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Use of Information Systems (Mobile Phone App) for Enhancing Smallholder Farmers' Productivity in Eastern Cape Province, South Africa: Implications on Food Security

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Abstract

The rapid growth of information systems in the form of mobile phone applications in developing countries resulted in several benefits compared to other choices in relation to costs, environmental exposure, and simplicity of usage. However, smallholder farmers fail to meet the soaring demand for food and other agro commodities in time, and dodging market overflows is an extreme encounter among communal farmers due to a deficiency of information and unacquainted administration. Therefore, the study analyzes the factors influencing the use of information systems for enhancing smallholder production in the Eastern Cape Province of South Africa. The study applied a descriptive survey research design. A multi-stage simple random technique was used to collect data from 220 emerging growers using a semi-structured survey. Data collected were analyzed using descriptive statistics and a logistic regression model. The study indicated that most smallholder growers in the mentioned study area use information systems (IS) for their agricultural activities and agribusinesses and have further changed the farming landscape. Interestingly, agricultural productivity has been enhanced, as well as improved the food security status among rural households. Smallholder farmers have experienced problems in using information systems on their farms. Empirical results reveal that socio-economic factors influence the use of mass media for agricultural purposes by smallholder farmers. Therefore, the study recommends the government should embark on educational awareness and training of farmers in using information systems to enhance productivity.

Keywords Food security · Information systems · Smallholder farmers' · Enhanced productivity · South Africa

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Introduction

The development of information systems (IS) has delivered new philosophies, approaches, and procedures broadcasting knowledge improvement, and information among persons in different societies. There is a vast growth in using IS in developing countries as they have made communication and use of innovative technologies very easy. The information provision is a very imperative apparatus used in the comprehension of whichever impartial or goal is set by the individual and remains the essence of any discrete. Awili et al. (2016) argued that information is one of the valuable resources required in any society, as well as sectors, especially the agriculture sector for attaining an indispensable improvement in agricultural productivity. Information is essential for communal existence as it hints at an affirmative transformation in one's state of understanding, especially in the farming sector (Akenola, 2017).

Importantly, the agricultural output can disputably be enhanced by pertinent, consistent, and expedient evidence and information. Agricultural information impacts production in a multiplicity of methods and is often managed through the specific development of information systems designed by agricultural organizations. These organizations circulate information systems to farmers that assist in most administrative processes which allow for additional constructive access to agricultural information such as market opportunities, farm management, agribusiness, and the significance of keeping farm records. There are a wide usage and reliance on information systems in the transference and transformation of agricultural information in Sub-Saharan Africa, in an effort to interrelate and unlock unknown openings in backing of occupation (Musungwini et al. 2018). These information systems, such as television (TV), radio, and mobile phones, play an imperious part in crafting sentience about novel agricultural expertise among agricultural societies transversely the world, especially smallholder productivity (Department of Agriculture, Forestry & Fisheries, 2016).

Smallholder agriculture features prominently by playing strategic roles in sustaining rural livelihoods and nutritional guarantees in developing communities of sub-Saharan Africa (Oteh et al. 2021. Moreover, Adam and Hassan (2015) assert that small-scale agriculture sustains the livelihoods of key practitioners such as farmers, collective actors, and agrarian communities through income-generating activities in South Africa. According to IFAD and UNEP (2013), smallholder farmers in developing countries are said to comprise over 50% of final consumers, creating employment opportunities and thereby alleviating poverty to a large extent. In other words, to actualize food sufficiency and security as articulated in the United Nations Sustainable Development Goals (SDGs), it becomes peremptory for the farmers who are mainly small-scale farmers to attain a productive and sustainable life (Musungwini, 2018).

