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Effectiveness of Mobile Phone Utilisation for Agricultural Information Dissemination among Tomato Farmers in Ondo State, Nigeria

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I N F O

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A B S T R A C T

This study examined the effectiveness of mobile phone utilisation for agricultural information dissemination among rural tomato farmers in Ondo State, Nigeria. Specifically, described the socioeconomic characteristics, assessed their knowledge and identified constraints to the use of mobile phone. Quantitative data were obtained from 100 tomato farmers through a multistage sampling procedure and analysed using descriptive and Chi-square statistics. The results revealed that 36% of farmers were aged, married (77%) and had secondary education (46%). Most respondents used mobile phones (94%). Mobile phones were effective in accessing government's input and credit support ($\bar{x}$ = 2.85; σ = 1.19). The severest constraints was "no light to charge phone" ($\bar{x}$ = 2.75; σ = 0.87). There was a significant relationship between age (χ^2=38.720; p< 0.05), marital status(χ^2=270.440; p< 0.05), family size (χ^2=63.061; p<0.05), secondary occupation (χ^2=58.080; p<0.05), level of education (χ^2=71.703; p< 0.05), sources of labor (χ^2=45.200; p< 0.05), sources of credit (χ^2=174.960; p<0.05), monthly income (χ^2=63.900; p< 0.05) and the effectiveness of mobile phone. Conclusively, mobile phones were effective in securing government support by the tomato farmers. The study recommended upgrading network infrastructure, promoting affordability of mobile services, developing user-friendly customized applications. and fostering digital literacy among the farmers.

1. Introduction

Mobile phone technology has revolutionalised agricultural production by offering platforms for smallholder farmers to upgrade their farming practices, access markets, and improve their livelihoods (Erlangga et al., 2023). One of the celebrated effects of mobile phone technology in the context of agriculture is its capacity to provide farmers with real time agricultural information and advisory services on weather forecasts, crop management practices, and pricing, thereby empowering them with pertinent information for running their farm enterprises (Emeana, et al., 2020).

This critical flow of information has the potential to improve crop yields, raise incomes, and enhance food security among farmers (Bellemare et al., 2017; Jensen, 2007). Mobile phone technology bridges the information gap that previously existed, especially for farmers in remote communities who have limited access to conventional information sources (Fafchamps and Minten, 2012). Through customized mobile-based advisory services delivered directly to farmers' phones, they can optimize farming practices and maximise returns. Moreover, the two-way communication that takes place through mobile phones allows farmers to interface with experts or extension officers, seek information, clarify grey areas and receive feedback. This interactive and iterative approach facilitates learning and problem-solving in farming operations. Additionally, mobile platforms promote knowledge sharing and peer-learning among farmers, engendering a culture of networking, collaboration and innovation within farming communities (Ndimbo et al., 2024). Similarly, mobile

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phone-based extension services and capacity building programs has the potential to reach a wider farming audience with relevant trainings and resources thereby imparting farmers with new skills and competences, improved practices, and farm management capacity.

Mobile phone technology also facilitates farmers' strategic marketing decision-making. Using the market information it provides, farmers can determine what markets to explore or penetrate to obtain fair prices for their commodities. Prior market intelligence and elimination of information asymmetries and moral hazards though direct contact, fosters market participation, increases bargaining leverage, and ensures higher incomes for farmers (Aker, 2016). Moreover, mobile banking services and digital payment platforms allow farmers to access financial services; reduce transaction costs and promote financial inclusion (Fafchamps & Minten, 2012). It also enables farmers to access necessary inputs such as seeds and pesticides, and supportive services through e-commerce platforms and digital supply chain systems. Digital supply chain platforms track the movement of inputs and produce from farm to market, ensuring traceability and guaranteeing quality (Coggins et al., 2022).

