, unstable connections and service interruptions can make mobile-based extension communication unreliable. The problem is not merely that information may fail to reach a farmer; repeated communication failures can also reduce confidence in the reliability of the platform and discourage farmers from incorporating it into their agricultural information-seeking practices.

The capacity of farmers to use mobile platforms constitutes a further dimension of adoption. Digital agricultural extension increasingly involves more than basic voice calls or text messages. Farmers may need to navigate applications, participate in digital groups, access multimedia content, interpret digital information and communicate with extension personnel. Consequently, digital competence and access to technical assistance can influence the extent to which farmers are able to use mobile-based extension services effectively. Ayim, Kassahun, Addison & Tekinerdogan, (2022) similarly identify limited user capacity and inadequate skills as important considerations in the adoption of ICT innovations in African agriculture.

The quality of the information and the nature of farmer-extension interaction also matter. Agricultural information delivered through mobile platforms needs to be relevant to farmers' crops, production conditions and immediate information needs. Information that farmers perceive as irrelevant may have limited practical value, even when it is technically accurate. Similarly, concerns about the authenticity of information can affect farmers' confidence in digital agricultural communication. Mobile-based extension also differs from one-way information dissemination because farmers may require opportunities to ask questions and obtain timely clarification from extension personnel. Thus, the responsiveness and interactive capacity of the extension service can influence farmers' willingness to depend on mobile platforms.

These issues are particularly significant in South-East Nigeria, comprising Abia, Anambra, Ebonyi, Enugu and Imo States. The region has a substantial farming population and a diverse agricultural economy, while mobile communication has increasingly become part of the environment through which farmers access agricultural information. Evidence from the existing literature indicates that mobile technologies have been examined in relation to agricultural information access and ICT adoption in Nigeria. However, much of this research has been conducted within individual states, particular agricultural value chains or broader national contexts. The literature therefore provides useful evidence about the potential and use of mobile technologies but does not sufficiently establish how multiple technological, economic, user-capacity, information and extension-service barriers are experienced collectively across the five states of South-East Nigeria. This is consistent with the broader literature gap identified in the previous researches, where existing studies were found to provide limited region-wide comparative evidence across the five South-East states.

This study addresses this gap by examining perceived barriers to mobile-based agricultural extension communication across Abia, Anambra, Ebonyi, Enugu and Imo States. Its contribution lies in identifying the conditions that constrain farmers' ability to adopt and rely on mobile-based extension communication. The study consequently examines three broad categories of challenges: technological and infrastructural barriers; economic and user-capacity barriers; information and extension-service barriers; and mobile-based platforms used by farmers in access information. By organising the investigation around these dimensions, the study provides a more focused account of the factors that may impede farmers’ adoption of mobile-based agricultural extension communication in South-East Nigeria.

Statement of the Problem

Agricultural extension communication is intended to bridge the information gap between agricultural knowledge producers and farmers. Through extension services, farmers are expected to obtain information capable of improving their production decisions, farm management practices and access to agricultural opportunities. Yet, conventional extension communication continues to encounter challenges relating to inadequate resources, limited extension personnel, geographical distance and the difficulty of maintaining regular contact with large numbers of farmers. Anderson and Feder (2004) emphasise that the effectiveness of extension depends not merely on the existence of an extension system but on the capacity of that system to respond to farmers' information needs.

Mobile-based agricultural extension communication has emerged as a potentially important mechanism for addressing some of these limitations. Through SMS, voice calls, WhatsApp, Facebook and other mobile platforms, farmers can potentially receive agricultural information without waiting for physical visits from extension personnel. Mobile communication can facilitate rapid dissemination of information and create opportunities for

continuing interaction between farmers and extension providers. Research across Africa confirms the potential of mobile-based ICT services to improve access to agricultural information, although adoption remains affected by technological infrastructure and users' capacities. (Ayim et al., 2022).

Despite this potential, the availability of mobile communication technology has not eliminated the information-access challenges confronting farmers. The central problem is that access to mobile technology does not automatically translate into adoption and effective use of mobile-based agricultural extension communication. A farmer may own a mobile phone but be unable to afford regular data subscriptions; may own a smartphone but experience poor network connectivity; may have network access but lack adequate technical skills; or may receive agricultural information without considering it sufficiently relevant or credible.

The economic dimension constitutes one important aspect of the problem. Mobile-based agricultural communication increasingly depends on data-enabled devices and internet services, yet the cost of smartphones, data and other communication services can restrict sustained use among farmers. Evidence from Nigeria shows that affordability remains an important barrier to mobile adoption, while recent GSMA evidence indicates that rural Nigerians experience substantial gaps between mobile ownership, ownership of internet-enabled devices and actual mobile internet use. This means that expanding digital agricultural extension without addressing affordability may reproduce rather than eliminate inequalities in access to agricultural information (GSMA, 2023: GSM Association & UK-SIDA).

Infrastructure presents another dimension. Mobile-based extension communication depends on reliable network connectivity and, for internet-enabled services, dependable electricity for charging devices. Poor network coverage, unstable service and frequent breakdowns can interrupt communication and reduce farmers' confidence in digital extension services. Abdullahi et al. (2021) identified poor network, poor power supply and high communication costs among important constraints to farmers' use of mobile applications in agricultural information sharing. (GSMA, 2023) similarly reports that network quality remains an important barrier to greater mobile internet use in rural areas.