In developing countries, the information systems sector has been introduced in agriculture as the ecosphere in trying to meet the increasing ultimatum for nourishment as the global inhabitants are increasing. The majority of information systems types are either mass media or mobile phone devices and applications,

especially in supplying facts and data on prices of food and agricultural commodities, thereby ensuring efficiency in the co-movement of prices across markets. This implies that handsets or mobile phone devices for farmers and the manner with which information penetrates the key players in the food supply chain determine, to a large extent offers an official approval statement for farmers to secure their position in the marketplace from a regional front (Sikundla et al. 2018).

More so, it is pertinent to reaffirm that handsets among other information systems applications are changing the conventional procedures and processes of farming, for increased agricultural productivity and sustainability (Abdul & Bashir, 2019). Khou and Suresh (2018) and Huq et al. (2017) specified that there is a rapid huge base of farmers using social media tools in the form of mobile phone applications for IS Apps such as Facebook, Twitter, YouTube, LinkedIn, and WhatsApp for fetching better ways of sharing agricultural information which has made a vast world impact. As a result, the extraordinary digital revolution (mobile phone applications in farming) has facilitated the global drive for development with technological progress which has assisted smallholder farmers in decreasing prices, easing information asymmetry, infrastructural deployment consequential in improved access to agricultural information, and bridging the information gap between large and smallholder farmers (James & Versteeg, 2007; Mwalupaso et al. 2019). Additionally, mobile phone applications have played imperative roles in driving the enhancement of smallholder productivity, employment, and economic growth (Ezinne et al., 2020).

Despite the massive potential of information systems in the form of mobile phone applications in linking smallholder farmers to remunerative marketplaces and improving agricultural output, smallholder farmers still fail to fully utilize this medium (Brugger, 2011; FAO, 2011). The underlying factors necessitating farmers not utilizing their mobile phones are still sketchy. Nevertheless, the impact of socio-economic factors on mobile phone usage is deprived as emphasized in local contexts as the focus is solely on generic factors (Lubua, 2017; Lubua & Kyope, 2019). Although agricultural trade and farmers have become important targets for IS in the form of mobile phone services, very restricted evidence about the dynamics impeding usage of mobile phone applications by smallholder farmers in getting farming info and the diffusion process in such contexts is somewhat scarce. Hence, the study focused on identifying the glitches confronting farmers in using mobile phones, as well as the factors influencing the usage of mobile phones by smallholder farmers in acquiring farming information in Eastern Cape Province.

Materials and Methods

The study was carried out in Eastern Cape Province, South Africa. The area is one of the largest regions in the republic, with a land mass area of 168,966 km^2. The area was formed from Xhosa-dominated regions of the Transkei and Ciskei, in the year 1994. Eastern Cape Province is the third supreme inhabited region in the republic with a population of 6,562,053 persons and represents 12.7% after Gauteng and KwaZulu Natal Provinces with an estimated population size of 12,272,263 persons (23.7%) and 10,267,300 (19.2%) million persons, respectively (Mdoda & Obi, 2019;

Hlomendlini, 2015). The area is surrounded by rural areas that derive their livelihoods from practicing agriculture, tourism, and formal employment.

The area of study lies between the sub-tropical regions of KwaZulu-Natal and the Mediterranean climate of the Western Cape Province. The territory is assembled by a bimodal precipitation pattern, with a winter rainfall zone to the west, and a summer rainfall zone to the east. With regard to unforeseeable weather conditions, growth periods vary throughout the area. The weather patterns in the area favor agricultural production, especially crops (perennial, arable, and horticulture), and livestock (ruminant and monogastric) production. The area is conquered by emerging crop farmers whose major livelihood source is farming.

Sample Size and Sampling Procedure

The target population for the study was the smallholder farmers using mobile phones for improving their productivity and bridging the gap of knowledge and skill regarding agriculture in South Africa. The study made use of both qualitative and quantitative approaches in gathering, as well as analyzing, data. A descriptive research design survey was conducted, and data were collected using copies of semi-structured questionnaires.

