

# Factors constraining the use of mobile phone technologies for accessing agricultural marketing information by grape smallholder farmers in Tanzania

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**Alex I Nyagango** 

Moshi Co-operative University

**Alfred S Sife**

Moshi Co-operative University

**Isaac Kazungu**

Moshi Co-operative University

## Abstract

The increased use of mobile phone technology is advocated to assist smallholder farmers in accessing relevant and accurate agricultural marketing information. Unfortunately, the use of mobile phones among smallholder farmers is still evolving, challenging, and debatable among scholars. This study examined factors constraining the use of mobile phones in accessing agricultural marketing information. A descriptive cross-sectional research design was adopted with a sample size of 400 grape smallholder farmers. A structured questionnaire, focus group discussions, and key informant interviews were used to gather data. Descriptive, ordinal logistic regression, and thematic approaches were used in data analysis. The study found that mobile phones were used for cross-checking prices and finding buyers. The study revealed that mobile phone use for accessing agricultural marketing information was constrained by illiteracy, inadequate skills and training, and high costs. Based on the findings, it is concluded that the factors were negatively impacting the effective use of mobile phones in accessing agricultural marketing information. It is recommended that concentrated efforts are required to increase training to stimulate the effective use of mobile phones for accessing agricultural marketing information.

## Keywords

Mobile phone, agricultural marketing information, grape smallholder farmers, Tanzania

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## Introduction

Access to agricultural marketing information is a vital factor in speeding up the competitiveness of agricultural marketing. Access to real-time and reliable agricultural marketing information on market conditions facilitates the right decision-making among smallholder farmers. Access to agricultural marketing information helps smallholder farmers reach distant markets, make informed decisions on marketing channels, improve bargaining power, networking, and marketing efficiency (Hartmann et al., 2021; Krell et al., 2021; Mgale and Yunxian, 2020; Syahza et al., 2021).

However, studies (Emeana et al., 2020; Kayamo and Tebeka, 2021) show that there are still difficulties in accessing agricultural marketing information, putting smallholder farmers in a disadvantageous position when negotiating with traders. Such difficulties in accessing agricultural marketing information have

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### Corresponding author:

Alex I Nyagango, Department of Marketing and Enterprise Management, Moshi Co-operative University, P.o. Box 474, Moshi, Tanzania.

Email: nyagango@gmail.com

also limited market access of smallholder farmers. While access to real-time agricultural marketing information is generally limited, perishable high-value crops have even less access to agricultural marketing information.

Grape farming is one of the most significant and valuable commercial fruit crops in Dodoma region. Its cultivation began in the 1960s, and among other factors, the development of the grape sub-sector depends on efficient flow of agricultural marketing information. Despite having access to agricultural marketing information, grape smallholder farmers have not yet received it from the right channels and sources (Kulwijila et al., 2018; Mlay, 2021). They mostly rely on internal search (own knowledge), and external search (friends, neighbours, and traders). These sources are ineffective in delivering reliable and timely agricultural marketing information. According to Benard et al. (2020) and Chowhan and Ghosh (2020), access to the right agricultural marketing information at the right time in the right form from the right sources and channels may mean success or failure. The long-run success of grape farming is partly dependent on reliable and timely access to agricultural marketing information. The use of mobile phones has proven to be successful in communicating and sharing agricultural marketing information among smallholder farmers.

The use of mobile phone is increasingly becoming a popular tool within the ambit of Information and Communication Technologies (ICTs). The advancement of mobile phones has dramatically improved access to agricultural marketing information. This has been spurred by improved network connectivity, accessibility, affordability, and user-friendliness (Khan et al., 2020; Mossey et al., 2019). The use of mobile phones has totally changed how smallholder farmers access and use agricultural marketing information. The use of mobile phones in communicating agricultural marketing information has been fruitful in improving farmers' marketing decisions. For instance, the study by Zant (2023) and Piabuo et al. (2020) found that the use of mobile phones reduces transaction cost, enhances bargaining power, and improves marketing efficiency. According to Anadozie et al. (2022) and Khan et al. (2022), most smallholder farmers proactively seek agricultural marketing information to make optimal marketing decisions.