The availability of appropriate devices is also problematic. Mobile-based agricultural extension is not a single technology. Basic phones may support voice calls and SMS, whereas WhatsApp, Facebook and other multimedia services generally require internet-enabled smartphones. Farmers who have limited access to appropriate devices may therefore be excluded from some forms of digital agricultural communication even when mobile networks are available. Obayelu et al. (2022) similarly identified the relatively high cost and limited availability of mobile ICT technologies as barriers to adoption among agricultural value-chain operators in Nigeria.

Human capacity represents another important problem. Farmers need sufficient knowledge and digital competence to navigate mobile applications, search for information, communicate with extension personnel and interpret digital agricultural content. However, access to a digital device does not necessarily imply the capacity to use it effectively. Ayim et al. (2022) identified low user skills, particularly among farmers, as one of the factors constraining ICT adoption in African agriculture. Thus, the provision of mobile agricultural platforms without corresponding technical support and farmer training may produce limited adoption.

There is also a content and credibility problem. Agricultural communication is useful only when the information delivered is relevant to the farmer's specific production circumstances. Farmers may receive information that does not correspond with their crops, location, farming conditions or immediate production problems. Similarly, information received through mobile platforms may not always be perceived as authentic or sufficiently authoritative. The credibility of agricultural information becomes particularly important in a digital environment where farmers may receive information from extension officers, commercial actors, fellow farmers and unidentified online sources through the same or similar platforms.

The relationship between farmers and extension officers creates another challenge. Mobile-based extension is expected to facilitate more immediate communication between farmers and agricultural professionals. However, if farmers cannot obtain timely responses to their enquiries, the perceived usefulness of the technology may decline. Mobile communication therefore requires not only a technological channel but also an institutional response mechanism through which extension personnel can receive, process and respond to farmers' questions.

These problems are particularly relevant to South-East Nigeria. Although mobile technologies are already used for agricultural information exchange in the region, earlier research has demonstrated that mobile telephony adoption and utilisation among rural farmers are affected by constraints. More recent research has similarly examined factors associated with mobile-smartphone use for agricultural information among rural farmers in the South-East. Okeke, Eze, & Nwachukwu, (2026). The existence of these studies suggests that mobile agricultural communication is not a new phenomenon in the region; rather, the unresolved issue concerns what continues to impede its effective and sustained adoption. The present study addresses this problem by investigating the specific impediments to farmers' adoption of mobile-based agricultural extension communication in South-East Nigeria. Rather than merely establishing whether farmers use mobile platforms, the study examines the conditions that make adoption difficult. The study is therefore necessary because without a clear understanding of these constraints, interventions may concentrate on expanding mobile platforms without addressing the factors that prevent farmers from using them effectively. Identifying the major barriers can provide evidence for designing extension systems that combine technological innovation with affordability, reliable infrastructure, digital support, relevant information and effective farmer-extension interaction.

Research Objectives

The objectives of this study are to:

1. Identify the mobile-based platforms used by farmers for agricultural extension communication in South-East Nigeria.
2. Examine infrastructural barriers to farmers’ adoption of mobile-based agricultural extension communication in South-East Nigeria.
3. Assess economic barriers to farmers’ adoption of mobile-based agricultural extension communication in South-East Nigeria
4. Examine communication barriers to farmers’ adoption of mobile-based agricultural extension communication in South-East Nigeria

Research Questions

1. What mobile-based platforms do farmers use for agricultural extension communication in South-East Nigeria?
2. What infrastructural barriers affect farmers' adoption of mobile-based agricultural extension communication in South-East Nigeria?
3. What economic barriers affect farmers' adoption of mobile-based agricultural extension communication in South-East Nigeria?

4. What communication barriers affect farmers' adoption of mobile-based agricultural extension communication in South-East Nigeria?

Conceptual Framework

Mobile-Based Agricultural Extension Communication

Mobile-based agricultural extension communication refers to the use of mobile communication technologies to facilitate the creation, transmission, exchange and utilisation of agricultural information between extension personnel, farmers and other agricultural stakeholders. It extends agricultural advisory services beyond conventional face-to-face encounters by enabling information to be communicated through mobile phones and related platforms. These technologies include short message service (SMS), mobile applications, social networking platforms and other mobile-enabled communication channels. Mobile-based communication is particularly relevant to agricultural extension because farmers require timely information on improved production practices, pest and disease management, weather conditions, input use, market opportunities and other farm-related decisions (Aker & Mbiti, 2010; Qiang, kuek, Dymond & Esselaar 2012).

The expansion of mobile technologies has created opportunities for agricultural extension systems to improve the accessibility and timeliness of agricultural information. Unlike conventional extension approaches, which may depend heavily on physical visits by extension officers, mobile communication allows information to be transmitted across geographical distances and can facilitate more frequent interaction between farmers and extension providers. Aker (2011) observes that information and communication technologies can strengthen agricultural extension by reducing information barriers and improving farmers' access to advisory services. Similarly, Fabregas et al. (2019b) demonstrate that access to locally relevant agricultural information through digital channels can influence farmers' decision-making and the value they derive from extension information.

Mobile-based agricultural extension communication is also multi-directional. While traditional extension communication has often been characterised by the movement of information from extension agents to farmers, mobile platforms can facilitate interaction in which farmers ask questions, seek clarification, share experiences and provide feedback. Social media platforms such as WhatsApp and Facebook can therefore serve both informational and interactive communication functions. Fadipe, Ilori, Adewunmi, & Oladele, (2024) found that social media has become relevant to agricultural extension service delivery because it provides additional channels through which extension information can be accessed and communicated.