The constraints to the use of mobile phone applications by farmers includes high phone and airtime costs, inadequate network coverage and erratic electricity supply (Abdullahi *et al.*, 2021).Similarly, Ifeanyi-Obi and Iferobia (2024) concluded that frequent power outages, elevated smartphones cost, expensive airtime and data, poor network availability, and digital illiteracy constrained the use of mobile phones for spreading agricultural information among rural farmers.

This study examines the effectiveness of mobile phone utilisation for agricultural information dissemination among tomato farmers in Ondo State, Nigeria. It describes their socioeconomic characteristics, assesses their knowledge in the use of mobile phone, and identifies constraints to using mobile phones for agricultural purposes in the study area.

Ho: There is no significant relationship between respondents' socioeconomic characteristics and the effectiveness of utilisation of mobile phone.

2. Material and methods

The study area is Ondo State, Nigeria. It lies between latitude 50 451 and 80 151 North and longitude 40 451 and 6 0 East. Ondo State is one of Nigeria's oil producing States although agriculture remains the mainstay of the economy. The State has a relatively young population with significant youth unemployment. Poverty rate is considerable illustrated by a multidimensional poverty incidence of 27% according to Nigeria's National Bureau of Statistics (NBS, 2022). Literacy level and educational attainment is high with the state hosting a horde of tertiary institutions including four universities.

Ondo State is made up of 18 Local Government Areas, located in the South Western Zone of Nigeria. It is bounded in the North-West by Ekiti State, West-Central by Osun State, South-East by Ogun State, South-East by Delta State and in the South by Atlantic Ocean with a population of about 3.4 million people (National Planning Commission, 2006). The state is characterised by rainforest and guinea savannah vegetation zones with two peaks of rainfall annually – dried and wet season. The crops cultivated in the State include cocoa, palm produce, kola nut, coffee, cashew, rubber, timber, maize, yam, plantain, cocoyam, and cassava. Tomato is one of the common crops cultivated by farmers as the region has limited rainfall compared to the southern region of the state.

The study population comprises all rural tomato farmers in Ondo State, Nigeria. Multistage sampling procedure was used to select respondents for this study. Firstly, Akoko South West Local Government Area (LGA) was purposively selected due to significant tomato production activities. Secondly, two out of the eight communities in Akoko South-West LGA (Ose and Oka-Akoko) were purposively selected due to a preponderance of tomato farmers relative to other communities. Owing to the lack of register for tomato farmers in the major tomato producing communities, snowball sampling technique

was used to sample 49 tomato farmers in Ose and 57 in Oka-Akoko; thus, 106 tomato farmers were selected for the study using a structured questionnaire. However, only 100 copies of questionnaire used were found validly filled and analyzable, thus, 100 tomato farmers formed the sample size for this study representing a response rate of 94.34%.

For the measurement of variables, socioeconomic characteristics such as age, household size, etc were measured at interval and nominal levels. To measure farmers' knowledge of mobile telephone, farmers were asked to indicate 'yes' or 'no' to a set of questions. To identify constraints in using mobile phone technology, farmers were asked to tick from a catalogue of constraints. The responses were aggregated, and the mean and standard deviations generated. The effectiveness of mobile phone utilisation for disseminating agricultural information was measured by asking respondents to tick from a list of items which were measured using a 3-point rating scale adapted from the Likert-type scale of mostly effective (3), less effective (2), and not effective (1). The responses were aggregated, and the mean calculated with a mean of 2.5 or more indicating effective.

Data collected were described with the use of descriptive statistics (frequency distributions, percentages, and mean scores) while inferential statistics (chi-square) was employed to analyse the relationship between farmers' socioeconomic characteristics and effectiveness of utilisation of mobile phones for dissemination of agricultural information.