A multi-stage sampling method was employed in selecting the study respondents. The principal part was selecting the District Municipality based on active participation in agricultural production. Afterward, four District Municipalities were selected, and they included Chris Hani, OR Tambo, Amatole, and Alfred Nzo District Municipalities. The second stage involved a purposive selection of 2 Local Municipalities within each District that is predominantly engaged in farming. In the third and final stage, towns and villages were chosen from the previously selected districts and a total number of 16 villages were selected based on the number of active smallholder vegetable farmers in the villages. The respondents were randomly selected from the list of vegetable farmers from the targeted villages. In all, a sample size of smallholder farmers using mobile phones for agrarian devotions, which represented 80% of the sample size (176), was randomly selected from the farmers using mobile phones for agrarian purposes and 20% of the sample size (44) were selected randomly from the usage of the non-mobile phones. Consequently, the method of sorting is imperative, since a substantial sample size of mobile phone and non-mobile phone usage is essential in evaluating the choice of information system and also the effect of using mobile phones in enhancing farmers' productivity who use mobile phones.

Data Collection

Primary data for the study were obtained through face-to-face interviews. Following that, a semi-structured questionnaire was designed by the researchers and established based on the evaluation of the literature. A semi-structured questionnaire was first pre-tested and overseen by the interviewees with the help of highly skilled enumerators who communicated well in IsiXhosa. The concluding variation of the

survey was overseen by the farmers' supervisor or head, thereby resulting in the antiquated representative of the farm selected. Data on copies of the semi-structured questionnaire are farmers' socio-demographic characteristics, resource abilities, access to media, mobile phones usage for agripreneurial programs, the impact of using mobile phones for smallholder productivity and welfare, dynamics impelling the use of mobile phones and problems smallholder growers face in accessing and using mobile phones in the farm, information's related to risk, and attitude towards media usage by farmers. The farm survey was conducted between 20 August and 15 November 2019 in the Eastern Cape Province.

Data

This section represents characters that can be considered for the study. But the variables were selected based on the consultation of specialists and relevant personnel working in the study area and related issues. Table 1

Analytical Framework

This section explores 2 types of analytical frameworks. Firstly, descriptive statistics like frequencies, percentagess, and mean value were calculated to summarize the farmers' profiles and characteristics in the study area while the logistic regression

Table 1 Description of variables used in the study

Variable	Description	Measurement
X_1	Farmers' gender of the farmer	1= male, 0 = otherwise
X_2	Farmers' age	Actual years
X_3	Farmers' marital status of the	1= married, 0 = otherwise
X_4	Farmers' family size	1 = > 4, 0 = otherwise
X_5	Number of years spent in formal education	1= actual years spent in school, 0 = otherwise
X_6	Farmers' source of income	1= social grants, 0 = otherwise
X_7	Number of years spent in farming	Actual years of farming
X_8	Distance/closeness to the market place	1= 10 km, 0 = otherwise
X_9	Access to extension agents by the farmer	1= access to extension agents, 0 = otherwise
X_{10}	Access to a financial institution by the farmer	1= access to finance, 0 = otherwise
X_{11}	Member of farm organization	1= member of farm organization, 0 = otherwise
X_{12}	Household monthly income	1=> 1500, 0 = otherwise
X_{13}	Occupation by the household head	1= full time farmer, 0 = otherwise
X_{14}	Farming as the only source of income	1= farming as an only income source, 0 = otherwise
X_{15}	Knowledge of using mobile phones for agricultural purposes	1 = can use mobile phone for agricultural purposes, 0 = otherwise

Researchers' Initiative, 2021

model was used in determining dynamics prompting the use of mobile phones to enhance smallholder farmers.

