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Original Article

Socio-Demographic Characteristics and Adoption of Mobile Phone Applications for Improved Small-scale Commercial Agriculture in Makonde District, Zimbabwe

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Mobile applications have provided a new way for agricultural transformation. This is set to revolutionise the agriculture sector with easy access to vital agricultural information on weather, market trends, pest, and disease management, and best agriculture practices to enhance agricultural productivity and profitability. However, there is a dearth of studies on the adoption of mobile applications in agriculture. It was important for this study to understand the impact of farmers' demographic characteristics on the adoption of mobile applications in small-scale commercial agriculture. The study applied the quantitative research approach, a sample size of 213 small-scale commercial farmers, a descriptive cross-sectional research design, and the structured household questionnaire survey instrument, purposive random and stratified sampling techniques to collect primary data. Data was analyzed using descriptive statistics. The findings of the study revealed a higher adoption rate of mobile applications among young farmers than old farmers. The study indicated that female small-scale commercial farmers adopted mobile applications than male farmers. The study revealed that the majority of small-scale commercial farmers were literate. Further, the study highlighted that married farmers exhibited a greater tendency to adopt mobile applications than single, divorced, separated, and widowed. Furthermore, the study revealed that the majority of small-scale commercial farmers were engaged in agriculture as their primary occupation. The study argued that young farmers, female farmers, educated farmers, married farmers, and farming as a primary occupation positively influenced the adoption of mobile phone applications for improved small-scale commercial agriculture. The study recommends that policymakers and implementers should consider socio-demographic characteristics as critical determinants of the adoption of mobile phone applications for improved small-scale commercial agriculture to tailor strategies that promote the adoption of mobile applications based on different farmer age groups.

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INTRODUCTION

Socio-demographic characteristics offer valuable insights into the specific needs and preferences of farmers, which inform the design and implementation of mobile phone applications in agricultural settings (Hoang, 2020; Landman et al., 2020; Mutambara, 2021; Mutuma et al., 2023). They help identify any disparities in the adoption of mobile phone applications, such as differences between age groups, genders, educational levels, marital status, and farmers' primary occupation (Hoang, 2020; Landman et al., 2020; Mutambara, 2021; Mutuma et al., 2023). Studies by Akter and Tan (2023); Hoang (2020); Landman et al. (2020); Mutuma et al (2023) and Osei-Kofi et al. (2023) affirmed that these socio-demographic characteristics influence the adoption of mobile applications. However, it appears that there is limited research on the socio-demographic characteristics of the adoption of mobile phone applications for improved small-scale commercial agriculture in Makonde District, Zimbabwe. Thus, the current study aims to fill this research gap.

LITERATURE REVIEW

Studies on socio-demographic characteristics and the adoption of mobile applications in the agricultural sector have yielded inconclusive results. It is essential to understand these variations. Thus, the reviewed literature indicates that the socio-demographic characteristics of small-scale commercial farmers play a crucial role in the adoption of mobile phone applications in agriculture.

Age and Adoption of Mobile Phone Applications in Agriculture

Age has been positively associated with the adoption of mobile phone applications in agriculture. Studies by Adams & Jumpah (2021); Dagar et al (2021); Nwali et al (2022) and Rahman et al (2020) attributed age differences to the adoption of mobile phone applications. Ahmad et al (2024); Akter & Tan (2023); Duc et al (2023); Hoang (2020); Krell et al. (2020); Mutambara (2021); Mutuma et al (2023) and Quandt et al. (2020) proved that younger farmers were more likely to adopt mobile phone applications in agriculture. Similarly, studies by Kabirigi et al (2022), Kilima and Chikuni (2021) concluded that younger farmers were more likely to adopt mobile

phone applications in agriculture. On the contrary, studies by Benard et al (2020) and Nwali et al (2022) emphasized that older farmers were constrained in their adoption of mobile applications. Thus, the study hypothesizes that:

H1: Young farmers are more likely to adopt mobile phone applications in agriculture than older farmers.