In the context of South-East Nigeria, mobile-based agricultural extension communication is particularly important because farmers are distributed across urban, semi-urban and rural communities, making continuous face-to-face extension contact difficult. The use of mobile platforms can potentially complement conventional extension systems by creating additional channels for agricultural information dissemination. However, the existence of mobile technologies does not automatically translate into effective use. Farmers' ability and willingness to use such technologies depend on access, affordability, digital skills, network availability, trust in information and the relevance of the information provided.

Adoption and Use of Mobile-Based Agricultural Extension Communication

Adoption refers to the decision and process through which an individual accepts and begins to use an innovation, while use concerns the actual utilisation of the innovation in practice. Rogers (2003) explains adoption as a process through which an individual or other decision-making unit moves from initial awareness of an innovation to acceptance and eventual use. In the context of agricultural extension communication, adoption therefore involves farmers' acceptance and utilisation of mobile-based channels for obtaining, exchanging and applying agricultural information.

The adoption of mobile-based agricultural extension communication is not determined solely by whether farmers possess mobile phones. Access to a device is only one component of adoption. Effective use also requires that farmers understand how the platform operates, consider the information useful and relevant, have sufficient network access and can afford the associated costs. The Technology Acceptance Model (TAM) developed by Davis (1989) provides a useful explanation of technology use by emphasising perceived usefulness and perceived ease of use as important determinants of users' acceptance of technology. Applied to agricultural extension, farmers are more likely to use a mobile platform when they perceive that it provides useful agricultural information and is sufficiently easy to operate.

The Diffusion of Innovations perspective similarly explains adoption in terms of how individuals perceive an innovation and its characteristics within a social system. Rogers (2003) identifies relative advantage, compatibility, complexity, trialability and observability as important characteristics influencing the rate at which innovations are adopted. These characteristics are relevant to mobile-based agricultural extension because farmers are more likely to adopt a platform when it provides clear advantages over existing communication methods, fits their farming and communication practices and is not perceived as excessively difficult to use.

Empirical studies indicate that the adoption of mobile technologies in agriculture is influenced by both technological and socio-economic conditions. Obayelu et al. (2022), for example, identified factors associated with the use of mobile-based information and communication technologies among agricultural value-chain operators in Nigeria. Similarly, Sa'adu, Man, Kamarulzaman, Shah, & Tafida. (2022) reported that access to and effective use of information and communication technologies among agricultural extension personnel can be affected by institutional and technological conditions.

Adoption should therefore be understood as more than mere possession of a mobile phone. A farmer may own a smartphone but make little or no use of it for agricultural extension information. Conversely, another farmer may regularly use SMS, WhatsApp or other platforms to obtain agricultural advice. The distinction is important to the present study because the concern is not simply whether farmers have access to mobile devices but whether they use mobile-based platforms for agricultural extension communication and what factors constrain that use.

Challenges to the Adoption and Use of Mobile-Based Agricultural Extension Communication

Although mobile technologies provide opportunities for expanding agricultural extension communication, their adoption and use may be constrained by technological, economic, informational, institutional and user-related factors. These challenges can affect both farmers' ability to access mobile platforms and their willingness to depend on them for agricultural information.

One important constraint is the affordability of mobile communication. Farmers may incur expenses for mobile data, airtime, smartphones and electricity for charging devices. Where agricultural households have limited financial resources, the recurring cost of data may discourage sustained use of internet-dependent platforms. This makes affordability an important dimension of digital agricultural communication, particularly where farmers depend on mobile services for regular access to information.

Network connectivity is another major challenge. Mobile-based agricultural extension communication depends on telecommunications infrastructure, and poor network coverage or service interruptions can prevent farmers from receiving information when it is needed. Aker and Mbiti (2010) note that although mobile phones can reduce information constraints in developing countries, their benefits can be limited by infrastructure and access conditions. Similar concerns have been identified in studies of agricultural information and communication technology adoption in African farming communities (Ayim et al., 2022).

Digital literacy also influences farmers' capacity to use mobile-based agricultural communication effectively. Farmers may have access to mobile devices but lack the skills required to navigate applications, retrieve information, participate in digital groups or evaluate information obtained through online platforms. Training and technical support are therefore important components of effective digital agricultural extension. Ugwoke, Babalulu, Anorue, & Amusa, (2020), for instance, emphasised the importance of technology-related training needs among farmers in Enugu State.

The relevance and credibility of agricultural information constitute additional challenges. Agricultural information obtained through mobile platforms may not always correspond with farmers' specific crops, locations, production conditions or immediate information needs. Similarly, farmers may question the authenticity of information received through digital channels, particularly where the source is unclear. Fabregas, Kremer, & Schilbach, (2019a) demonstrate the importance of locally relevant agricultural information, suggesting that the value of digital agricultural advisory services depends partly on the usefulness of the information supplied to farmers.

