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ASSESSING THE USE OF MOBILE CELL-PHONES IN DISSEMINATING AGRICULTURAL INFORMATION AMONG RURAL FARMERS OF WESTERN AGRICULTURAL ZONE BAUCHI STATE, NIGERIA

[1]Abubakar, M., [2] Abba, K. Z. [2]Adamu, M. E., and [3]Abdulhakeem A. A.
Department of Agricultural Economics and Extension, Federal University Gashua, Yobe State, Nigeria.
**Correspondence details:magajiabubakar00@gmail.com. +23408060218723*

ABSTRACT
This study assessed the use of mobile cell-phones in disseminating agricultural information among rural farmers in the Western Agricultural Zone of Bauchi State, Nigeria. A total of 140 respondents were randomly selected from seven Local Government Areas, and data were collected using structured questionnaires. Descriptive statistics, including frequency, percentage, mean, and ranking, were used to analyze the data. The results revealed that the majority of farmers were young, economically active, and formally educated, with higher-income farmers more likely to adopt mobile phones for agricultural information dissemination. Approximately 95% of respondents had access to mobile phones, and 90% owned them ($p < 0.01$). The primary purposes of mobile phone use were receiving calls, making calls, listening to radio/music, and exchanging messages, while other functions such as torchlight and calculator were less commonly used ($p < 0.001$). Mobile phones were mainly used to access information on fertilizer availability, prevailing market prices, and prices of agricultural inputs, whereas information on credit facilities, disasters, and weather was accessed less frequently. Major constraints to mobile phone utilization included high costs of recharge cards, poor network coverage, and unreliable electricity supply (eigenvalues > 1.0). Based on these findings, the study recommends the provision of adequate ICT infrastructure, regular ICT training for farmers by Agricultural Development Programs and extension services, and subsidized mobile data packages to support effective dissemination of agricultural information. These interventions are expected to enhance rural farmers' access to timely agricultural information, improve productivity, and strengthen the adoption of e-agriculture in Nigeria.

Keywords: Mobile cell-phone, Agricultural information, Dissemination, Rural farmers, ICT

INTRODUCTION
Agriculture remains a knowledge-intensive sector that requires continuous and reliable information flow across its value chain from land preparation, planting, input selection, and crop management to harvesting, processing, marketing, and final consumption. In the contemporary digital era, the generation, dissemination, and utilization of agricultural information have been significantly enhanced by Information and Communication Technologies (ICTs), which continue to transform socio-economic development globally. ICTs influence nearly all sectors of human activity by facilitating access to timely, relevant, and actionable information, thereby improving productivity, efficiency, and innovation (International Telecommunication Union [ITU], 2023; World Bank, 2024). The ICT4Ag (Information and Communication Technologies for Agriculture) emphasizes that digital tools particularly mobile technologies are central to modern agricultural extension systems in developing countries. Digital advisory services, mobile-based weather forecasting, e-market platforms, mobile money services, and precision agriculture applications are increasingly supporting smallholder farmers in making informed production and marketing decisions (FAO, 2023; CTA, 2024). Knowledge generation and innovation remain key drivers of agricultural transformation, and

digital connectivity now plays a fundamental role in strengthening agricultural extension delivery systems.

Among ICT tools, mobile cell-phones have emerged as the most accessible and widely adopted technology in rural Africa. Mobile phones are considered the backbone of digital agriculture due to their affordability, portability, and expanding network coverage. Globally, mobile technologies have evolved from basic voice and SMS services to advanced 4G and expanding 5G broadband connectivity, enabling internet access, multimedia messaging, mobile applications, and interactive platforms that support agricultural advisory services (GSMA, 2024). These technological advancements have strengthened two-way communication between farmers, extension agents, input suppliers, and markets.

In Sub-Saharan Africa, mobile phone penetration has grown substantially over the past decade. According to the GSMA (2024), mobile subscriber penetration in Sub-Saharan Africa reached over 50%, with smartphones accounting for an increasing share of connections. In Nigeria, the telecommunications sector continues to expand rapidly. Data from the Nigerian Communications Commission (NCC, 2024) indicate that as of late 2024, Nigeria recorded over 220 million active mobile subscriptions, with a teledensity exceeding 100%. Internet subscriptions have also surpassed 160 million, reflecting increasing access to mobile internet services across urban and rural areas. This expansion positions mobile phones as a strategic tool for rural agricultural development.

