USAGE OF MOBILE PHONE APPLICATIONS FOR THE MANAGEMENT OF CROP DISEASES AMONG ARABLE CROP FARMERS IN ONDO STATE, NIGERIA

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Abstract
Arable farming, which involves the cultivation of annual food crops, faces significant challenges from crop diseases that negatively impact productivity, particularly in Nigeria. Despite limited understanding of the underlying causes, farmers recognize the adverse effects of diseases. With the rapid adoption of Information and Communication Technologies (ICT), especially mobile phones, in Nigeria and across Africa, there is potential for these tools to enhance disease management among farmers. This study aims to assess the socio-economic characteristics of farmers, their awareness, and knowledge of using mobile phones for crop disease management, and the constraints they face in utilizing these technologies. A multi-stage sampling method was employed to select 120 arable crop farmers from Ondo State, Nigeria. Data were collected using structured interviews and analyzed using descriptive statistics, Chi-square, and correlation analysis. Results indicated that while most farmers (65.8%) are highly aware of the potential of mobile phones for disease management, there is a low perception of their practical application due to concerns about reliability and accessibility. Significant relationships were found between farmers' socio-economic factors, such as primary occupation and mobile phone ownership, and their awareness and knowledge of using mobile phones for crop disease management. The study concludes that although mobile phones can potentially improve disease management among farmers, barriers such as inadequate extension support, high illiteracy, and high data and smartphone maintenance costs limit their effectiveness. The findings suggest a need for targeted educational programs and integrated extension approaches to enhance farmers' capabilities in using mobile technologies for agricultural purposes.

Keywords: arable, diseases, farmers, mobile, phones

Introduction

Arable farming involves the production of a wide range of annual food crops, completing the entire life cycle of these crops from germination to seed production within one year (Ibidapo *et al.*, 2018). However, crop diseases pose a major constraint to increased productivity, particularly in Nigeria (Mekele Research Center 2015). Although farmers might not fully understand the underlying causes of crop diseases, they are aware of the damage inflicted on field and horticultural crops by diseases such as cereal rusts, smuts, powdery mildews, and bulb or root rots.

In recent years, there has been rapid transformation and growth in the use of ICT especially mobile phones in Nigeria and across Africa (Jensen, 2017). Mobile phones can be used as a tool for the identification and management of crop diseases. Farmers have found innovative ways to

utilize mobile phones for various purposes, such as accessing market information for financial transactions and seeking agriculture emergency assistance and expert advice (Basu & Goswami, 2012; Churi *et al.,* 2012). According to Martin and Abbott (2011), Okello et al. (2012), and GSMA (2013) mobile phones are particularly beneficial for rural people including the farmers. Interactions through mobile phones provide cost-effective means for smallholder farmers to connect with stakeholders, while the phones offer a sense of security and social status. Having adduced the many benefits of the mobile phone to agriculture, there remains a knowledge gap regarding their use among smallholder farmers (Mary, Lusike et al., 2024). It is to this end that the study is addressing the following objectives which are to:

1. describe the socio-economic characteristics of the respondents;
2. determine the level of awareness of the respondents in mobile phone usage for crop disease management;
3. determine the level of farmers' alertness to mobile phone technology for crop disease management and
4. ascertain the constraints to using mobile phones for crop disease management in the study area.

Research Methodology

The study was conducted in Ondo State, which is located between latitudes 5^{o}45' and 7^{o}52'N and longitudes 4^{o}20' and 6^{o}5'E. The total land area of the state is approximately 15,500 square kilometres. A purposive sampling technique was employed. In the first stage, three Local Governments (LGAs) in the state were purposively selected: Ondo West, Ondo East and Odigbo. In the second stage, three communities known for high production of arable crops were chosen from these LGAs. in the final stage, 20 arable crop farmers were randomly selected from each of the three communities selected, resulting in a total sample size of 120 farmers. The data for this study was collected using a well-structured and validated interview schedule to collect relevant information based on the objectives of the study. The data were analyzed using descriptive statistics such as frequency counts, percentages, mean and standard deviation. also, chi-square tests and correlation analyses were conducted to determine the relationship between the dependent and independent variables of the study.