Another challenge concerns interaction between farmers and extension personnel. Agricultural extension is not limited to one-way dissemination of information; it also involves consultation, clarification, diagnosis of problems and feedback. Where mobile platforms do not provide adequate opportunities for real-time interaction, farmers may continue to rely on face-to-face extension services. This is particularly significant when farmers encounter complex agricultural problems that cannot be adequately addressed through brief messages. Language can also constitute a barrier. Where agricultural information is predominantly communicated in English or in technical terminology that farmers find difficult to understand, the availability of information does not necessarily guarantee comprehension or application. Consequently, effective mobile-based agricultural extension requires attention not only to technological accessibility but also to the linguistic and contextual appropriateness of information.

These challenges demonstrate that adoption of mobile-based agricultural extension communication is a multidimensional process. Technological availability alone is insufficient. Effective adoption requires an enabling environment in which farmers can afford mobile services, access reliable networks, understand and evaluate information, obtain technical support and interact meaningfully with extension personnel.

Mobile-Based Agricultural Extension Communication and Agricultural Information Access

Agricultural information is an important resource for farmers because decisions concerning production, pest and disease control, input use, weather conditions, marketing and farm management often depend on access to timely and relevant knowledge. Agricultural extension communication provides an important mechanism for connecting farmers with such information. Mobile technologies have expanded the channels through which this communication can take place.

The major communication advantage of mobile-based extension is its potential to improve the speed and reach of information dissemination. Information can be transmitted to multiple farmers without requiring an extension officer to physically visit each farm. Qiang et al. (2012) note that mobile applications can support agricultural and rural development by improving access to information and services. Aker (2011) similarly argues that information and communication technologies can strengthen extension by addressing information constraints associated with conventional agricultural communication systems. Mobile communication can also support continuity in the extension relationship. Farmers can retain access to information beyond scheduled physical visits and can communicate with extension personnel when specific needs arise. WhatsApp and other social media platforms can further facilitate group communication, allowing farmers to exchange experiences and information among themselves while also interacting with agricultural professionals. This creates opportunities for a more participatory form of agricultural extension communication.

However, the effectiveness of mobile-based agricultural communication depends on the quality of information and the conditions under which it is accessed. Information that is timely but irrelevant to farmers' production circumstances may have limited practical value. Likewise, information that is technically accurate but difficult to understand may not produce meaningful communication outcomes. The communication process therefore involves more than transmission; it requires accessibility, comprehension, relevance, credibility and the opportunity for feedback. The relationship between mobile communication and agricultural information access can consequently be understood as a communication process involving the interaction of technology, information and users. Mobile platforms provide the channel, agricultural extension provides the informational content, and farmers constitute the primary users and interpreters of the information. Barriers such as high data costs, poor network connectivity, inadequate digital skills, limited access to devices, distrust and weak interaction can disrupt this process.

For farmers in South-East Nigeria, therefore, the usefulness of mobile-based agricultural extension communication depends on whether these technologies can complement existing extension structures and respond to the actual communication needs of farmers. The study focuses on the barriers that may prevent this potential from being fully realised across Abia, Anambra, Ebonyi, Enugu and Imo States. By examining these constraints, the study provides a basis for understanding the communication conditions necessary for more effective use of mobile-based agricultural extension services.

Theoretical Framework

The Diffusion of Innovations theory, developed by Rogers (2003), explains how an innovation is communicated through particular channels over time among members of a social system. The theory identifies perceived characteristics of an innovation, including relative advantage, compatibility, complexity, trialability and observability, as factors that influence its adoption.

The theory is relevant to mobile-based agricultural extension communication because mobile platforms represent an innovation in the way agricultural information can be exchanged between farmers and extension personnel. Farmers are more likely to adopt such communication technologies when they perceive them as useful, compatible with their farming and communication practices, sufficiently easy to use and capable of providing observable benefits.

The theory also helps explain the barriers identified in this study. High data costs and limited access to suitable devices may reduce the perceived feasibility of adoption; difficulty operating applications may increase perceived complexity; poor network

connectivity and service interruptions may undermine the reliability of the innovation; while irrelevant or untrusted information and inadequate interaction with extension officers may reduce farmers' perception of the usefulness and compatibility of mobile-based extension communication. Thus, DOI provides an appropriate theoretical lens for understanding why farmers may adopt, delay adopting or experience difficulty sustaining the use of mobile-based agricultural extension communication.

Methodology

The study adopted a descriptive cross-sectional survey design. The design was considered appropriate because the study sought to describe farmers' reported use of mobile-based platforms and their perceived barriers to adopting mobile-based agricultural extension communication A descriptive survey permits the collection of standardised information from a defined population and the presentation of respondents' views, experiences and characteristics using appropriate descriptive statistics.

The study was conducted in South-East Nigeria, comprising Abia, Anambra, Ebonyi, Enugu and Imo States. The zone is predominantly agrarian, with farming constituting an important livelihood activity across its rural communities.

The target population comprised registered farmers in the five states of South-East Nigeria. The population figure used for the study was 664,240 registered farmers, comprising 160,000 in Anambra, 80,240 in Enugu, 109,000 in Imo, 190,000 in Ebonyi and 125,000 in Abia. The population figures were compiled from available state agricultural records and the 2022 agricultural census records consulted during the study, it was the latest available population figure used as the sampling population at the time of the study

The sampling frame consisted of the registered farmer population identified through the agricultural development programmes (ADPs), Ministries of Agriculture and available farmer-registration records in the five states, and the sampling procedure employed a multi-stage procedure; the five states of south-east were purposively selected; two agricultural zones were purposively selected giving ten agricultural zones; two local government areas were randomly selected giving twenty LGAs; two communities were randomly selected from the LGAs giving forty communities; from these communities, farmers were selected using systematic random sampling. Eligible participants were registered adult farmers residing in the selected communities who were actively engaged in farming and were willing and able to respond to the questionnaire. The multistage approach enabled the study to cover farmers across the five states while making field administration feasible.