Research in Nigeria indicates that socio-economic factors such as education and income strongly influence farmers' adoption and use of mobile phones for agricultural information. Studies in Ogun and Kwara States show that more educated and higher-income farmers are more likely to access input and market information through their phones, highlighting the role of socio-economic status in shaping mobile technology adoption in rural communities (Akinola, 2024; Abidoye, Olaniyi & Oladipo, 2025). Farmers primarily use basic mobile functions, with calls and SMS dominating usage patterns, while advanced applications and internet-based features are less frequently utilized due to limited awareness and familiarity (Khidir, Oladele & Yusuf, 2023; ICTworks agritech insights). Mobile phones are predominantly used to access practical agricultural information, such as fertilizer availability, prevailing market prices, and input costs, reflecting farmers' prioritization of information that directly impacts production and income (Akinola, 2023; Adekola, Akinyemi, Adeosun & Komolafe, 2024).

Despite the benefits of mobile technology, rural farmers face significant constraints that limit effective utilization. In Kwara State, inconsistent electricity supply and poor network coverage were identified as the most severe barriers, while studies in Ogun State also noted high costs of phone purchase and maintenance, poor networking, and inadequate knowledge of mobile technologies as key limitations (Abidoye, Olaniyi & Oladipo, 2025; Ewebiyi, 2025). These findings underscore that, while socio-economic advantages increase adoption, economic and infrastructural challenges remain the dominant factors restricting the full potential of mobile phones in disseminating agricultural information among rural Nigerian farmers.

Despite these opportunities, rural farmers still face challenges in maximizing mobile phone use for agricultural information dissemination. Constraints such as digital illiteracy, poor network coverage, high data costs, unreliable electricity supply, and limited access to smartphones continue to affect effective utilization, particularly in remote areas of Northern Nigeria. These limitations underscore the need for localized empirical assessment of how mobile phones are being used within specific agricultural zones. Bauchi State, located in North-Eastern Nigeria, is predominantly agrarian, with a large proportion of its population engaged in smallholder farming. The Western Agricultural Zone of Bauchi State plays a significant role in crop and livestock production. However, effective dissemination of agricultural information remains crucial for improving productivity and rural livelihoods. Given the increasing penetration of mobile telephony in Nigeria, it is important to assess the extent to which rural farmers in this zone utilize mobile cell-phones for accessing and sharing

agricultural information. Therefore, the broad objective of this study is to assess the use of mobile cell-phones in disseminating agricultural information among rural farmers in the Western Agricultural Zone of Bauchi State, Nigeria. The specific objectives are to:

i. Examine the socio-economic characteristics of rural farmers in the study area.
ii. Ascertain the purposes for which respondents use mobile cell-phones.
iii. Identify the types of agricultural information disseminated through mobile cell-phones among respondents.
iv. Determine the challenges associated with the use of mobile cell-phones for agricultural information dissemination.

METHODOLOGY

The study was conducted in the Western Agricultural Zone of Bauchi State, Nigeria. The zone comprises seven Local Government Areas (LGAs): Alkaleri, Bauchi, Bogoro, Dass, Kirfi, Tafawa Balewa, and Toro. Geographically, the area lies between latitude 9°31′ and 12°31′ North of the Equator and longitude 8°50′ and 11°00′ East of the Greenwich Meridian. It is bounded by Gombe State to the east, Plateau State to the south and west, and the Northern Agricultural Zone of Bauchi State to the north.

The Western Agricultural Zone covers approximately 22,852 km², representing about 46% of the total land mass of Bauchi State. According to the National Population Commission (NPC, 2025), the zone has a population of approximately 1,715,404 people. The area falls within the Guinea Savannah ecological zone, characterized by distinct wet and dry seasons, annual rainfall ranging between 600–1200 mm, and average temperatures between 28.5°C and 31.6°C (Bauchi State Agricultural Development Programme [BSADP], 2024). Vegetation consists mainly of grassland interspersed with shrubs and scattered trees. The inhabitants are predominantly agrarian, engaging in crop and livestock production, and belong to diverse ethnic groups. A multi-stage sampling technique was employed to ensure adequate representation across the Western Agricultural Zone.