Results and Discussions

Socio-economic Characteristics of the Respondents

Table 1: *Socio-economic Distribution of Respondents* **n=120**

Variables	Frequency	Percentage	Mean	Standard Deviation
Gender				
Male	112	93.3		
Female	8	6.7		
Age				
<20	1	8	47.17	9.20
21-40	38	31.7		
41-60	78	65.0		
>60	3	2.5		
Religion				
Christian	91	75.8		
Muslim	29	24.2		
Marital status				
Single	5	4.2		
Married	113	9.4		
Separated	2	1.7		
Household				
1-3	12	10.0	4.92	1.38
4-6	94	78.3		
7-10	14	11.7		
Size of the arable land Variable				
1-3	110	91.7	2.23	1.53
4-6	6	5.0		
7-10	4	3		
Years of farm experience				
1-10	27	22.5	14.07	5.057
10-20	87	72.5		
20-30	5	4.2		
>30	1	8		

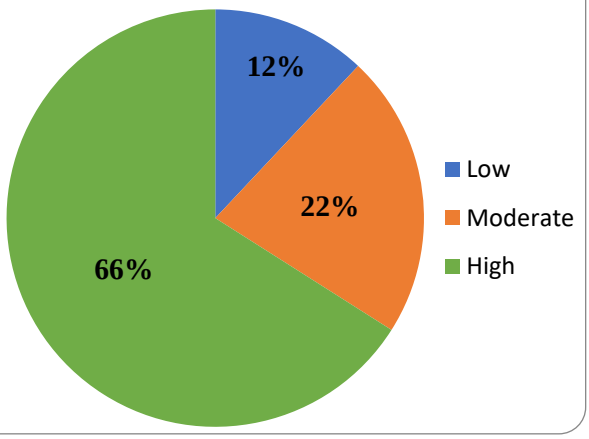
Source: Field Survey, 2023

The results in Table 1 show that 93.3% of the respondents were males while 6.7% percent were females. This implies that there are more males involved in arable crops in the study area compared to females. Also, 65.0% of the respondents were aged between 41-60 years, 31.7% were aged between 21-40 years, and 2.5% were above 60 years of age. The average age of the respondents was 47.17. In terms of religious affiliation, about 75.8% of the respondents

identified as Christian, while 24.2% were adherents to Islam. The majority of respondents (94%) were married, with 4.2% single and only 1.7% separated. The average household size was 4.92 with a standard deviation of 1.38. The study's finding of an average household size of 4 contradicts the findings of Muhammed-Lawal *et al.* (2009) that farm families in rural communities have a reasonably large family size which may provide more family labour in agricultural production.

Level of awareness of mobile phone potential for crop disease management

Figure 1: *Level of awareness of mobile phone potential for crop managemnt %*



The results in Figure 1 show that 11.7% of the respondents had low awareness, 22.5% were moderately aware, and 65.8% were highly aware of the potential of the mobile phone for managing crop disease. The implication of the finding shows that respondents were conscious of the potentials of the mobile phone to access information that would help them manage pests and diseases affecting their arable crops.

Farmers' Perception of Mobile Phone Application in Crop Disease Management

Table 2: *Farmers' Perception of Mobile Phone Application in Crop Disease Management*

Statements	A Freq. (%)	U Freq. (%)	D Freq. (%)	Mean Score	Standard Deviation	Rank
It could be risky and unrealistic to rely on mobile applications for crop disease identification.	25 (20.8)	3(2.5)	92(76.7)	1.44	.81782	11th
Farmers are receiving useful information through mobile applications.	19(15.8)	2(1.7)	99(82.5)	1.33	.73717	12th
Mobile applications could be used for agricultural purposes.	20(16.7)	2(1.7)	98(82.5)	1.35	.75203	10th
Many mobile applications could be used for agriculture.	18(15.0)	9(7.5)	93(77.5)	1.37	.73407	8th
Mobile applications may give false information about disease identification and management.	17(14.2)	10(8.3)	93(77.5)	1.36	.72103	9th
I know that mobile applications could be used for crop disease management	22(22.5)	3(2.5)	90(75.0)	1.47	.83979	7th
Mobile applications expose my confidential information.	32(26.7)	1(0.8)	87(72.5)	1.54	.88779	6th
I think mobile applications can give false information that can lead to loss of output.	41(34.2)	3(2.5)	76(63.3)	1.70	.94732	5th
Mobile applications are too expensive for usage.	100(83.3)	2(1.7)	18(15.0)	2.68	.72162	4th
Mobile applications are suitable for the types of farming I do.	103(85.8)	10(8.3)	7(5.8)	2.80	.52820	3rd
Using agricultural mobile applications fits the way I'm running my farm.	106(88.3)	9(7.5)	5(4.2)	2.84	.46735	2nd
Agricultural mobile applications are compatible with disease management	115(95.8)	1(0.8)	4(3.3)	2.92	.37038	1st
Grand mean= 1.90						