The study drew a sample of 385 farmers from the population of 664,240. By using the Cochran (1977) formula for a large population: Using a 95% confidence level, 50% estimated population proportion and 5% margin of error gives approximately 384 respondents; this was rounded to 385 for the study. The 385 copies of questionnaires were proportionally allocated to the five states according to their population sizes:

$$n_i = \frac{N_i}{N} \times n$$

where:
n_i = sample allocated to a state
N_i = population of registered farmers in the state
N = total population of registered farmers in the five states
n = total sample size.

Table 1 | Population of Study and Sample Size

State	Farmer population	Sample
Anambra	160,000	93
Enugu	80,000	47
Imo	109,000	63
Ebonyi	190,000	110
Abia	125,000	72
Total	**664,240**	**385**

Data were collected using a structured questionnaire developed in line with the objectives of the study and the variables identified from the relevant characteristics, mobile-based platforms used for agricultural extension communication and perceived barriers to adoption. The barrier items covered network connectivity, service reliability, access to smartphones or digital devices, cost of mobile data, difficulty using mobile applications, technical support or training, relevance of agricultural information, trust in information authenticity, access to real-time response for extension officers and the interactive nature of mobile-based communication. Language and preference for traditional extension were also measured.

The barriers were measured using a five-point Likert scale ranging from strongly agree (5) to strongly disagree (1). Higher mean scores indicated stronger perceptions that the respective factors constituted a barrier to adoption. The mean decision rule was based on a class interval of 0.80:

Table 2 | Mean Range and Interpretation

Mean range	Interpretation
1.00 – 1.80	Strongly disagree
1.81 – 2.60	Disagree
2.61 – 3.40	Neutral
3.41 – 4.20	Agree
4.21 – 5.00	Strongly Agree

The questionnaire was subjected to content validity by the researcher’s supervisor and experts in the relevant field to establish the adequacy, clarity, relevance and coverage of the items in relation to the study objectives. A pilot study was conducted before the main survey to access the consistency and suitability of the instrument. The reliability of the barrier scale was assessed using Cronbach’s alpha, with coefficient of 0.82. this indicates a satisfactory level of internal consistency among the items measuring the perceived barriers to adoption.

Data collection was conducted between February and May 2026, with the help of two trained research assistants. A total of 385 copies of questionnaire were administered. Four copies of questionnaire were not returned from Ebonyi state for analysis, resulting in 381 properly completed questionnaires retrieved and considered suitable for analysis, representing a 99.0%, a high level of questionnaire return.

The study did not receive formal institutional ethical approval. Participation was nevertheless voluntary. Before administration of the questionnaire, the researcher and trained research assistants explained the purpose of the study to the selected farmers and informed them that participation was voluntary. Informed consent was obtained from participants before the questionnaire was administered, no respondent was compelled to participate. Participants were informed that their responses would be treated confidentially and used solely for academic purposes. No

personally identifying information was required in the questionnaire, and the completed copies of questionnaire were handled securely by the researcher.

Data obtained from the 381 valid questionnaire were coded and analysed using the Statistical Package for the Social Sciences (SPSS). Frequency and percentages were used by to summarise the mobile platforms used by farmers. Mean scores were used to assess the perceived severity of identified barriers to adoption.

Table 3 | Response Rate

Response Status	Frequency	Percentage (%)
Completed and returned	381	99.0
Not returned	4	1.0
Total	**385**	**100**

Source: Field Survey, 2026

The table indicates that the study obtained 381 usable responses from the 385 copies questionnaire administered. The 1% of questionnaire not returned resulted in high usable response rate. The 381 copies of questionnaire therefore constituted the dataset used for the subsequent analysis.

Table 4 | Distribution of Mobile-Based Platforms Used by Farmers

Mobile-based platform	Frequency (responses)	Percentages (%)
WhatsApp	142	37.3
SMS	106	27.8
Facebook	74	19.4
USSD	0	0.0
None	76	19.9
Total	**398**	**104.4**

Source: Field Survey, 2026

The table indicates that farmers utilised more than one mobile-based platform for agricultural extension communication, confirming that their engagement with mobile extension services was not restricted to a single communication channel. WhatsApp emerged as the most commonly selected platform, followed by SMS and Facebook. USSD recorded no reported use, while some respondents indicated that they did not use any of the listed platforms. The prominence of WhatsApp suggests that internet-enabled, interactive mobile communication has become an important channel through which farmers access agricultural extension information. Its functionality for text messaging, voice communication, images, videos and group interaction may make it particularly suitable for exchanging agricultural information and maintaining communication beyond physical extension visits. SMS also retained considerable relevance, demonstrating that agricultural communication is not dependent exclusively on smartphone-based applications. Facebook had a comparatively lower level of selection, indicating a more limited role in the farmers' agricultural extension communication repertoire.

The multiple-response nature of the question is particularly significant. The combined platform selections produced more responses than the 381 respondents because some farmers selected two or more platforms. Thus, the frequencies should be understood as the number of selections made for each platform, rather than the number of unique farmers. Similarly, the percentages are calculated against the 381 respondents and therefore legitimately exceed 100% when aggregated.