3. Results and Discussion

3.1 Socioeconomic characteristics of respondents

Table 1 show that 56% of the respondents were male, while 44% were female, indicating a relatively even gender distribution, albeit slightly tilted toward the male gender. This reflects the disproportionate access to farm resources by men typical of the traditional rural economy where men often assume decision-making roles (Hidrobo et al., 2024). Beuchelt and Badstue (2021) noted that men usually take on leadership roles in agricultural operations. The age distribution shows that 36% of respondents were aged 40-49 years, 21% were aged 30-39 years, and 17% were aged 50-59 years. This shows a preponderance of middle-aged participants in the sample, reflecting their strength and capacity to cope with the physical exertions associated with farming activities (Kolapo and Didunyemi, 2024). This is corroborated by Nyagango, *et al.* (2023), who found that farmers in this age bracket often combine experience with the energy required to handle the labour-intensity of farming operations.

Majority of respondents were married (77%) while 15% were single. Marriage could provide the respondents with social and economic stability and engender greater attention to the farming enterprise for income to support their families (Smith, 2023). Simotawe *et al*. (2023) observed that married farmers benefit from pooled labour resources within the household, which supports agricultural productivity. Christianity is the dominant religion among the respondents (72%), with Islam accounting for 28%. Matching religious affiliations often provide cohesive platforms for farmers to share knowledge which might positively influence their agricultural practices (Kargbo and Davies, 2021). Paris *et al*. (2023) claimed that religion fosters greater interactions and cooperation in farming communities thereby enhancing agricultural productivity. Approximately half (49%) of the respondents had family size of 5-7 members, followed by families with 2-4 members (38%). This indicates largely medium size families which avails them with reasonable family labour for farm work (Nyarko and Awuni, 2020). Bezabih and Hadera (2020) maintained that family size is a critical determinant of labour supply in smallholder farming systems. Trading is the most common (59%) secondary occupation engaged in by the respondents followed by driving(26%) and fashion design (26%). This indicates some measure of income diversification which cushions risks from price volatility or crop failure (Alabi and Olatunde, 2021). Alam *et al*. (2021) found that farmers often embrace secondary occupations to augment their incomes and attain financial stability.

Family labour is the most used (51%) labour source by the respondents, followed by hired labour (28%). This confirms the prominence of family labour in the prosecution of farming duties in rural communities. This is especially the case for smallholder farmers who often lack the financial wherewithal to hire labour (Owusu et al., 2018). Beuchelt and Badstue (2021) upheld the heavy reliance on family labour in small-scale agricultural enterprise. Only 8% of the respondents had no formal education, while 92% had some level of educational attainment. This suggests a highly educated farming group with positive implications for their ability to effectively utilize mobile phone technology and assimilate information disseminated there-from (Rahman et al., 2020). Ndemdou and Fongang (2021) alluded to the importance of education in accessing and utilizing agricultural information. Much of the credit needs (82%) of the respondents derive from personal savings, suggesting self-financing as the dominant mode of executing farming operations. This implies limited access to formal credit outlets, with implications for the expansion prospects of the farms (Mohammed & Suleiman, 2021). Simotawe *et al.* (2023) affirmed the reliance of smallholder farmers on personal savings due to restricted access to formal credit facilities.

More than two-fifth of respondents (45%) earned $34.40 to $67.45 monthly from tomato farming which indicates modest income from the activity, Charles *et al.* (2022) noted that low or moderate-income earnings dampens farmers' investment or reinvestment aspirations due to limited savings. The yield distribution from tomato farming shows 40% of the respondents' generated annual yield of 0.50 tonnes, followed by 26% that generated 0.05-0.25 tonnes and 0.55-0.75 tonnes, respectively. This shows moderate yields from tomato farming, possibly due to limited access to high-yield inputs or technology (Lagos and Obiora, 2021). Fadare et al. (2025) confirmed that most smallholder farmers generate modest yields from their farms constrained by limited inputs and poor irrigation. Finally, most respondents (97%) own a mobile phone, indicating high penetration of mobile technology. This suggests that mobile phones could facilitate the diffusion of agricultural information among the farmers (Akinyemi and Bello, 2022). Hellin *et al.* (2021) concluded that ownership of mobile phones substantially improved farmers' access to market information and agricultural extension services.