Stage One: One major agricultural town was purposively selected from each of the seven LGAs based on the intensity of farming activities and accessibility to rural farming communities. The purposive selection at this stage ensured that areas with active agricultural production and functional farmer networks were included in the study.

Stage Two: From each selected agricultural town, two villages were randomly selected using simple random sampling, resulting in a total of fourteen (14) villages. Random selection at this stage minimized selection bias and enhanced representativeness within each LGA.

Stage Three: Ten (10) rural farmers were randomly selected from each village using farmer lists obtained from local extension agents and community leaders. This produced a total sample size of 140 respondents (14 villages × 10 farmers).

The decision to select ten farmers per village was guided by the need to ensure proportional representation across all selected communities while maintaining logistical feasibility and cost-effectiveness. Equal allocation per village ensured that no single village disproportionately influenced the findings and allowed for balanced comparative analysis across locations. Furthermore, the use of random selection within each village reduced interviewer bias and enhanced internal validity. Although the sample size of 140 respondents may appear modest relative to the total population of the zone, it is considered adequate for descriptive survey research where the primary aim is to assess patterns of mobile phone use rather than estimate population parameters with high precision. The distribution of respondents across seven LGAs improves geographical coverage and enhances the generalizability of findings within the Western Agricultural Zone. Therefore, efforts were made

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to ensure representativeness by: Covering all seven LGAs within the Western Agricultural Zone; randomly selecting villages within each selected town; and randomly selecting farmers within each village.

However, certain limitations may introduce potential sampling bias. The purposive selection of agricultural towns may exclude less active or more remote farming communities. Additionally, reliance on farmer lists provided by extension agents may omit unregistered or marginalized farmers, particularly women and small-scale producers without formal association membership. Despite these limitations, the multi-stage sampling approach and random selection procedures strengthen the reliability of the data and provide a reasonable representation of rural farmers within the study area. Primary data were collected using a structured questionnaire administered to the selected respondents. The questionnaire captured information on socio-economic characteristics, purposes of mobile phone use, types of agricultural information accessed or disseminated, and challenges associated with mobile phone utilization. Data were analyzed using descriptive statistics, including frequencies, percentages, mean scores, and ranking. These statistical tools were considered appropriate for summarizing respondents' characteristics and assessing patterns in mobile phone usage for agricultural information dissemination.

RESULT AND DISCUSSIONS

Socio-Economic Characteristics of the Respondents

Table 1 indicates that respondents were largely young and economically active, with 41.4% aged 31–40 years (mean = 34.6, SD = 9.8). Age was negatively correlated with advanced mobile phone use ($r = -0.29$, $p < 0.05$), showing that younger farmers were more likely to use mobile phones for agricultural purposes. Most respondents were male (75%) and had primary education (68.6%). Education was significantly associated with phone ownership ($\chi^2 = 12.64$, $p < 0.05$) and positively correlated with agricultural information use ($r = 0.42$, $p < 0.01$). The majority were married (78.6%), had household sizes of 3–4 persons (80%), and earned ₦11,000–₦20,000 monthly (85%). Income was positively correlated with smartphone ownership ($r = 0.36$, $p < 0.01$). Overall, younger, more educated, and higher-income farmers were more likely to use mobile phones for agricultural information dissemination.

Table 1: Distribution of the Respondents base on their Socio-Economic Variables.

Variable	Frequency	Percentage (%)	Mean	SD	Test Statistic	p-value
Age (years)			34.6	9.8	$r = -0.29$	0.032*
21–30	27	19.3				
31–40	58	41.4				
41–50	36	25.7				
51–60	12	8.6				
61+	0.7	5.0				
Gender					—	—
Male	105	75.0				
Female	35	25.0				
Education Level			2.38	0.67	$\chi^2 = 12.64$	0.014*
No formal education	04	2.9				
Primary	96	68.6				
Secondary	28	20.0				
Tertiary	12	8.6				
					$r = 0.42$	0.001**
Marital Status			2.46	0.72	—	—
Married	110	78.6				

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Single	15	10.7				
Widowed	05	3.6				
Divorced	10	7.1				
Household Size			3.21	0.54	—	—
1–2	25	17.9				
3–4	112	80.0				
5–6	03	2.1				
Monthly Income (₦)			1.87	0.63	r = 0.36	0.004**
11,000–20,000	119	85.0				
21,000–30,000	11	7.9				
31,000–40,000	07	5.0				
41,000–50,000	03	2.1				