The finding also reveals that USSD was not utilised for agricultural extension communication by the respondents, despite its potential suitability for farmers using basic mobile phones. This may indicate limited availability, awareness or integration of USSD-based agricultural extension services within the study area. The respondents who selected “None” demonstrates that access to mobile technology does not automatically translate into participation in mobile-based agricultural extension communication. Some farmers therefore remain outside the mobile extension communication system, providing an important basis for examining the infrastructural, economic and communication barriers investigated in the subsequent objectives. Overall, the multiple-response findings demonstrate that farmers' mobile-based agricultural extension communication is characterised by multi-platform use.

Table 5 | State-Level Distribution of Mobile-Based Platforms Used by Farmers

State	WhatsApp	SMS	Facebook	USSD	None	Total platform selection	Responndents(n)
Anambra	35	28	16	0	19	98	93
Enugu	20	12	9	0	10	51	47
Imo	22	17	11	0	13	63	63
Abia	25	19	12	0	15	71	71
Ebonyi	40	30	26	0	19	115	107
Total	**142**	**106**	**74**	**0**	**76**	**398**	**381**

Source: Field Survey, 2026

In table 5, multiple responses were permitted; therefore, the total number of platform selections exceeds the number of respondents. “total platform selections” represents the sum of all platform responses, while “respondents (n)” represents the number of farmers surveyed in each state. The figures shown above are the state-level frequencies currently contained in the manuscript; the additional multiple responses should only be allocated to individual states when their state of origin is confirmed.

The distribution shows that WhatsApp was the most represented mobile platform across the five states, although its use varied across the states. Ebonyi recorded the highest number of WhatsApp users, followed by Anambra, while Enugu recorded the lowest number in absolute terms. This pattern should, however, be interpreted in relation to the different numbers of respondents sampled from each state rather than as evidence that WhatsApp was necessarily more popular in one state than another. SMS was also used across all five states and constituted the second major platform. Ebonyi recorded the highest number of respondents using SMS, followed by Anambra, while Enugu recorded the lowest absolute frequency. The continued presence of SMS across the states indicates that mobile-based agricultural extension communication is not exclusively dependent on internet-enabled platforms.

Facebook recorded lower frequencies than WhatsApp and SMS across the states. Ebonyi had the highest number of reported Facebook users, followed by Anambra, while Enugu had the lowest. The relatively lower use of Facebook suggests that farmers' engagement with mobile agricultural communication may be concentrated on platforms perceived as more convenient or accessible for direct communication. USSD recorded no reported use across the five states. This is a noteworthy finding because USSD does not depend on smartphone applications in the same way as WhatsApp and Facebook. Its absence suggests that the availability of a technically accessible channel does not automatically result in its utilisation for agricultural extension communication. The respondents who reported using none of the listed platforms were present in all five states. Ebonyi and Anambra recorded the largest absolute numbers in this category, while Enugu recorded the smallest. This finding is important because it demonstrates that mobile-based agricultural extension communication has not yet reached all farmers within the study population.

Table 6 | Infrastructural and Technological Barriers to Mobile-Based Agricultural Extension Communication

Barriers	Mean	Decision
Frequent service breakdown	3.64	Agree
Lack of technical support	3.51	Agree
Poor network	3.17	Neutral
Limited access to device	3.40	Neutral
Difficulty using applications	3.02	Neutral

Source: Field Survey, 2026

The result indicated that frequent service breakdown and lack of technical support were the clearest technology-access barriers reported by respondents. The mean for frequent service breakdown falls within the agreement range, indicating that respondents generally perceived interruptions in mobile services as a barrier to the use of mobile-based agricultural extension communication. Lack of technical support also falls within the agreement range, suggesting that inadequate assistance or training may make sustained use of mobile-based extension platforms more difficult. Poor network connectivity, limited access to devices and difficulty using applications, however, fall within the neutral range under the adopted decision rule. These factors should therefore not be described as statistically established barriers on the basis of the mean scores alone. They may represent concerns experienced by some respondents, but the aggregate responses do not reach the threshold established for agreement.

Table 7 | Economic Barriers to Mobile-Based Agricultural Extension Communication

Economic barrier	Mean	Decision
High cost of mobile data	3.76	Agree

Source: Field Survey, 2026

The finding demonstrates that the cost of mobile data constitutes a significant economic constraint to farmers' use of mobile-based agricultural extension communication. The relatively high mean (3.76) indicates that respondents generally perceived the financial cost of maintaining mobile connectivity as a constraint to their ability to access agricultural information through mobile platforms. The finding is particularly important because mobile-based extension depends on sustained connectivity; consequently, the availability of a mobile platform does not necessarily translate into continuous use when farmers must repeatedly incur data expenses. The finding also suggests that the economic dimension of digital agricultural extension extends beyond the availability of mobile technologies. Farmers may possess or have access to mobile devices but still face difficulties sustaining their participation in digital extension when the cost of connectivity competes with other household and farming expenses. This interpretation is consistent with evidence in the thesis showing that socioeconomic conditions shape farmers' access to mobile-based extension services and that financial support may be necessary to extend digital communication to less-favoured groups.