Table 1: Socioeconomic characteristics of respondents

Variables	**Frequency**	**Percentage (%)**
Sex		
Male	56	56
Female	44	44
Age in years		
20 – 29	14	14
30 – 39	21	21
40 – 49	36	36
50 – 59	17	17
60 – 69	9	9
70 – 79	3	3
Marital Status		
Single	15	15
Married	77	77
Separated	3	3
Divorced	3	3
Widow	1	1
Widower	1	1
Religion		
Christianity	72	72
Islam	28	28
Traditional	-	-
Family size		

2 – 4	38	38
5 – 7	49	49
8 – 10	10	10
11 – 13	3	3
Secondary Occupation		
Artisan	7	7
Civil service	8	8
Trading	59	59
fashion designer, driver	26	26
Level of Education		
No formal education	8	8
Primary education	26	26
Secondary education	46	46
Tertiary education	16	16
Postgraduate	4	4
Source(s) of labour		
Self	14	14
Family	51	51
Hired labour	28	28
Communal labour	7	7
Source of credit		
Personal savings	82	82
Banks	5	5
Cooperative	11	11
Friends and relatives	2	2
Income (monthly) in dollars		
Less than $33.72	33	33
$34.40-$67.45	45	45
$68.12 - $101.17	8	8
$101.85 - $134.90	8	8
Above $134.90	6	6
Quantity of yield[tonnes]		
0.05 – 0.25	26	26
0.30 – 0.50	40	40
0.55 – 0.75	26	26
0.80 – 1.0	6	6
1.05 and above	2	2
Do you have a mobile phone?	97	97
If yes, what type		
Smartphone	60	60
Others	40	40

Source: Field survey, 2024.

3.2 Knowledge of mobile phone by respondents

Table 2 reveals that a huge proportion of respondents (94%) indicated that they could make, receive a call or send SMS using a mobile phone, suggesting a high level of familiarity with the mobile phone gadget and reasonable tech-savviness among the farmers, signalling the potential for routing vital agricultural information and resources through mobile devices (Akinyemi and Bello, 2022). Furthermore, 66% of the respondents indicated that they utilised their mobile phones for agricultural purposes such as accessing price information, contacting purchasers, obtaining advisory services, and accessing government support, demonstrating the role of mobile technology in supporting farming activities. Meanwhile, 62% of respondents had access to internet services on their phones, reinforcing the prospect of funneling agricultural information and services through this channel. Roughly half (51%) of the respondents reported that mobile phones influenced their tomato production practices through receiving advice from extension agents, accessing storage facilities and modern technology, and earning incomes. Hellin et al. (2021) affirm that the proliferation of mobile phones and digital applications in developing countries has significantly improved farmers' access to extension services, climate-smart technologies, and market intelligence. Such improvements not only enhance productivity but also contribute to resilience against climate-related shocks, which are particularly pressing for smallholder farmers.

Table 2: Knowledge of mobile phone by respondents

Knowledge on mobile phones	**Freq.**	**%**
Do you know how to make, receive a call or send SMS using a mobile phone?	94	94
Do you use your Mobile phone for agricultural purposes? (price information, contact with purchasers, advisory services, government support)	66	66
Do you have access to the internet on your phone?	62	62
Has mobile phones influenced your tomato production practices? (e.g. receiving advice from extension agents, storage facilities, use of modern technology, making more profit	51	51
Do you receive information about tomato productionon the phone? crop management practices	69	69

Source: Field survey, 2024.