Gender and Adoption of Mobile Phone Applications in Agriculture

Gender is among the common variables for determining the adoption of mobile phone applications in agriculture. Studies by Dagar et al (2021) and Zheng & Ma (2023) showed that women were less likely to adopt mobile phone applications in agriculture, while Krell et al (2021) indicated that men were inclined towards the adoption of mobile phone applications in agriculture. On the contrary, studies by Akter & Tan (2023); Duc et al (2023); Miine et al (2023); Mutambara (2021), and Mutuma et al (2023) indicated a larger number of female farmers have adopted mobile phone applications compared to their male counterparts. Further, a study by Yassen et al (2021) showed that men and women differed significantly in the adoption of mobile phone applications in agriculture. Therefore,

H2: Men are more likely to adopt mobile phone applications in agriculture than women.

Education Level and Adoption of Mobile Phone Applications in Agriculture

Education level is one of the most important socio-demographic characteristics influencing the adoption of mobile phone applications in agriculture. Studies by Abubakari et al (2023) Adams & Jumpah (2021); Diaz et al (2021); Duc et al (2023); Dube-Takaza et al (2023); Hoang (2020); Khan et al (2020); Krell et al (2021) and Landman et al (2020) found that education positively influenced the adoption of mobile phone applications for agricultural purposes. On the contrary, studies by Rahman et al (2020) and

Ujakpa et al (2021) affirmed that illiterate farmers were less likely to adopt mobile phone applications in agriculture. Thus, the following hypothesis is proposed:

H3: Education level significantly influences the adoption of mobile in agriculture.

Marital Status and Adoption of Mobile Phone Applications in Agriculture

The marital status of farmers is one of the significant determinants of the adoption of mobile phone applications in agriculture. Studies by Akter & Tan (2023); Dube-Takaza et al (2023); Mutuma et al (2023); Neway & Zegeye (2022); Spencer et al (2022) and Yakomo (2020) reported that married farmers shared usage experiences as they sought to accomplish common goals hence similar intentions on adoption of mobile phone applications. Further, Dissanayake et al (2022); Hoang (2020a); Hoang (2020b), and Miine et al (2023) observed that married farmers were willing to adopt mobile phone applications in agriculture. The study hypothesized that:

H4: Married farmers significantly and positively influence on the adoption of mobile phone applications in agriculture.

Farmers' Occupation and Adoption of Mobile Phone Applications in Agriculture

Farmers' primary occupation has been observed to influence the adoption of mobile phone applications in agriculture. Studies by Abubakari et al (2023); Akter & Tan (2023); Hoang (2020); Krell et al (2020); Mutambara (2021); Mutuma et al (2023) and Osman et al (2022) revealed that farming as a primary occupation has a favorable and significant influence on the adoption of mobile phone applications in agriculture. The study hypothesized that:

H5: Farming as a primary occupation influenced the adoption of mobile phone applications in agriculture.