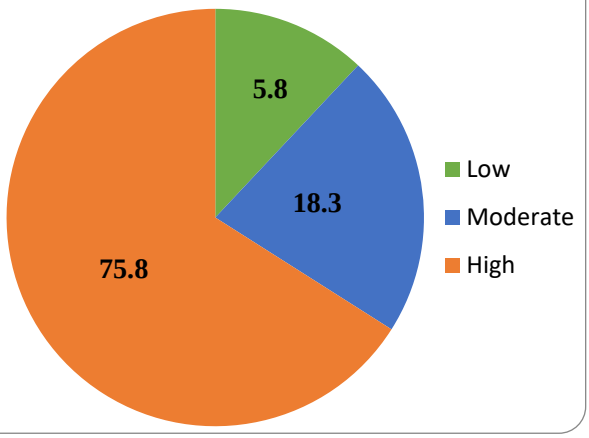
Source: Field Survey, 2023

The results in Table 2 indicate that the respondents felt "agricultural mobile applications are compatible with disease management with a mean score of 2.92, which ranked the highest among the items assessing the perception of farmers on Mobile phone applications. In contrast, the item "farmers are receiving useful information through mobile application" with a mean score of 1.33 was ranked twelfth. Overall, the grand mean score for farmers' engagement with

mobile phone applications in crop disease management was 1.73 which showed a moderate perception of their effectiveness.

Level of farmer Alertness to Mobile Phone Application in Crop Disease Management

Figure 2: *Level of Alertness to mobile phone application to crop disease management*



The results in Figure 2 show the overall level of farmers' alertness to mobile phone applications in crop disease management. This awareness was categorized into three levels: low, moderate and high level, using equal intervals. Scores of less than 8 were classified as low, scores between 8-16 were considered moderate, and scores above 16 indicated a high level of alertness to mobile phone applications. These findings reveal that 18.3% of the respondents exhibited a low level of alertness to mobile phone applications in crop disease management, while 75.8% had a moderate level of alertness. Only 5.8% of the respondents demonstrated a high level of alertness to mobile phone applications in crop disease management. The implication of the finding shows that the majority of respondents have moderate alertness to mobile phone applications in crop disease management.

Farmers' Knowledge of Mobile Phones for Crop Diseases Management

Table 3: *Farmers' Knowledge of the Use of Mobile Phones for Crop Diseases Management*

Variable	Nk Freq. (%)	Fk Freq. (%)	K Freq. (%)	Hk Freq. (%)	Mean Score	Standard Deviation	Rank
Use of mobile phones to contact friends, farmers and neighbours who are involved in common crop products for advice.	29(24.2)	17(14.2)	66(55.0)	8(6.7)	2.44	.93302	1st
knowledge on how to identify crop diseases after browsing?	30(25.0)	26(21.7)	61(50.8)	3(2.5)	2.31	.87731	2nd
Use of mobile phone to share your diseases on any social media or search the internet for information on the diseases.	40(33.3)	15(12.5)	63(52.5)	2(1.7)	2.21	.94543	5th
Use of Facebook or Google pages for disease identification and management.	36(30.0)	23(19.2)	59(49.2)	2(1.7)	2.22	.90249	4th
Use of mobile phone to take pictures of crop disease leaves to expert and extension agents in other to seek advice.	44(36.7)	64(53.3)	11(9.2)	1(0.8)	1.75	.65144	6th
Purchase pesticides and insecticides through mobile phone usage?	47(39.2)	62(51.7)	9(7.5)	2(1.7)	2.23	1.00196	3rd
Use of mobile phones to make calls to extension agent with your mobile phone.	99(82.5)	12(10.0)	8(6.7)	1(0.8)	1.26	.61488	7th
Do agricultural extension services and expert visited farms to give farmer advice on how to used mobile phone to control crop disease?	107(88.2)	7(5.8)	6(5.0)	0(0.0)	1.16	.48500	8th

Source: Field survey, 2023 NK=Not Knowledgeable, FK= Fairly Knowledgeable, K= Knowledgeable, HK= Highly Knowledgeable, SD=Standard Deviation

Results in Table 3 show that the use of mobile phones to contact friends, fellow farmers and neighbours involved in common crop products ranked the highest among the activities respondents engaged in regarding their knowledge of mobile phones for managing crop diseases with a mean of 1.50. This was followed by the knowledge of how to identify crop diseases which ranked second with a mean score of 1.31. The use of mobile phones for disease identification and management as well as for sharing information about disease on social media both received a mean score of 1.23, ranking third among the activities. Managing crop diseases using mobile

phone technology ranked sixth, with a mean score of 0.72. Additionally, contacting extension agents via mobile phone ranked seventh with a mean score of 0.26. The involvement of agricultural extension services and experts visiting farms to give farming advice on mobile phone use received the lowest ranking with a mean score of 0.16. Overall, the grand mean score of 1.50 suggests that respondents possess a moderate level of knowledge regarding the use of mobile phones for crop disease management.