Table 8 | Communication-Related Barriers to Mobile-Based Agricultural Extension Communication

Communication Barriers	Mean	Decision
Information not relevant	3.11	Neutral
Lack of trust in information	2.27	Neutral
No real time response	3.17	Neutral
Lack of interactivity	2.90	Neutral
Prefer traditional extension	2.74	Neutral
Language barrier	2.19	Disagree

Source: Field Survey, 2026

The results indicate that none of the communication-related items reached the 3.41 threshold required for an overall agreement that the factor constituted a barrier. The highest mean within this group was recorded for lack of trust in information, followed by lack of real-time response and information relevance. However, these remained within the neutral range. The result suggests that although communication quality and trust may pose concerns for some farmers, the aggregate responses do not provide sufficient evidence to classify these factors as generally agreed barriers under the study's predetermined decision rule. Similarly, lack of interactivity and preference for traditional extension were not sufficiently endorsed at the aggregate level to qualify as barriers under the adopted criterion. Language recorded the lowest mean and fell within the disagreement range, suggesting that respondents generally did not perceive language as a major barrier to their use of mobile-based agricultural extension communication.

Discussion of findings

The finding established that farmers in South-East Nigeria use a combination of mobile-based platforms for accessing agricultural extension communication, with WhatsApp, SMS and Facebook constituting the principal platforms reported by respondents. The multiple-response pattern is particularly important because it demonstrates that farmers' engagement with mobile-based extension is not necessarily confined to one platform. Some farmers use more than one platform, suggesting that platform choice may depend on the nature of information required, availability of the technology, ease of use and the communication preferences of individual farmers. The prominence of WhatsApp can be understood in terms of its capacity to support relatively rich and interactive communication. Unlike conventional SMS, WhatsApp permits the exchange of text, photographs, audio messages, videos and group-based communication. These functions can support agricultural extension activities that require explanation, demonstration or rapid exchange of information.

The finding is consistent with Aker (2011), who established the potential of mobile communication to improve the flow of agricultural information between extension providers and farmers. It also agrees with Fadipe et al. (2024), who found social media to be relevant to agricultural extension service delivery in Nigeria. The continued use of SMS is equally significant. Its relevance suggests that mobile agricultural extension in South-East Nigeria is not entirely dependent on smartphones or internet-based applications. SMS can reach farmers through relatively basic

mobile phones and therefore remains useful where smartphone ownership, internet connectivity or digital competence is limited. This agrees with the broader argument by Aker and Mbiti (2010) that mobile phones can reduce communication constraints and facilitate access to information in African economies.

The finding that some farmers use multiple platforms also has theoretical significance. From the perspective of Rogers' (2003) Diffusion of Innovations Theory, adoption is influenced by the perceived relative advantage, compatibility and complexity of an innovation. Farmers may therefore adopt or combine platforms according to how well each platform fits their communication needs. A farmer may, for example, use SMS for short alerts while using WhatsApp for interactive communication or visual agricultural information. Thus, the findings suggest that mobile-based agricultural extension should be conceptualised as a multi-channel communication system rather than a single-platform intervention.

Although USSD has the technical advantage of functioning without internet-enabled applications, its non-use in the study suggests that technical availability alone does not guarantee adoption. There may be limited awareness, inadequate integration of USSD into agricultural extension services or insufficient institutional provision of USSD-based agricultural content. This finding points to an important distinction between availability of technology and availability of useful agricultural services through that technology. Overall, the finding demonstrates that mobile-based agricultural extension communication has gained a presence among farmers in South-East Nigeria, but adoption remains platform-specific and uneven. The implication is that extension agencies should avoid relying exclusively on a single digital channel and instead develop complementary communication strategies involving platforms that correspond to farmers' technological circumstances and communication needs.

The study also revealed that frequent breakdown of mobile-based services and inadequate technical support or training emerged as the clearest infrastructural and technology-related barriers. Other factors, including poor network connectivity, limited access to smartphones and digital devices and difficulty using applications, did not reach the predetermined threshold for overall agreement and should therefore not be described as established barriers at the aggregate level. The finding concerning frequent service breakdown is important because mobile-based extension communication depends on the reliability of the communication infrastructure. Even where farmers possess mobile devices and have the skills to use them, interruptions in service can disrupt the timely receipt of agricultural information. This is particularly consequential for information that has a short decision window, such as pest and disease alerts, weather information or market opportunities.

The finding is consistent with Adebayo (2020), who identified information infrastructure as an important consideration in the adoption of agricultural technologies among small-scale farmers in Nigeria. It identifies network coverage and technological infrastructure as persistent challenges to digital agricultural communication in developing contexts. The importance of technical support is equally revealing, the challenge is not simply whether farmers possess mobile devices, but whether they can use those devices and applications effectively for agricultural purposes.

The findings from this study is also consistent with Akinwale, Olagunju and Salami (2025), whose study found that digital literacy and the ability to navigate mobile applications positively influenced farmers' utilisation of mobile-based agricultural information services, while inadequate digital training constrained adoption. It also agrees with Aker (2011) who found that digital competence enhanced farmers' ability to access, evaluate and apply agricultural information through mobile systems. Although poor network connectivity recorded a moderate mean, it did not reach the revised agreement threshold, evidence indicates that service reliability and technical support were more strongly endorsed as barriers at the aggregate level. From the Technology Acceptance Model perspective, this finding reinforces the importance of perceived ease of use. A technology may be available, but where users require assistance to operate it effectively, its practical usefulness can be diminished. Similarly, Diffusion of Innovations Theory suggests that complexity can slow adoption, particularly when an innovation appears difficult to understand or operate (Rogers, 2003). The implication is that digital agricultural extension programmes should move beyond simply providing farmers with access to mobile technologies. Reliable services, user support, practical demonstrations and continuing digital-literacy assistance are necessary to convert technological availability into effective utilisation.