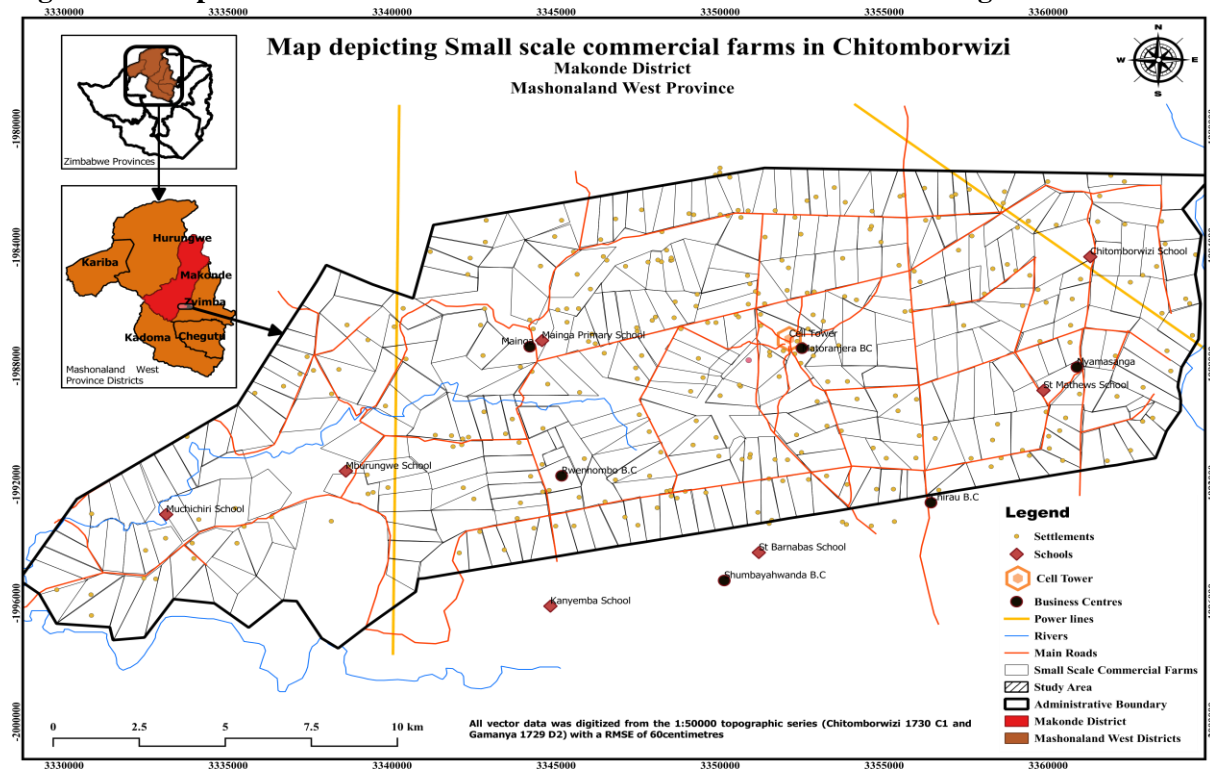
METHODOLOGY

Description of the Study Area

The research was conducted in the Chitomborwizi region, which is characterized by small-scale commercial farming within the Makonde District of Mashonaland West Province in Zimbabwe (fig.3.1). The study area relies heavily on agriculture, which

serves as the primary sector and a crucial catalyst for socio-economic development among the majority of small-scale commercial farmers. It is one of the agriculturally productive areas in the district. Therefore, Chitomborwizi was deemed an appropriate study area due to its concentration of small-scale commercial farming activities.

Figure 3. 1 Map of Makonde-Chitomborwizi small-scale Commercial Farming Area



Source: Author (2024)

Data Collection

The study employed a descriptive cross-sectional research design to investigate how socio-demographic characteristics influence the adoption of mobile phone applications for improved small-scale commercial agriculture. To enhance the understanding of the impact of socio-demographic characteristics on the adoption of mobile applications, a quantitative approach was employed in the study. Quantitative data were collected using a researcher-administered structured household questionnaire survey instrument. The use of the

household questionnaire survey instrument was favored due to its appropriateness for effectively presenting quantitative findings.

Sampling Techniques

The study focused on a target population of 475 small-scale commercial farmers, from which a sample size of 213 small-scale commercial farmers was extracted. The sample size was calculated utilizing the RaoSoft online-based sample size calculator, ensuring a 95% confidence level, 5% margin error, and 50% population proportion. To ensure validity of the sample, purposive random and

stratified sampling techniques were adopted in the selection process of small-scale commercial farmers.

Data Analysis

The primary data collected from small-scale commercial farmers through the structured household questionnaire survey underwent analysis utilizing the Statistical Package for Social Sciences (SPSS) version 28 to determine socio-demographic

characteristics that influence the adoption of mobile phone applications for improved small-scale commercial agriculture. Descriptive summaries were done for socio-demographic characteristics data using frequency counts and percentages.

PRESENTATION AND ANALYSIS OF RESEARCH FINDINGS

Descriptive Statistics on Socio-Demographic Characteristics Participants

Table 1. 1 Variables and Measurements

Variables	Measurements
<i>Dependant Variable (Y)</i>	
Adoption of Mobile Phone Applications	Binary: Y is 1 if farmers have adopted mobile applications and 0 if they did not adopt mobile applications.
<i>Independent Variables (X)</i>	
Age	Age ranges 1=20-29; 2=30-39; 3=40-49; 4=50-59; 5=60-60; 6=70 and Above
Gender	1= Male; 2= Female
Education Level	1=Primary Education; 2=Secondary Education; 3=Certificate Level; 4=Diploma; 5=Degree; 6=Master's Degree; 7=Doctorate, 8=Others
Marital Status	1= Single; 2= Married; 3= Divorced; 4=Widowed; 5=Seperated; 6=Divorced.
Farmers' Primary Occupation	1= Farmer; 2= Driver; 3= Business Owner; 4=Civil Servant; 5=Craftsman; 6=Others.