Despite the extant body of literature on mobile phone technologies, studies (Diaz et al., 2021; Hoang et al., 2022; Hoang and Drysdale, 2021; Kabirigi

et al., 2022; Mdoda and Mdiya, 2022; Victor et al., 2021) have mainly focused on the adoption and use of mobile phone. Furthermore, studies that ventured into mobile phone usage challenges remain up for debate with mixed reactions. Iliya and Ononiwu (2021) and Rahman et al. (2020) found that the use of mobile phones is challenged by erratic power supply, high costs, and network problems. On the other hand, Emeana et al. (2020) and Getahun (2020) revealed that language problems, illiteracy, and a lack of skills were hampering the effective use of mobile phones. Moreover, in the grape farming context, studies (Kalimangasi et al., 2021; Kulwijila, 2021; Mlay, 2021) concentrated on marketing challenges, post-harvest losses, input demand responses, and factors affecting marketing performance. Thus, evidence regarding factors constraining the use of mobile phones among grape smallholder farmers is unavailable, and the existing studies have paid insufficient attention to such factors. Drawing upon the identified gap, understanding factors constraining the use of mobile phones is important for accessing agricultural marketing information. Specifically, the study sought to ascertain the status of mobile phone ownership, determine the extent of mobile phone use in accessing agricultural marketing information, and examine factors constraining the use of mobile phones for accessing agricultural marketing information.

### **The diffusion of innovation (DOI) theory**

The study was guided by the Diffusion of Innovation (DOI) theory developed by Rogers in 1995 to explain the factors constraining the use of mobile phones for accessing agricultural marketing information. The theory is embedded in the process by which innovation diffuses within a social system through communication channels over time (Adnan et al., 2019; Dearing and Cox, 2018). The expected end result of the diffusion is the adoption of the technology or idea. The rate at which the innovation will diffuse within a social system will depend on the perceived advantage over the existing practices, compatibility with the prevailing values and needs, complexity of use, limited time for trialability, and observability of the expected results (Brhane et al., 2017; Simin and Janković, 2014).

Perceived advantage describes the relative expected benefits from the innovation. The greater the perceived benefits, the higher the rate of adoption. Compatibility describes the degree of conformity and consistency with the values and needs of the society. Incompatible

innovations diffuse more slowly than compatible ones. Complexity of use entails the ease or difficulty of the innovation for end-users. The ease with which the innovation is understood, the more rapidly it will be adopted. Trialability means the extent to which the innovation is implemented on a limited basis. The trial process provides confidence in the expected future benefits and reduces the associated risks and uncertainties of the innovation. The extent to which the expected outcome will be visible to the adopters describes the observability attribute.

Innovation decision making goes through a series of steps over time. The decision to adopt or reject the innovation passes through five major stages (knowledge, persuasion, decision, implementation, and confirmation), where knowledge is the most significant stage of the innovation (Freeman and Mubichi, 2017; Isaya et al., 2018; Talebian and Mishra, 2018). During the knowledge stage, the user becomes aware of the prevailing innovations. In the persuasion stage, the user forms a favorable or unfavorable attitude towards an innovation depending on the cost-benefit ratio of the innovation. In the decision stage, the utility to be derived from the innovation will determine whether to adopt or reject it. The implementation really involves the deployment of the innovation, whereas the confirmation enables the validation of the decision of whether the adoption was right or wrong (Kantor and Whalley, 2019).

It is argued that users differ significantly in the degree of their readiness for innovation. Users have been categorized into five segments based on their propensity to adopt an innovation, which include innovators, early adopters, early majorities, late majorities, and laggards (Kardan et al., 2022; Saari et al., 2022). The behavior required to adopt an innovation involves proper management of the anticipated risks and uncertainties. In the persuasion stage, individual networks and key individuals are the influencers for the adoption of the innovation. Opinion leaders are at the very core of interpersonal communication and social networks with better socio-economic status and are more innovative than the rest of the community members (Chawla and Kowalska, 2019; Leon et al., 2017; Tamir et al., 2018). The underlying assumption is that opinion leaders will exert influence on others because of their perceived skill, knowledge, and personality. However, the most recorded limitation of the DOI theory for potential users is the personal and external barriers to innovation (Matthews, 2017). The theory was adopted because it adequately provides explanations for the relational nature of technological innovation and social relations.