Constraints of the Use of Mobile Phone Application for Crop Disease Management

Table 4: *Constraints of the Use of Mobile Phone Applications for Crop Disease Management*

Constraints	Mean Score	Rank
Inadequate extension constraints.	1.83	1st
Mobile phone operating complexity.	1.77	2nd
High level of illiteracy	1.73	3rd
Low quality of service by mobile phone	1.72	4th
High cost of smartphones	1.42	5th
Inadequate supply of electricity for charging the battery	1.19	6th
High cost of data subscription.	1.05	7th
High cost of maintenance.	0.98	8th

Source: Field survey, 2023

The results presented in Table 4 indicate that the most significant constraint affecting the use of mobile phone applications for crop disease management is inadequate extension services, with a mean score of 1.83. Following this, mobile phone operating complexity was ranked second by the respondents, with a mean score of 1.77. The third highest constraint was a high level of illiteracy, which received a mean score of 1.73. The two lowest-ranked constraints were the high cost of data subscriptions (mean = 1.05), which was ranked seventh, and the high cost of maintenance (mean = 0.98), ranked eighth by the respondents.

Hypotheses Testing

Hypothesis 1: There is no significant relationship between the socio-economic characteristics of the respondents (sex, marital status, religion, primary occupation, and mobile phone ownership) and the farmer's alertness to mobile phone applications for the management of crop disease among arable crops.

Results of Chi-square analysis

Table 5: *Relationship between Socio-economic Characteristics of Respondents and Level of Farmer's Alertness to Mobile Phone Application*

Variable	χ^2 - value	D.f	C	P-value	Decision
Sex	2.418	2	0.141	0.29	NS
Marital status	1.748	4	0.120	0.78	NS
Religion	5.812	2	0.215	0.05	S
Primary occupation	13.211	4	0.291	0.00	S
Mobile phone ownership	7.110	2	0.201	0.00	S

**Significant at P≤ 0.05; C = Contingency coefficient; D.f = Degree of freedom; χ^2 = Chi-square

The results of the chi-square analysis presented in Table 5 indicate a significant association between religion (χ^2 = 5.812), primary occupation (χ^2 = 13.211), and mobile phone ownership (χ^2 = 7.110) among respondents, at a significance level of P ≤ 0.05. However, no significant associations were found for sex (χ^2 = 2.418) and marital status (χ^2 = 1.748), with a significance level of P ≤ 0.78. This suggests that a higher level of external orientation among respondents correlates with increased farmer alertness to mobile phone applications for managing crop diseases in arable crops. Similarly, it also implies that primary occupation can influence respondents' engagement with mobile phone applications for managing crop diseases in the study area.

Results of Correlation Analysis

Table 6: *Relationship between some selected socioeconomic characteristics and the level of farmer's alertness to mobile phone application*

Variable	r-value	p-value	Decision
Household size	0.564**	0.05	S
Age	-0.073	0.42	NS
Years of farming experience	0.271**	0.00	S
Years of formal education	0.143	0.11	NS
Estimated annual income	0.236**	0.00	S

Source: Field survey, 2023; **Significant at P≤ 0.00

The results in Table 6 reveal that household size (r = 0.564), years of experience (r = 0.271), and estimated annual income (r = 0.236) all showed significant positive correlations at p ≤ 0.05. This suggests that increases in household size, years of experience, and estimated annual income among respondents contribute to greater alertness regarding mobile phone applications for managing crop diseases in arable crops. In contrast, age (r = -0.073) and years of formal

education (r = 0.143) had no significant relationships with farmers' alertness to mobile phone applications for crop disease management, as both were not significant at $p \leq 0.11$.

Hypothesis 2: There is no significant relationship between awareness and farmer's alertness to mobile phone applications for the management of crop disease among arable crops.

TABLE 7: *Result of Correlation Analysis Showing the Relationship between the Awareness and Alertness of Respondents*

Variable	r-value	P-value	Decision
Relationship between awareness & alertness in the farmer's alertness to mobile phones application for management of crop disease among arable crops	0.503**	0.00	S

Source: Field survey, 2023; **Significant at $P \leq 0.05$

Table 7 shows a positive and significant relationship between respondents' awareness and their alertness regarding mobile phone applications for managing crop diseases in arable crops (r = 0.503**, $P \leq 0.00$). This suggests that as respondents become more aware of these applications, they are increasingly alert to their potential for managing crop diseases in the study area.