Logistic Regression

This study adopted the logit regression model in measuring the influences prompting the usage of mobile phones to enhance smallholder productivity in the study area. The word "logit" denotes the log-likelihoods which presupposes the likelihood of declining interest in 1 of 2 groups on the detailed elastic of concentration (Wooldridge 2009). Besides, Mdoda et al. (2019) and Chauke et al. (2013) specified that the logistic regression dimension may be used to evaluate the likelihood relationship for autonomous variables in a model. The logit model was used for this study because of the dichotomous nature of the dependent variable, implying that the respondents are categorized into using mobile phones and not using mobile phones. In the study, the usage of mobile phones explains the farmers that have implemented the use of handsets in enhancing smallholder productivity. The regression scrutiny is, therefore, comprised of two distinct substitutes. Given that the reliance on the variable is binary, the study follows a binomial logistic model, viz, 0 when a farmer did not use the mobile phone on the farm; and 1 when using a mobile phone on the farm.

For this paper, the two choices are "usage of mobile phones" and "not usage of mobile phones." The twofold regression analysis is modeled to elucidate Y=1 to enable the farmer to use mobile phones on the farm, and Y=0 for the regions where the farmer did not employ the usage of mobile phones on the farm. As mentioned by Wooldridge (2009), the assumption that X is described as a pathway for eloquent features, while p is the probability that Y=1, two-way likelihood relationships is well-noted and is captured below:

$$p\,(Y=1) = \frac{e^{\beta\chi}}{1+e^{\beta\chi}} \tag{1}$$

$$p\,(Y=0) = 1 - \frac{e^{\beta\chi}}{1+e^{\beta\chi}} = \frac{1}{1+e^{\beta\chi}} \tag{2}$$

where Eq. 2 is the subsidiary response level, that is, the possibility that smallholder farmers employ the usage of handsets on their farms, as this will likely be revealed using the logistic regression approach. The computations simultaneously show the logit adjustment results with probability proportions explained thus:

$$\log it\,[\Theta(x)] = \log\left[\frac{\Theta\,(x)}{1-\Theta\,(x)}\right] = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \ldots\ldots\ldots\cdots + \beta_n X_n \tag{3}$$

Asides from authorizing its estimate as a direct regression, the following representations relate:

Θ = logistic amendment of the contingency fraction; = the intercept span

β = explanatory or critical variables; and

Xi = predictor or forecaster variables.

The preceding procedures were feasible inside the STATA. More so, Eq. 3 indicates the perusal generated the chances of relations depleting the highest expectation technique. The logistic deterioration in this study can be stated as follows:

$$Y_1 = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 \cdots + U_n \quad (4)$$

where

Yi (mobile phones usage) = the reliance on variable distinct as mobile phones usage = 1 and 0 otherwise

α = constant

β = slope of the distinct forecaster variables

Xi = forecaster variables

U_n= alteration or variation error term

Results and Discussion

This segment is split into two parts with respect to descriptive and empirical results as proposed in the study objective.

Socio-economic Characteristics of the Smallholder Farmers

This section provides a summary profile of smallholder farmers who operate mobile phones to enhance their productivity with respect to their social and economic characteristics. The majority of the farmers adopt innovative technologies to enhance better usage of their lands for higher yields and returns. The study findings indicate that the majority (70%) of the emerging growers in the province are using mobile phones to enhance their productivity. The study displays that the majority (88%) of smallholder farmers practiced are females, while the rest (12%) are males. The mainstream of the dependents fell between the age range of 28 and 50 years, indicating a mature group involved in vegetable farming. The findings are consistent with that of Sikundla et al. (2018) and Jabri (2011), which submits that farming in pastoral areas is practiced by the elderly, and this will have solemn effects on the sustainability of farming among the newer cohort who are hypothetical to thrive the grown-up farmers. The majority of the smallholder growers were married with the numeric strength of their family as 4 persons per household. Smallholder farmers were using family labor as farming labor required to save costs. The education level of smallholder farmers was primary education as farmers spent 7 years in school. These results were in line with Chisama (2016) who found that most of the agriculturalists who used mobile phones to access agrarian info had primary education in Malawi. From the study, smallholder farmers indicated a farm size of 6 hectares with experience in vegetable farming for 12 years.