3.3 Effectiveness of mobile phone utilisation for agricultural information

Effectiveness of mobile phones utilization was measured with 3 – point rating scale. The results reported in Table 3 reveals that the statement: "we receive government support to alleviate constraints faced by tomato farmers" ($\bar{X}$= 2.85; σ = 1.19), had a mean score exceeding the threshold of 2.5, suggesting that respondents considered mobile phones effective in accessing government assistance in form of improved seed varieties, fertilizers, pesticides, credit). This illustrates the utility of mobile phones in bridging the communication gap between the government and the farmers, culminating in the delivery of essential aid to unlock bottlenecks (Alabi and Olatunde, 2021). The mean scores of other statements were less than 2.5, indicating that while some benefits accrued to the respondents from mobile phone usage in those areas, they were not rated as effective. For instance, use of mobile phones to connect to buyers to make purchases ($\bar{X}$= 1.72; σ = 0.95), improve access to extension agents for advisory services on post-harvest tomato management ($\bar{X}$ = 2.11; σ = 0.90), enhance farming practices such as soil management, fertilizer application, and pest control ($\bar{X}$ = 2.30, σ = 0.85), and interaction with other farmers on market prices ($\bar{X}$ = 1.61; σ = 0.82), all had mean scores below the effectiveness threshold. Hellin *et al*. (2021) asserted that despite the potential of

mobile phone technology, its effectiveness is often limited by factors such as network coverage gaps, elevated costs, and digital illiteracy.

Table 3: Effectiveness of mobile phone utilisation for agricultural information

Effectiveness	$\bar{x}$	σ
I can easily connect to my buyer to make purchases	1.72	0.95
I believe that using mobile phone technology improved access to extension agents for advisory services on post-harvest tomato management	2.11	0.90
Mobile phone technology enhances my tomato farming practices such as soil management, fertilizer application and pest control	2.30	0.85
It helps me to interact with other tomato farmers on market prices	1.61	0.82
I receive government support (improved seed varieties, fertilizers, pesticides, credit) to alleviate constraints faced by tomato farmers	2.85*	1.19

Source: Field Survey, 2024.

*Mean≥ 2.5 =Effective

3.4 Constraints faced by tomato farmers using mobile phone technology

Table 4 shows that the constraint: "no light to charge phone" ($\bar{X}$= 2.75; σ = 0.87), exceeded the mean score threshold of 2.5, indicating that it was a severe constraint to the tomato farmers. Evidently, chronically poor infrastructure, especially inadequate and epileptic power supply, impedes the periodic charging of phone batteries, significantly limiting the effectiveness of mobile telephony in rural agricultural settings (Charles, *et. al*, 2022). Similarly, the constraint:"network issues on my mobile phone" ($\bar{X}$ = 2.68; σ = 0.76) was also severe, underscoring mobile phone network reliability challenges in the villages. This reflects the limited penetration of the necessary infrastructural backbone, bandwidth constraints and defective network navigation protocols, to support mobile telephone services in rural communities. The abysmal performance and poor quality of services rendered by telecommunication companies illustrated by network congestions, high latency, high drop call rates, frequent service disruptions and occasional service collapses, impacts the reliability of mobile communication and user satisfaction. However, constraints such as "lack of technical skills to operate mobile phones/illiteracy" ($\bar{X}$ = 2.08, σ = 0.77), "agricultural information received may not be clear and understandable" ($\bar{X}$ = 2.04;σ = 0.75), and "high cost of *SIM* card and data" ($\bar{X}$ = 2.34; σ = 0.79) were not rated as severe by the respondents. Regardless, these constraints remain significant concerns affecting the seamless and efficient operations of mobile communication services for agricultural purposes. For instance, the high cost of data precludes poor rural users from remaining online most of the time and in some cases, forces them to stay offline for extended days or weeks. This couldmake them miss out on crucial time-bound pieces of information, especially those relating to weather patterns or making specific payments to suppliers or agricultural authorities. Moreover, a considerable number of people in rural areas merely own basic mobile phone sets which are not end-to-end internet-enabled and therefore not perfect for regular information exchanges. Akinyemi and Bello (2022) posited that infrastructural deficiencies and high communication costs are major barriers to mobile technology adoption among smallholder farmers.