Source: Author's Illustration

AGE

Table 1.2 shows the distribution of research participants by age.

Table 1. 2 Distribution of Participants by Age Groups

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	20-29	47	22.1	22.1	22.1
	30-39	63	29.6	29.6	51.6
	40-49	54	25.4	25.4	77.0
	50-59	26	12.2	12.2	89.2
	60-69	17	8.0	8.0	97.2
	70 and Above	6	2.8	2.8	100.0
	Total	213	100.0	100.0	

Source: Primary Data

Table 1.2 illustrates the results of the descriptive statistical analysis of 213 surveyed small-scale commercial farmers' age distribution. The age group of 20-29 had 47 (22.1%) participants; 30-39 had 63 (29.6%) participants, 40 to 49 age group had 54 (25.4%) participants; 50-59 had 26 (12.2%) participants; 60-69 had had 17 (8.0%) participants

and 70 and above had 6 (2.8%) participants of the total small-scale commercial farmers. This implies that a greater number of young farmers adopted mobile applications in small-scale commercial agriculture compared to older farmers.

GENDER

Table 1.3 shows the distribution of research participants by gender.

Table 1. 3 Distribution of Participants by Gender Orientation

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	99	46.5	46.5	46.5
	Female	114	53.5	53.5	100.0
	Total	213	100.0	100.0	

Source: Primary Data

Table 1.3 shows that out of the 213 small-scale commercial farmers surveyed, 114 (53.5%) were female, while 99 (46.5%) were male. Further, the results indicate that there was a 7% higher representation of female farmers in comparison to their male counterparts. This implies that the number of female farmers who adopted mobile

applications in agriculture is more, while the number of male farmers is few.

EDUCATION LEVEL

Table 1.4 shows the distribution of participants by education level.

Table 1. 4 Distribution of Participants by Education Levels

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Primary Education	26	12.2	12.2	12.2
	Secondary Education	45	21.1	21.1	33.3
	Certificate	28	13.1	13.1	46.5
	Diploma	38	17.8	17.8	64.3
	Degree	41	19.2	19.2	83.6
	Master's Degree	32	15.0	15.0	98.6
	Doctorate	3	1.4	1.4	100.0
	Total	213	100.0	100.0	

Source: Primary Data

Table 1.4 shows that out of 213 small-scale commercial farmers surveyed 26 (12.2%) had primary education, 45 (21.1%) had secondary education, 28 (13.1%) had certificates, 38 (17.8%) had diplomas in relevant fields, 41 (19.2%) had degrees, 32 (15.0%) had masters degrees and 3 (1.4%) had doctoral degrees. This implies that

small-scale commercial farmers surveyed who adopted mobile applications in agriculture were literate.

MARITAL STATUS

Table 1.5 shows the distribution of research participants by marital status.

Table 1. 5 Distribution of Participants by Marital Status

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Single	35	16.4	16.4	16.4
	Married	111	52.1	52.1	68.5
	Divorced	16	7.5	7.5	76.1
	Widowed	30	14.1	14.1	90.1
	Separated	21	9.9	9.9	100.0
	Total	213	100.0	100.0	

Source: Primary Data

Table 1.5 indicated that out of 213 small-scale commercial farmers surveyed, 35 (16.4%) were single; 111 (52.1%) were married; 16 (7.5%) were divorced; 30 (14.1%) were widowed and 21 (9.9%) were separated. This implies that the majority of

small-scale commercial farmers who adopted mobile applications in agriculture were married.

FARMERS' PRIMARY OCCUPATION

Table 1.6 shows the distribution of research participants by occupation.

Table 1. 6 Distribution of Participants by Primary Occupation

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Farmer	182	85.4	85.4	85.4
	Driver	9	4.2	4.2	89.7
	Business (Shop Owner)	2	.9	.9	90.6
	Civil Servant (Nurse, Teacher, Extension Officer)	20	9.4	9.4	100.0
	Total	213	100.0	100.0	

Source: Primary Data

Results from Table 1.5 showed that the majority of small-scale commercial farmers surveyed 182 (85.4%) were found to be engaged primarily in agriculture, 9 (4.2%) had driving as their primary occupation, 2 (0.9%) were shop owners and 20 (9.4%) were a civil servant. This indicates that the majority of small-scale commercial farmers who adopted mobile applications in agriculture were engaged in farming as a primary occupation.