Analysis of household income and the income sources specified that most of the vegetable farmers generate about R 10,700 per month from framing sources which were useful in investing in vegetable farming. From their studies, Khan et al. (2009)

and Lambrecht et al. (2016) made a similar observation that vegetable farming was recorded as the major occupation in developing courtiers. More so, the majority (80% and 70%) of the households indicated that membership in farmer organizations and access to extension and advisory services serve as a respective alternative or complementary information source(s) for farmers. It is pertinent to note that the farmers come from diverse social settings, but the majority have a general farming environment and farming was recorded as their main occupation. This agrees with the findings of FAO (2015) that smallholder farming is important for rural dwellers. This is the case because farming is important for the sustainable production of smallholder farming in order to enhance food security, income generation, employment creation, and promote livelihoods. The majority (56%) of vegetable farmers did not receive any form of credit and were using farm revenue for farm operations. The study outcomes implied that more than a partial (80%) of the smallholder agriculturalists in the study area has information on vegetable farming and culture. This, therefore, implies that smallholder farmers who have knowledge and experience may lead to pursuing information from diverse subsequent sources resulting in higher production ensured.

Mobile Phone Apps Used by Smallholder Farmers

The new 4th Industrial Revolutions have developed a social media app that is very useful in gathering agricultural information quickly than waiting for extension personnel to provide such innovative technologies.

From Table 2, results indicate that mainstream agriculturalists have adopted the usage of mobile phones for their farming and to improve their productivity. The majority (54%) of the mobile phone app used by vegetable farmers is WhatsApp application as they can share relevant agricultural information to their farming operations followed by Facebook application (27%). These two are largely used because young farmers normally spent quality time chatting, promoting, and selling their products. Moreover, Newspapers and Twitter are other applications that are used by farmers but at limited times.

Mobile Phones Usage for Agricultural Purposes to Enhance Vegetable Farming

Agricultural information is imperative for improving farming operations as it constantly provides new techniques adopted for farming and new market information. Table 3

Table 2 Frequency distribution showing the extent of usage of mobile phone apps for agricultural information dissemination

Categories	Frequency	Percentage (%)
WhatsApp	120	54
Facebook	60	27
Newspapers	30	14
Twitter	10	5

Source: Field Survey, 2021

Table 3 Frequency of mobile phone usage for agricultural information

Categories	Frequency	Percentage (%)
Daily	136	62
Weekly	34	15
1–4 times a week	20	9
2–3 times a month	30	14

This specifies that vegetable agriculturalists in ECP are using mobile phones for agrarian info which is essential for enhancing productivity daily as results indicate that 136 agriculturalists are using mobile phones daily. The study results reveal that 34 farmers make use of mobile phones weekly while 30 farmers stated they use mobile phones 2–3 times a month, and lastly, 20 farmers make use of mobile phones 1–4 times a week.

Main Purpose for Using Mobile Phones by Smallholder Farmers

The use of mobile phone applications by smallholder farmers is crucial given changing times of farming and innovative technology usage in farming to improve yields and returns.

Table 4 presents the major purposes of using mobile phones by smallholder farmers. The study outcomes indicate that mainstream farmers use mobile phones in reminding farmers of farm management activities, which must be done with 18%. They use mobile phones to set up farm operations/activities as they tend to forget. Similarly, from his study, Chisama (2016) asserts that the majority of

Table 4 Frequency of farmers' usage of mobile phones

Categories	Frequency	Percentage (%)	Rank
Farmers' usage of mobile phones and the internet for extension advice	10	5	8
Farmers' usage of mobile phone agriculture business	30	13.64	3
Farmers using mobile phones for traceability	20	9.00	6
Farmer groups and money transfer	10	5	10
Pasture management and livestock distribution	5	2.27	12
Weather updates	10	5	9
Fertilizer application rates	22	10	5
Improved crop varieties and market information	15	6.82	7
Access training and improved product marketing	28	12.73	4
Reminders on farm management activities	40	18.00	1
Soil fertility management and agricultural prices	32	14.55	2
Irrigation practices	8	3.64	11