Table 4: Constraints faced by tomato farmers using mobile phone technology

Constraints	Mean	Std. Dev.
No light to charge phone.	2.75*	0.87
Lack of technical skills to operate it/illiteracy.	2.08	0.77
The agricultural information received may not be clear and understandable.	2.04	0.75
High cost of sim card and mobile data.	2.34	0.79
I experienced network issues on my mobile phone.	2.68*	0.76

Source: Field Survey, 2024. *Mean≥ 2.5 = Severe constraints

3.5 Hypothesis test result

Table 5shows a significant relationship between socioeconomic characteristics of the farmers such as age (χ^2=38.720; p< 0.05), marital status (χ^2=270.440;p< 0.05), family size (χ^2=63.061;p< 0.05), secondary occupation (χ^2=58.080;p<0.05), level of education (χ^2=71.703;p< 0.05), sources of labour (χ^2=45.200;p< 0.05), sources of credit (χ^2=174.960;p< 0.05), and monthly income (χ^2=63.900;p< 0.05) and effectiveness of mobile phone technology for disseminating agricultural information (χ^2=58.080; p< 0.05). However, sex shows no significant relationship with effectiveness of mobile phone usage for agricultural purposes (χ^2=1.440; p>0.05). These findings imply that socioeconomic factors like education, income, and labour sources influence how effectively farmers utilize mobile technology for agricultural activities. This is consistent with the finding of Marengo *al.* (2022) who confirmed that mobile phones enabled market access and information flows when socioeconomic barriers are minimised. Therefore, calibrated interventions incorporating socioeconomic factors are essential for maximizing the benefits of mobile technology for agricultural practices in rural settings. The non- significance of the gender variable suggests that both men and women benefit from mobile phone technology, given similar socioeconomic characteristics.

Table 5: Relationship between respondents' socioeconomic characteristics and the effectiveness of mobile phones utilisation

Variables	χ^2	*p*-value
Effectiveness	58.08*	0.000
Sex	1.44	0.230
Age	38.72*	0.000
Marital status	270.44*	0.000
Family size	63.06*	0.000
Secondary occupation	71.70*	0.000
Level of education	56.40*	0.000
Sources of labor	45.20*	0.000
Sources of credit	174.96*	0.000
Monthly income	63.90*	0.000

*Significant at $p \leq 0.05$, **Source**: Field survey, 2024.

Conclusions

This study examined the effectiveness of mobile phone technology in enhancing agricultural information dissemination among tomato farmers in Ondo State. The socioeconomic characteristics of tomato farmers in the study area revealed a relatively balanced gender distribution, with a slight

predominance of males (56%). Most respondents fall within the middle-aged adult category with 36% aged 40-49 years and 21% aged 30-39 years. Most (77%) of them were married, with household size of 5-7 members (49%) and almost half (46%) had secondary education. Trading is the most prevalent secondary occupation among respondents (59%). Mobile phones are widely owned and used by farmers, not only for communication but also for accessing agricultural information and improving farming practices. There was basic knowledge of mobile phone usage for making, receiving calls or sending SMS among the respondents. Mixed effectiveness was found for use of mobile phone technology in facilitating agricultural information depending on purpose. Mobile phones were effective for accessing government support for provision of inputs and credit, while other uses of mobile phones such asinteracting with peers on market pricesand connecting to buyers were not effective. The severest constraint faced by tomato farmers in using mobile phone technology was lack of electricity to charge phones. Other constraints included network connectivity issues, lack of technical skills and high cost of data. Chi-Square analysis revealed significant relationships between the effectiveness of mobile phone technology utilization and various socio-economic factors, including sex, age, marital status, family size, secondary occupation, education level, sources of labor, sources of credit, and monthly income.

Recommendations

It is recommended that electricity supply should be improved in rural communities, mobile phone network infrastructure should be upgraded in these communities to reduce connectivity problems, mobile services should be made more affordable to farmers, user-friendly and customized applications that address specific constraints of the farmers should be developed while digital literacy should be promoted through trainings and workshops at community level.

Conflict of interest

The authors declare no conflicts of interest

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