Interpretation of Research Findings

AGE

Table 1.2 revealed that young small-scale commercial farmers adopted mobile phone applications for improved small-scale commercial agriculture than older farmers. This finding is consistent with prior studies conducted by Ahmad et al. (2024); Akter and Tan (2023); Hoang (2020); Kabirigi et al. (2022); Kilima and Chikuni (2021); Krell et al. (2020); Mutambara (2021); Mutuma et al (2023) and Quandt et al. (2020). These studies reported that young small-scale commercial farmers are more tech-savvy and have a greater understanding of the benefits of mobile phone applications in agriculture. Further, the results of the current study indicated that older farmers are less likely to adopt mobile phone applications for improved small-scale commercial agriculture. The

results concur with studies conducted by Ahmad et al. (2024); Akter and Tan (2023); Benard et al. (2020); Hoang (2020); Mutambara (2021); Mutuma et al. (2023) and Nwali et al. (2022). These studies argued that older farmers are less familiar with mobile phone applications, and less motivated to learn new technologies due to their near retirement age or a preference for traditional farming methods. It is essential to recognize that both young and older small-scale commercial farmers possess unique perspectives and capabilities that contribute to the successful implementation of mobile technology. Therefore, the study underscored the need to consider different age groups of farmers when implementing agricultural projects to establish the level of adoption and proffer strategies to scale up the adoption of mobile phone applications. The study hypothesized that:

H1: Young farmers are more likely to adopt mobile phone applications than older farmers.

Gender

Table 1.3 indicated that a larger number of female farmers adopted mobile phone applications compared to their male counterparts. These outcomes are consistent with previous research conducted by Akter and Tan (2023); Miine et al. (2023); Mutambara (2021) and Mutuma et al.

(2023) who reported that women make up a significant portion of the agricultural workforce are bringing new perspectives and innovative approaches to technology adoption in the agricultural sector. Further, the large number of women could be attributed to a large number of females living on the farms as compared to males who have moved out looking for work to fend for their families. The results of the current study are contrary to studies by Dagar et al. (2021); Krell et al. (2021) and Zheng and Ma (2023) who observed that women were less likely to adopt mobile phones. These studies are linked to the conventional thinking that men are the ones who always adopt mobile phone applications than women. In contrast, a study by Yassen et al (2021) showed that men and women differed significantly in the adoption of mobile phone applications in agriculture. Thus, it is critical to consider the gender differences when implementing agricultural projects to establish the level of influence and reasons for the adoption of mobile phone applications for improved small-scale commercial agriculture. The study hypothesized that:

H2: Female farmers are more likely to adopt mobile phone applications than male farmers.

Education Level

Table 1.4 indicates that the majority of the research participants were literate. These results concur with previous research conducted by Abubakari et al. (2023); Adams and Jumpah (2021); Ahmad et al. (2024); Diaz et al. (2021); Dube-Takaza et al. (2023); Hoang (2020); Khan et al. (2020); Krell et al. (2021); Landman et al. (2020); Mutambara (2021) and Ujakpa et al. (2021). These studies argued that educated small-scale commercial farmers possess greater access to information, resources that facilitate decision-making processes, the capacity to comprehend, and interpret data, can carefully evaluate the credibility and feasibility of information from agricultural mobile applications in their decision-making process. On the contrary, studies by Rahman et al. (2020) and Ujakpa et al.

(2021) affirmed that illiterate farmers were less likely to adopt mobile phone applications in agriculture. Thus, it is critical to consider small-scale commercial farmers' educational level when implementing agricultural projects to establish the level of influence on the adoption of mobile phone applications for improved small-scale commercial agriculture. The study hypothesized that:

H3: Literate farmers are more likely to adopt mobile phone applications for improved small-scale commercial agriculture.