*Results appearing in multiple responses with frequencies and percentages ($N = 220$)

Source: Computed from Field Survey Data, 2021

farmers are more inclined to the usage of mobile phones in reminding farmers of their farm management duties. Another purpose(s) of using mobile phones are soil fertility management and agricultural prices (15%), farmers using mobile phones for agriculture business (13.6%), access to farming training and improved product marketing (12.7%), fertilizer application rates (10%), farmers using mobile phone for traceability (9%), improved crop varieties and market information (6.8%), farmers using mobile phone for extension advice and internet (5%), farmer groups and money transfer (5%), weather updates (5%), and irrigation practices (3.6%). The least used purpose of mobile phones by smallholder farmers was pasture management and livestock distribution (2.3%). Mobile phones play an imperative role in enhancing smallholder productivity by providing information instantly for farmers.

The Benefits of Using Mobile Phone Application in Farming

At the moment, there is an increase in the global demand for agricultural productivity, due to the increase in the global population which traditional methods of farming cannot provide. The application and development of information systems useful in fast-tracking agricultural productivity can be seen as the way forward in meeting global food demands and achieving SDGs, especially first and second objectives which are fundamental for developing countries. Table 5 illustrates the benefits of using mobile phones for farming devotions. Agriculturalists were choosing multiple choices.

Table 5 presents the benefits experienced by smallholder farmers in using mobile phones for farming purposes, which has yielded positive fortunes for smallholder farmers. The major noticeable benefit (77%) of using mobile phones by farmers is the increase in high-yielding seeds, marketing information, and pricing (73%;, crop and livestock farming technique (59%); and fertilizer use (50%). The use of mobile phones is imperative as it brings exclusive agrarian information which mostly takes years to reach smallholder farmers.

Table 5 Benefits of using mobile by smallholder farmers

Variable	Frequency	Percentage (%)
High-yielding seeds	170	77
Fertilizer use	110	50
Market information and pricing	160	73
Crop and livestock production techniques	130	59
Pesticides and herbicides use	80	37
Training from agricultural extension services	90	45
General agricultural news	90	45

Source: Field Survey, 2021

Bottlenecks Encountered by Smallholder Farmers to Mobile Phones Usage in Accessing Agricultural Information

The challenges encountered by smallholder farmers in using mobile phones in accessing agricultural information are summarized in ranges of expensive, mobile phone operating problems, network coverage, high cost of repair, technical problems, and difficulty in usage. Hence, the constraints confronted by the farmers in receiving information and extension advice by movable phone usage are presented in Table 6.

From Table 6, the first problem faced by smallholder farmers in using mobile phones is that mobile phones are expensive for farmers and ranked first followed by the mobile phone operating problem and network coverage problems ranked second and third as the case may be, and are handled as a severe problem. Difficulty in using mobile phones was treated as the least problem. Problems always hamper productivity, particularly those that pose severe problems and are the responsible problems impacting smallholder farmers' productivity in the study area.

Econometric Estimation Identifying the Factors Affecting Farmers' Usage of Mobile Phone

The paper employed the usage of the logit regression model in determining dynamics disturbing the use of mobile phone applications by smallholder agriculturalists in the Eastern Cape Province. From Table 6, the estimated logit regression results further explain the level of fitness for the model. The R^2 value which is 72% indicates that the dependent variable in the logit regression explains the variations and probability in modern farm technology adoption. The likelihood ratio (148.569) together with the p-value (0.000) implies that the model is a good representation. Table 7 displays the combined impact of the socio-economic features on the likelihood of agriculturalists' use of mobile phones for agrarian information devotion. It is evident that socio-economic aspects are certainly interrelated with agriculturalists' use of mobile phones for agrarian information (R=0.72). Results from correlation tests indicated that the independent factors or variables were somewhat low, which is a clear indication that the model is altruistic.