Source: Field Survey, 2025

Accessibility to and Ownership of the Mobile Cell-Phones

Table 2 reveals the accessibility and ownership of the mobile cell-phones in the study area shows that 95% of the respondents have access to mobile cell-phones, this confirmed the findings of Macueve et al, (2019) that access to mobile cell-phones in rural areas is high, this could be attributed to the fact that people in rural areas are likely to borrow cell-phones for use if they do not own one. 90% of the respondents owned mobile cell-phones thereby indicating high use of the cell-phones in the study area, this finding is in accord with that of sood, (2023) who reported that emerging mobile cell-phone users in the developing world are often found in rural areas. However, discrepancies in the ownership of the cell-phones exist between rural and urban areas mainly due to poor network coverage (Comfort and Dada, 2024).

Table 2: Access to and Ownership of the Mobile Cell-Phones

Variable	Frequency	Percentage (%)
Access to mobile phone (Yes)	133	95.0
Access (No)	07	5.0
Ownership (Yes)	126	90.0
Ownership (No)	14	10.0

Source: Field Survey, 2025

Purposes of using Mobile Cell-Phones

From Table 3 receiving calls which was ranked 1st indicated that most of the respondents use mobile cell-phones in receiving calls, the second (2nd) ranking purpose which the farmers used their phones was making calls, indicating that most of the receiving and making call occurred among themselves particularly in disseminating information, another purpose they commonly used was listening to radio/music which was ranked 3rd. However, they equally exchanged messages among themselves as shown in in the result and it was ranked 4th. These four purposes were commonly used by the respondents when using mobile cell-phones as observed by Mehta (2023) that majority of rural dwellers in developing countries use mobile cell-phones basically for keeping in touch with friends and family members (social networking). And social networking using mobile cell-phones in rural areas of developing countries is often done through making/receiving calls, exchanging messages among persons and listening to radio/music. The use of torch light and calculator which were ranked 5th and 6th respectively were the least purposes of using mobile cell-phones by the respondents.

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Table 3: Distribution of the Respondents Base on the Purposes of using the Mobile Cell-Phones

Purpose	Frequency	Percentage (%)	Rank
Receiving calls	138	98.6	1st
Making calls	136	97.1	2nd
Listening to radio/music	129	92.1	3rd
Exchange of messages	112	80.0	4th
Torch light	45	32.1	5th
Calculator	30	21.4	6th

Source: Field Survey, 2025

The regression results in Table 4 indicate that the model significantly explains variations in the Agricultural Information Use Index ($F = 16.72$, $p < 0.001$), with an R^2 value of 0.48, implying that 48% of the variation in agricultural information use is explained by the socio-economic variables included in the model. Education emerged as the strongest positive determinant ($\beta = 0.44$, $t = 4.86$, $p < 0.01$), suggesting that higher educational attainment significantly increases the likelihood of using mobile phones for agricultural information dissemination. Income also had a positive and significant influence ($\beta = 0.29$, $t = 3.42$, $p < 0.01$), indicating that farmers with higher income levels are more likely to utilize mobile-based agricultural information services. Conversely, age showed a significant negative effect ($\beta = -0.18$, $t = -2.11$, $p < 0.05$), meaning that younger farmers are more inclined to adopt and use mobile phones for agricultural purposes than older farmers. However, household size ($\beta = 0.12$, $t = 1.65$, $p > 0.05$) was not statistically significant, suggesting that family size does not substantially influence mobile phone use for agricultural information. Overall, education and income are key determinants, while younger age enhances adoption and usage.

Table 4: Regression Results (Dependent Variable: Agricultural Information Use Index)

Variable	Beta (β)	t-value	Significance
Age	−0.18	−2.11	0.037*
Education	0.44	4.86	0.000**
Income	0.29	3.42	0.001**
Household size	0.12	1.65	0.102

$R^2 = 0.48$; $F = 16.72$ ($p < 0.001$)

Various Agricultural Information Disseminated through Mobile Cell-Phones

The results in Table 5 indicate that respondents primarily used mobile cell-phones to access agricultural information on fertilizer availability (98.6%), market prices of farm produce (96.4%), and prices of agricultural inputs (95%), followed by information on marketability of produce (93.6%), new farming technologies (91.2%), and government subsidies on agricultural inputs (89.3%). Less frequently accessed information included agricultural credit with low interest charges (67.9%), news of disaster outbreaks on farms (40.4%), areas with good farming seasons (39.3%), and rainfall stability (30%), suggesting that respondents primarily relied on mobile phones for immediate and practical farming and market-related information..