## Hypotheses development

Hypotheses on factors constraining the use of mobile phones for accessing agricultural marketing information were derived from the literature review. Adeyemi et al. (2023), Rahman et al. (2020), Sennuga et al. (2020), and Shi et al. (2019) found that the use of mobile phones faces challenges due to high cost, low education, and erratic power supply. McCampbell et al. (2023), Harry and Stanley (2022), and Abdullah et al. (2021) revealed that lack of training, high cost, and network problems negatively impacted mobile phone usage among smallholder farmers. Abdulai et al. (2023), Hoang and Drysdale (2021), Chhachhar and Memon (2019), and Benard et al. (2020) highlighted that smallholder farmers face challenges with mobile phones due to a lack of knowledge, skills, high costs, and networks. Cai et al. (2023), Kabirigi et al. (2022), and Misaki et al. (2018) recognized that lack of confidence, training, language, and internet constrained the use of mobile phones among smallholder farmers. Similarly, Rekha et al. (2022) and Girma and Kelil (2021) reported that farmers were not effectively using mobile phones due to lack of skills, network problems, limited power supply, and high costs. Furthermore, Kabirigi et al. (2023), Sigdel et al. (2022), and Rengaraj and Shibu (2022) noted that high costs, limited power supply, lack of training, and lack of knowledge and skills were the obstacles constraining the use of mobile phones among smallholder farmers. From the empirical literature review, the study hypothesises that:

**H<sub>1</sub>:** Illiteracy level does not constrain the use of mobile phones for accessing agricultural marketing information.

**H<sub>2</sub>:** High costs does not constrain the use of mobile phones for accessing agricultural marketing information.

**H<sub>3</sub>:** Electricity does not constrain the use of mobile phones for accessing agricultural marketing information.

**H<sub>4</sub>:** Training does not constrain the use of mobile phones for accessing agricultural marketing information.

**H<sub>5</sub>:** Skills do not constrain the use of mobile phones for accessing agricultural marketing information.

## Methodology

### Research design

In addressing the stated objectives, the study used a descriptive cross-sectional research design to guide

the study. The use of this design is justifiable based on the nature of the problem and the objectives. The study employed quantitative and qualitative approaches to gather primary data at a single point in time. The use of a mixed method provided a wider and richer understanding of factors constraining the use of mobile phone for accessing agricultural marketing information (Alharahsheh and Pius, 2020).

### *Study area*

The study was carried out in the semi-arid regions of Dodoma. Dodoma is the only agriculturally gifted area for grape production in Tanzania. Grape farming is the key livelihood activity practiced in the study area. Though grape farming is a dominant economic activity, grape smallholder farmers have been challenged by untimely access to agricultural marketing information (Kulwijila et al., 2018; Mlay, 2021). Therefore, the region was considered appropriate because it is the only region with grape production potential, and grape smallholder farmers have been hampered by unreliable and untimely access to agricultural marketing information.

### *Sample size and sampling procedures*

The study targeted a population of 2914 grape smallholder farmers from whom a sample size of 400 respondents was drawn. The sample size calculation was possible through an online Raosoft sample size calculator at a confidence level of 96.86 percent, 5 percent precision, and 50 percent skewness. Moraes et al. (2022) and Serdar et al. (2021) recommend that sample size calculations should consider the degree of confidence, the margin of error, and the level of skewness. According to Alenazi et al. (2022) and Qazi et al. (2022), Raosoft sample size calculator offers flexibility for representative sample sizes. Niebi et al. (2021) proposed that a 200–500 unit sample size is ideal for econometric analysis. The study employed multi-stage sampling techniques in selecting a representative sample. Firstly, Dodoma region and the three leading villages (Hombolo Bwawani, Mbabala, and Mpunguzi) in grape production were purposively chosen. Secondly, from the selected villages, a systematic sampling procedure was used to choose study respondents. The first respondent was randomly selected, and the subsequent respondents were selected using a three-interval estimation method.