Table 6 Problem faced by smallholder farmers in using mobile phones

Problem	Frequency	Percentage (%)	Rank
Expensive	145	66	1
Mobile phone operating problem	115	52	2
Network coverage problems	110	50	3
The high cost of repairing	95	43	4
Technical problems	90	41	5
Difficulty in using mobile phones	88	40	6

Source: Field Survey, 2021

Table 7 Factors influencing the use of media by smallholder farmers

Variable	Coefficient	Std. error	Significance	dy/dx
Intercept	−1.948	0.613	0.002***	0.2123
Age	−0.287	0.651	0.043 **	0.2242
Years spent in school	0.163	0.058	0.004***	0.1903
Family size	0.163	0.058	0.004***	0.2003
Farming experience	−0.681	0.425	0.023**	0.1530
Total income level	0.423	0.145	0.038***	0.2156
Number of observers = 220 Pseudo R^2 = 0.72	−2 log likelihood 148.569 Adjusted R square = 0.70		Prob (chi-square)= 0.000 DF = 8.00	

Standard errors: $^{**}p < 0.05$, $^{***}p < 0.001$

Source: Field Survey, 2021

Table 7 illustrates the explanatory variables that influenced the usage of mobile phone applications for agrarian information. These variables comprise majorly socio-economic variables. The enlightenment of the substantial autonomous variables accessible in Table 7 is founded upon the forecaster variable.

From the results, farmers' age is statistically significant at 1% level implying that there is a negative correlation between respondents' age and usage of phone handsets for agrarian information. This, therefore, suggests that a unit increase of 1 additional year in the age of the farmer led to a decrease in the use of mobile phone applications for agrarian information by 0.287%. It designates that the age of the farmer primarily standardizes the use of mobile for receiving information. This implies that the older the farmers, the lower their usage of mobile phones for agricultural purposes as it is a highly technical devices in which older people face problems using effectively. From their findings, Asif et al. (2017) made a similar observation that older persons are challenged in using mobile phones due to less official schooling and little disclosure of tools as it necessitates procedural acquaintance to function it likening to undeveloped persons who establish it fairly tranquil to use. This implies that the age of the farmer is 22% points less likely to use a mobile phone application for agrarian information. Farmers' risk behavior has an optimistic measurement and was statistically substantial at a 5% level. This implies an optimistic correlation between farmers' risk behavior and mobile phone usage for agrarian grounds suggesting that a 1% unit increase in the farmers' risk behavior will induce mobile phone usage for agrarian purposes by 0.615%. This implies that farmers' risk behavior is 18% points more likely to use a mobile phone application for agrarian purposes.

More so, years spent in school recorded an optimistic measurement, thereby indicating that is statistically significant at 1% level. The realization of farmers' fundamental education encourages a positive disposition with regard to the usage of mobile phones by the farmers to enrich production by 0.163%. Mwalupaso et al. (2019) and Jaime and Salazar (2011) made similar observations that education facilitates the acquisition of knowledge and skills which enable educated farmers to be able to adapt and apply technology in their farms for better yields. Hence, the

number of years spent in the usage of mobile phones in search of agrarian information by the farmer recorded 19% points.

More so, farming experience showed that there is 5% level of significance implying that there is a unit increase of 1 year in the farming experience which resulted in a decrease in the usage of mobile phones for agricultural purposes (0.681%). This suggests that the more skilled the farmer is, the less innovative it becomes for agricultural purposes. This implies that farming experience is 15% points less likely to use mobile phones for agrarian purposes. These outcomes were in line with Akinola (2017) who found out that farm experience adversely influences mobile phone usage for agrarian information in Nigeria.