Marital Status

Table 1.5 indicated that married farmers adopted of mobile phone applications for improved small-scale commercial agriculture than the single, divorced, separated, and widowed. These results confirm prior research results conducted by Akter and Tan (2023); Ayenew et al. (2020); Dissanayake et al. (2022); Dube-Takaza et al. (2023); Hoang (2020), Mutambara (2021); Mutuma et al. (2023); Miine et al. (2023); Neway and Zegeye (2022) and Yakomo (2020), who reported that married farmers are a crucial driver of the adoption of agricultural technology. On the contrary, Ahmed et al. (2024) found that married farmers showed an inverse linkage with farmers' engagement with mobile phone use. Scholars like Akter and Tan (2023); Hoang (2020a); Mutambara (2021); and Mutuma et al. (2023), contend that while shared resources and support within a household may play a role in technology adoption, the influence of married farmers alone may not be prominent. It appears that the adoption of mobile phone applications varies depending on the socio-cultural context, religious beliefs, farming circumstances, technology infrastructure, and the availability of technologies for adoption. It is critical to consider the factors that influence married farmers on the adoption of mobile phone applications when implementing agricultural projects to establish the level of adoption of mobile phone applications for improved small-scale commercial agriculture. The study hypothesized that:

H4: Married farmers are more likely to adopt mobile phone applications than the single, divorced, separated, and widowed.

Farmers' Primary Occupation

Results from Table 1.6 revealed that farming as a primary occupation has a favorable and significant influence on the adoption of mobile phone applications for improved small-scale commercial agriculture. This conclusion aligns with prior research conducted by Abubakari et al. (2023); Akter and Tan (2023); Hoang (2020); Krell et al. (2020); Landman et al. (2020); Mutambara (2021); Mutuma et al. (2023); Osman et al. (2022) and Quandt et al. (2020). These studies argued that small-scale commercial farmers who rely solely on farming for their livelihood are more inclined to invest in innovative ways to enhance their agricultural practices and boost productivity. However, it is important to note that the adoption of mobile phone applications varies depending on cultural context and farmers' circumstances. Thus, it is critical to explore farming as the main occupation in agricultural settings when implementing agricultural projects to establish the level of influence on the adoption of mobile phone applications. The study hypothesized that:

H5: Farmers who have farming as a primary occupation are likely to adopt mobile phone applications for improved small-scale commercial agriculture.

CONCLUSION

The results of the study highlighted that young farmers who have grown up in the digital era are more tech-savvy and adopt mobile phone applications for agricultural purposes, while old farmers who were less familiar with digital technologies and less motivated to learn technologies are less likely to adopt mobile phone applications. The research highlighted females adopt mobile applications more than their male counterparts. The adoption of mobile phone applications varies depending on the socio-cultural

context, religious beliefs, farming circumstances, technology infrastructure, and the availability of technologies for adoption. Similarly, farmers with higher levels of education exhibited a greater willingness to embrace mobile phone applications that facilitate access to information, decision-making processes, and the capacity to comprehend and interpret data through the adoption of mobile phone applications in small-scale commercial agriculture. Farmers' education levels are critical for evaluating the credibility and feasibility of information provided through mobile phone applications. The results of the study show that farmers' married farmers drive the adoption of agricultural mobile phone applications more than the single, divorced, separated, and the widowed.

On the contrary, the research underlined that farmers' married status does not always positively influence the adoption of mobile phone applications for improved small-scale commercial agriculture. Further, the research asserted that farmers' married status on adoption of mobile phone applications vary depending on the socio-cultural context, religious beliefs, farming practices, regional differences, technology infrastructure, levels of technology adoption, and availability of technologies for adoption. The study results revealed that small-scale commercial farmers whose primary occupation is farming are more inclined to adopt mobile phone applications than civil servants and artisans. This study concluded that socio-demographic characteristics that influence farmers to adopt mobile applications do not act in isolation, but rather as an amalgamation of related characteristics. However, farmers indicate that socio-demographic characteristics are critical in the development of strategies for the implementation of mobile phone applications for improved small-scale commercial agriculture. Thus, the research identified the need to consider socio-demographics when designing policies and programs aimed at promoting the use of technology in agricultural settings.

Recommendation

The study recommends that policymakers and agricultural project implementers should consider socio-demographic characteristics (age, gender, educational level, marital status, and farmers' primary occupation) as critical determinants of the adoption of mobile applications for improved small-scale commercial agriculture based on different farmer age groups to scale up the adoption process.

Future Studies

For further research, studies should replicate this study in other contexts to find out how socio-demographic characteristics influence the adoption of mobile phone applications for improved small-scale commercial agriculture.

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