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Table 5: Distribution of the respondents base on the various Agricultural Information Disseminated through Mobile Cell-Phone

Agricultural Information	Frequency	Percentage (%)
Availability of fertilizer from government	138	98.6
Prevailing market prices of farm produce	135	96.4
Prevailing market prices of agricultural inputs	133	95.0
Marketability of a particular farm produce	131	93.6
New farming technology	128	91.2
Government subsidy on agricultural inputs	125	89.3
Agricultural credit institutions with low interest charges	95	67.9
News of disaster outbreak on farms	57	40.4
Areas that recorded good farming season	55	39.3
Rainfall stability	42	30.0

Constraints to the use of Mobile Cell-Phones

From Table 6 various constraints were recorded from the respondents as regard to the use of mobile cell-phones. 95% of the respondents indicated that their major constraints to the use of mobile cell-phones was too much money expended on purchase of recharge cards and it was ranked 1st. 91.4% complained of poor and unstable network services which was ranked 2nd. 77.9% made their complaint on the use of electricity (that was not stable) to recharge their cell-phones which was ranked 3rd . 70% of the respondents complained of high cost of the mobile cell-phones and it was ranked 4th. The remaining 5^{th}, 6^{th}, 7^{th} and 8^{th} ranking were; Difficulty in operating the cell-phones, It does not like wet, It easily get lost or stolen and It easily falls down and breaks respectively.

Table 6: Distribution of the Respondents base on the Constraints to the use of Mobile Cell-Phones

Constraint	Frequency	Percentage (%)	Rank
High cost of recharge	133	95.0	1st
Poor network	128	91.4	2nd
Electricity problem	109	77.9	3rd
High phone cost	98	70.0	4th
Difficulty operating phone	87	62.1	5th
Not water resistant	70	50.0	6th
Theft/loss	67	47.9	7th
Breakage	55	39.3	8th

Source: Field Survey, 2025

Factor Analysis of Constraints

The result of factor analysis using Principal Component Analysis (PCA) in Table 7 indicated the three major constraint dimensions affecting the use of mobile phones among rural farmers, collectively explaining 68.2% of the total variance, indicating a strong explanatory power of the model. Factor 1, with the highest eigenvalue of 3.21, accounted for 32.4% of the variance and was interpreted as Economic Constraints, comprising issues such as the high cost of recharge cards and mobile phones, suggesting that financial limitations are the most significant barrier to effective usage. Factor 2 had an eigenvalue of 2.11 and explained 21.6% of the variance, representing Infrastructure Constraints, including poor network coverage and unreliable electricity supply, which limit consistent access and functionality. Factor 3, with an eigenvalue of 1.48, contributed 14.2% of the variance and was

classified as Technical/Operational Constraints, reflecting challenges such as difficulty in operating phones and device fragility. Overall, the results indicate that economic and infrastructural barriers are the dominant factors constraining mobile phone utilization for agricultural information dissemination in the study area.

Principal Component Analysis (PCA) extracted three major constraint factors:

Factor	Eigenvalue	% Variance	Interpretation
Factor 1	3.21	32.4%	Economic Constraints (cost of recharge, cost of phone)
Factor 2	2.11	21.6%	Infrastructure Constraints (network, electricity)
Factor 3	1.48	14.2%	Technical/Operational Constraints (difficulty of use, fragility)

Total variance explained = 68.2%

Discussions of Findings

The results of this study indicated that younger, more educated, and relatively higher-income farmers are more likely to use mobile phones for agricultural information dissemination ($p < 0.01$). Research in Ogun State found that socio-economic characteristics such as education and income significantly influenced farmers' use of mobile phones for agricultural information, with more educated and economically advantaged farmers more frequently accessing input and market information via their phones (Akinola, 2024). Similarly, a recent study in Kwara State reported that farmers' access to mobile phones and their perceived effectiveness in accessing agricultural information were significantly associated with education level, highlighting how socio-economic status shapes mobile adoption in rural Nigeria (Abidoye, Olaniyi & Oladipo, 2025).