Discussion

The study provides valuable insights into how farmers currently use mobile phones to manage crop diseases. Conducted with 120 arable crop farmers, the research examines farmers' socio-economic characteristics, awareness, knowledge, and perceptions of mobile phone applications for disease management, as well as the constraints they face in utilizing these technologies. One significant finding is that a majority of the farmers (65.8%) are highly aware of the potential benefits of mobile phones in managing crop diseases. This is important as these technologies can help promote sustainable practices by reducing crop losses and enhancing food security (Asani et al., 2023). This awareness indicates that farmers understand the benefits mobile technology could offer in accessing timely and accurate agricultural information. However, despite this high level of awareness, the practical use of mobile phones for managing crop diseases remains limited. Many farmers have expressed concerns about the reliability of information received via mobile applications, identifying this as one of their primary concerns.

Socio-economic factors played a significant role in shaping farmers' awareness and use of mobile phones for crop disease management. For instance, significant relationships were observed between mobile phone ownership, primary occupation, and farmers' alertness to mobile phone applications. This implies that individuals with greater access to resources and higher involvement in farming activities are more likely to adopt mobile technologies for disease management. Moreover, household size, years of farming experience, and annual income positively influenced farmers' alertness to mobile applications. This suggests that more experienced and economically stable farmers are better equipped to utilize these tools.

The study revealed several barriers that limit the effective use of mobile applications among farmers. One of the main constraints is inadequate extension support, indicating that farmers lack sufficient guidance from agricultural experts on how to integrate mobile technologies into their crop management practices. Additionally, the complexity of mobile phone operations and high levels of illiteracy among some farmers were highlighted as significant challenges. While mobile phone penetration is high, the cost associated with smartphone, data subscription fees, and maintenance expenses further hinder the broader adoption of mobile applications in agricultural practices. These findings align with those of Tran, Cao, Uy.et al., (2023) which reported significant correlations between mobile phone usage and demographic factors, suggesting that young and educated farmers should be prioritized in digital service development, while also emphasizing the importance of ensuring female farmers have access to mobile technology. However, the study also supports the findings of Mary, Lusike et al. (2024) which indicate that economic factors significantly hinder the adoption of mobile technology among smallholder farmers.

Farmers have a moderate knowledge of using mobile phones for disease management. The most common use of mobile phones is for contacting friends, neighbours, or fellow farmers to seek advice on crop-related issues. This peer-to-peer communication ranked highest in terms of farmer knowledge and application. However, more advanced uses of mobile phones, such as purchasing pesticides or communicating directly with extension agents, ranked lower. This reflects a gap between basic communication uses of mobile phones and more specialized agricultural applications, which require additional training and support contrasting the view that mobile apps are designed for ease of use, allowing farmers to access disease management tools anytime, anywhere (Bangole, 2024).

In terms of perceptions, farmers exhibit a mix of optimism and caution regarding mobile phone applications. While there is recognition that mobile phones can support farming practices and can provide valuable assistance, many farmers remain wary of relying solely on mobile applications due to concerns about false information, potential privacy risks, and the overall costs involved. Farmers perceive mobile applications as potentially useful but also risky if not properly regulated or supported by reliable data sources.

Conclusion

This study emphasizes the potential of mobile phone technology as a tool for managing crop diseases among arable farmers in Ondo State, Nigeria. Despite the high level of awareness of mobile phones' capabilities, there remains a gap in their effective utilization due to various constraints, including inadequate extension services, high operating costs, and complex technology usage. Significant socio-economic factors, such as primary occupation and mobile phone ownership, play a crucial role in influencing farmers' knowledge and perception of using these technologies for agricultural purposes. The findings underscore the need for a multifaceted approach to enhance the adoption and effectiveness of mobile phone applications in agriculture. to achieve this, it is essential to improve farmers' digital literacy through targeted training

programs, integrating traditional extension services with digital tools, and addressing the affordability and accessibility challenges related to mobile technology. By bridging these gaps, farmers can better leverage mobile phones for timely disease identification and management, ultimately leading to improved crop productivity and sustainable farming practices. Local governments and stakeholders must collaborate to create supportive environments that empower farmers to fully utilize mobile technology for effective crop disease management.

Recommendations

Based on the findings the following recommendations are made:

1. The use of mobile phones should be maximized in extension but should be combined with conventional extension approaches involving farmer-extension contact and farm visits.
2. Efforts should be geared towards training farmers on the appropriate management strategies with emphasis on the need for the farmers to adopt innovation that will enhance improved farm practices.
3. Government at the local Government level should therefore organize an adult education programme for the farmers to increase their knowledge and understanding of risk and application of the appropriate management strategies.

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