Family size has an affirmative coefficient which is critical at 1% level proposing that a component upsurge of a member in the family size will induce a rise in the use of mobile phone applications for agrarian purposes by 0.163%. This suggests that the greater the family size, the more media mobile phone usage for agrarian purposes by farmers. This implies that family size is 20% points more likely to use a mobile phone application for agrarian purposes.

A total income has an affirmative and momentous influence on the use of mobile phone applications in agricultural information ($p < 0.05$). This implies that a unit increase of 1% in total income will induce an increase in mobile phone applications for agricultural information by 0.423%. This suggests that substantial disposable incomes will result in inflated disbursements and more reflections for non-food items such as mobile phones as understood to be imperative for enhancing smallholder productivity. In their study, the findings of Masuku et al. (2016) were somewhat similar and submitted that the greater is total income in the households, the more afford farmers to purchase mobile phones and then used them for farming purposes. This implies that total income is 22% points more likely to use a mobile phone application for agrarian purposes. Social grants as a source of remuneration recorded a cynical measurement and were statistically significant at 5% confidence level.

Implications on Farmers' Food Security Status

Findings from the study highlight crucial implications for future policies that are aimed at improving smallholder farmers' productivity and ultimately food security in South Africa. The results suggest that the adoption of information systems (such as mobile phone) for a range of agricultural activities recorded an increase in its agricultural yields by smallholder farmers. The development of IS was established to promote food security status through agricultural development given the fact that the majority of rural households in the Eastern Cape Province rely on farming for livelihood generation. The ability of IS, in particular mobile phones, to produce, store, and transmit information makes mobile phones a potential tool to aid in the dissemination of agriculture strategies resulting in increased social and economic development and thus enhancing food security. The study result displays that the adoption of IS by farmers has an imperative contribution to food security through increased agricultural output. Therefore, government agencies and NGOs should

encourage smallholder farmers, even in other provinces, to use phones for agricultural practices to increase their yields.

Limitations and Future Direction

The main limitation of the study is related to the sample size. The sample size was limited by the lack of funds and time to cover a large sample of smallholder farmers. Only 176 smallholder farmers were interviewed. However, as outlined earlier, this sample size was appropriate given the nature and objectives of this exploratory study. Therefore, the following issues require further investigation:

- The influence of other ICTs such as radio and television
- The scale on the use of mobile phones

Conclusion

The paper explored the factors influencing mobile phone usage in enhancing smallholder farmers' productivity in the Eastern Cape Province of South Africa as part of developmental information systems. It is pertinent to note that the usage of mobile phones by smallholders in the study area recorded a satisfactory level because farmers had adopted and utilized information systems in form of mobile phone solicitations to enhance their productivity. As an essential device in the hand of farmers, mobile phones, to a reasonable extent, assist. Smallholder farmers have enjoyed benefits by using mobile phones for strict agricultural purposes as their productivity and profitability have been enhanced extremely which further improves farmers' food security status. Smallholder farmers have experienced problems in the usage of mobile phone application with severe problems encountered such as mobile phones being expensive, mobile phone operating problems, and network coverage problems which hampered productivity negatively. This paper concludes that socio-economic status was the main reason determining the adoption of mobile phone application to enhance smallholder productivity in the Eastern Cape Province of South Africa. Therefore, the paper recommends that government should take initiatives in ensuring, as well as improving, infrastructure in rural areas, to ensure that farmers can adopt innovative technologies, thereby enhancing productivity. Furthermore, the study recommends that mobile phone usage be maximized by extension personnel to be shared with conformist extension approaches connecting farmer-extensionists to pay visits to farms. More so, it is recommended that the Department of Agriculture and Agrarian Reforms must set about additional programs on education among small-scale farmers to inspire the use of the mobile phone in agrarian information and to attract young people in practicing farming. Government, NGOs, and policymakers should take into reflection and take edges for enlightening the farmers` socio-economic conditions.

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Declarations

Conflict of Interest The authors declare no competing interests.

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