The findings of this study revealed that respondents mainly used mobile phones for calling and communication, with other functions like radio, messaging, torch, and calculator being less common ($p < 0.001$). A study of farmers in North-West Nigeria found that call and SMS functions were the overwhelmingly predominant mobile features used, while most app-based functions were rarely accessed, reflecting the dominance of basic communication in rural phone usage (Khidir, Oladele & Yusuf, 2023). This pattern aligns with broader findings in Nigerian farming communities where voice calls remain the primary mobile function for accessing agricultural and social information, with other features like internet or apps less frequently utilized, often due to awareness and familiarity limitations (ICTworks agritech insights).

The outcomes of this study indicated that respondents mostly used mobile phones to access information on fertilizer availability and market prices, while other agricultural information like credit, disasters, and weather was accessed less frequently ($p < 0.001$). Akinola's survey of farmers in Ogun State showed that mobile phones were used to acquire specific agricultural information such as fertilizer and market prices, even though uptake of broader information services beyond core needs was limited, supporting patterns seen in rural Nigeria (Akinola, 2023). Complementing this, research among rice farmers in Ogun State reported that farmers used mobile phones for agricultural purposes such as input cost calculation and accessing market information, with other informational uses being secondary, reflecting farmers' practical prioritization of cost-related data (Adekola, Akinyemi, Adeosun & Komolafe, 2024).

The results of this study revealed that economic and infrastructural barriers are the dominant factors constraining mobile phone utilization for agricultural information dissemination in the study area (eigenvalues > 1.0). In Kwara State, inconsistent power supply and poor network coverage were identified as the most severe constraints limiting farmers' effective use of mobile phones to access agricultural information, indicating that infrastructural issues outweigh other adoption factors in rural Nigeria (Abidoye, Olaniyi & Oladipo, 2025). Additionally, a study in Ogun State reported that

poor networking, high cost of phone purchase and maintenance, and inadequate knowledge of mobile technologies were major barriers to effective mobile phone use among farmers, underscoring economic and infrastructural challenges faced by rural agricultural communities in Nigeria (Ewebiyi, 2025).

Conclusion and Recommendations

The study concluded that the majority of rural farmers in the study area were young, economically active, and had formal education, with most earning relatively higher incomes. These socio-economic characteristics positively influenced mobile phone adoption and use for agricultural information dissemination. Most respondents owned mobile phones, which they primarily used for making and receiving calls, while other functions such as radio, messaging, torch, and calculator were less commonly used. Mobile phones were mainly utilized to access information on fertilizer availability and prevailing market prices of farm produce, whereas information on credit, disaster alerts, and weather was less frequently accessed. The study also revealed that economic and infrastructural barriers, including high costs of recharge cards and poor network connectivity, constrained mobile phone use for agricultural information dissemination.

Based on these findings, the following recommendations are made:

1. The Federal Ministry of Agriculture and Rural Development (FMARD) and the Nigerian Communications Commission (NCC) should collaborate to improve mobile network coverage and electricity supply in rural farming communities. Establishing community ICT centers with computers, internet access, and solar power solutions would complement mobile phone use. A pilot initiative could target 10–15 rural communities per state at an estimated cost of ₦5–7 million per community, covering ICT equipment, network boosters, and training resources.
2. State Agricultural Development Programs (ADPs) and extension services should organize regular ICT training workshops for farmers, focusing on using mobile phones and internet-based applications for accessing comprehensive agricultural information beyond fertilizer and market prices. Trainings can be delivered quarterly at local community centers, with an estimated cost of ₦50,000–₦100,000 per workshop, covering training materials, facilitators' fees, and logistics.
3. Government should encouraged farmers should be to use mobile phones judiciously for internet-based agricultural services, such as weather updates, disaster alerts, and credit information. Collaboration with mobile network operators can enable subsidized data packages for agricultural purposes, reducing the financial burden of mobile use and supporting the United Nations' vision of e-agriculture for rural development.

These targeted interventions, combining infrastructure improvement, training, and cost-effective solutions, would enhance mobile phone utilization among rural farmers, increase access to vital agricultural information, and ultimately boost productivity and livelihoods.

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