The study also identified the cost of mobile data as the principal economic barrier to farmers' use of mobile-based agricultural extension communication. This finding is important because it demonstrates that digital agricultural inclusion has a recurrent financial dimension. Access to a mobile platform does not mean that a farmer can necessarily afford the connectivity required to use it consistently. The finding is consistent with the broader literature on ICT use in developing economies, where affordability remains an important component of digital inclusion. Aker and Mbiti (2010) emphasised the economic significance of mobile communication in Africa, while Coggins et al. (2022), as reviewed in the thesis, identified affordability alongside digital access and technological competence as continuing challenges to digital agricultural extension. The finding can also be interpreted through Diffusion of Innovations Theory. Although the theory focuses on characteristics such as relative advantage and compatibility, an innovation that imposes continuing financial costs may have a lower perceived advantage for economically constrained users. Thus, even when farmers recognise the usefulness of mobile-based agricultural information, affordability may limit sustained engagement. The implication is that policies aimed at expanding digital agricultural extension should address affordability as well as access. If farmers are expected to depend increasingly on internet-based agricultural communication, the cost of maintaining connectivity becomes part of the extension system itself. Partnerships among government agricultural agencies, telecommunications operators and development organisations could therefore explore affordable agricultural data packages or zero-rated access to selected agricultural extension services.

Another finding from the study presents a more nuanced picture. The communication-related items measured in the survey did not reach the threshold for overall agreement as barriers. In particular, respondents did not collectively endorse information relevance, trust, real-time response, interactivity or preference for traditional extension as sufficiently strong barriers under the study's predetermined decision rule. Language was even less strongly supported as a barrier. This result is important because it prevents an overstatement of communication problems. The finding concerning real-time communication is particularly relevant to the role of extension officers. Mobile communication can potentially reduce the physical distance between farmers and extension personnel, but this advantage depends on the responsiveness of the extension system. If farmers send questions but cannot obtain timely responses, mobile communication may reproduce rather than eliminate some of the weaknesses of conventional extension. The finding on preference for traditional extension is also significant. Farmers' relatively limited endorsement of this factor suggests that mobile-based communication should not necessarily be viewed as a replacement for face-to-face extension. Rather, the two approaches can operate complementarily. The implication is that agricultural extension policy should pursue a hybrid extension model, combining mobile com-

munication with face-to-face engagement. Mobile platforms can facilitate speed, continuity and wider reach, while physical extension remains useful for demonstrations, clarification, trust-building and farmers who have limited digital capacity.

Conclusion

This study examined the challenges associated with farmers' adoption of mobile-based agricultural extension communication in South-East Nigeria. The findings demonstrate that mobile-based extension communication is already part of the agricultural information environment of farmers in the region, with WhatsApp, SMS and Facebook serving as important channels. The multiple-response pattern further indicates that some farmers use more than one platform, suggesting that mobile agricultural communication is increasingly characterised by a multi-platform rather than single-platform approach. However, the study also demonstrates that the usefulness of these technologies is shaped by the conditions under which farmers access and use them. Frequent service breakdown, inadequate technical support and the cost of mobile data emerged as the most clearly endorsed constraints. Other issues, including device access, network connectivity, application difficulty, information relevance, trust and real-time communication, were present in the farmers' responses but did not reach the predetermined threshold for overall agreement as barriers.

The findings therefore suggest that the challenge facing mobile-based agricultural extension in South-East Nigeria is not simply whether farmers have access to mobile technologies. Rather, effective adoption depends on the availability of reliable services, affordable connectivity, appropriate user support and functional relationships between farmers and extension personnel. The study further concludes that mobile-based agricultural extension should not be conceptualised as a complete substitute for conventional extension. The evidence indicates greater value in an integrated system in which digital platforms extend the reach and continuity of extension services while face-to-face interaction remains available for practical demonstrations, clarification, trust-building and farmers who experience digital limitations.

Importantly, the study's descriptive design means that the findings establish reported barriers and patterns of use, rather than causal relationships between particular barriers and adoption. Future research using inferential or longitudinal designs would be necessary to establish which factors significantly predict adoption and sustained use.

Recommendations

Based on the findings, the study makes the following recommendations:

1. Improve reliability of mobile communication services, whereby agricultural extension agencies and relevant government authorities should collaborate with telecommunications providers to improve the reliability and continuity of mobile communication services in farming communities. Particular attention should be given to areas experiencing recurrent service interruptions.
2. Establishing farmer-oriented digital support and training through agricultural extension programmes to incorporate continuous digital-literacy and technical-support components. Training should be practical rather than theoretical and should demonstrate how farmers can access agricultural information, send questions, receive multimedia content and verify information received through digital platforms.
3. Government and agricultural development agencies should address the affordability of mobile connectivity to explore partnerships with telecommunications operators to develop affordable data arrangements for agricultural communication. Where feasible, agricultural extension platforms or selected agricultural information services could be provided at reduced connectivity costs.
4. Extension agencies should not depend on one mobile platform. Since farmers use different platforms and some combine several platforms, agricultural information should be disseminated through a complementary mix of WhatsApp, SMS and other appropriate channels, depending on the characteristics and needs of the target farming community.

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