### *Data collection*

The study used a self-administered structured survey questionnaire with both closed-ended and open-ended questions to solicit information from grape smallholder farmers. The questionnaire was organized into segments capturing mobile phone ownership and use and factors constraining mobile phone use for accessing agricultural marketing information. The questionnaire was randomly pre-tested to 30 respondents at Mvumi Mission Village in Chamwino district. Yusoff et al. (2021) argue that a default sample size of 30 respondents is ideal for pre-testing of data collection instruments. According to Teshome et al. (2022) and Jima'ain et al. (2022), the pre-testing enhances high internal consistency of data collection instruments before actual data collection. The questionnaire was used because it encourages a high response rate compared to other approaches (Ali et al., 2021; Christensen et al., 2022).

Two Focus Group Discussions (FGDs), each consisting of seven purposively selected participants at a time were conducted. Mobile phone usage experience, gender, and age were highly considered for participants' selections. The discussion was moderated for an hour in a conveniently selected venue to encourage maximum interaction. The researcher and a trained assistant played a facilitative role in moderating the discussion. According to Fatimah et al. (2020) and Christensen et al. (2022), FGDs are commonly used to increase efficiency in collecting primary data. Furthermore, Key Informant Interviews (KIIs) with open-ended questions were held with the extension officers. These participants were presumed to be knowledgeable on various aspects in the study area. Majid et al. (2017) argue that the participants should share as similar criteria as possible for the group of respondents in the major study. The key informant interview was meant to supplement data collected through other methods by soliciting shared views and experiences on the main theme of the study.

### *Data analysis*

The collected data were analysed descriptively (percentages and frequency) in line with the pre-stated objectives. The ordinal logistic regression was specifically applied to analyse factors constraining the use of mobile phones for accessing agricultural marketing information. The model was considered appropriate for carrying out statistical analysis because the dependent variable was captured as an ordinal variable. Williams

(2016), Xue et al. (2016), and Erkan and Yildiz (2014) suggested the use of an ordinal logistic regression model when the dependent variable is ordinaly arranged. The model estimate is shown in equation (1)

$$\text{Logit } Y = \ln\left(\frac{\pi}{1-\pi}\right) = \alpha + \beta_1x_1 + \beta_2x_2 + \beta_3x_3 + \beta_4x_4 + \beta_5x_5 \dots \dots \dots \epsilon \tag{1}$$

Where Y = Dependent variable (extent of mobile phone use corresponding to five-point rating scale of 1 = Never, 2 = Rarely, 3 = Occasionally, 4 = Frequently, and 5 = Very frequently.  $\pi$  = Probability of an event,  $\alpha$  = Y-intercept,  $\beta$  = Logit regression coefficient, Xs = A set of predictor variables and  $\epsilon$  = Error term.

$$\begin{aligned} \text{Extent of mobile phone use} = & \alpha + \beta_1\text{illiteracy} + \beta_2\text{cost} + \beta_3\text{electricity} + \beta_4\text{time} + \beta_5\text{training} \\ & + \beta_6\text{skills} + \beta_7\text{network} \\ & + \beta_8\text{language} \dots \dots \dots \epsilon \end{aligned} \tag{2}$$

Qualitative data were analysed thematically to confirm, refute, and enrich quantitative data. The process was carried out through a thematic content method by cross-checking, sorting, summarizing and categorising themes based on their level of similarities.

**Operationalisation of the study variables**

*Variables description and measurements.* The review of existing literature (Awojide and Akintelu, 2018; Lekopanye and Meenakshi, 2017; Mapiye et al., 2023; Rahman et al., 2020) guided the identification of the appropriate measures of the dependent variables. The summary of the variable measurements is presented in Table 1.

**Findings and discussion**

*Mobile phone ownership among respondents*

Understanding mobile phones owned by respondents is of significant importance for accessing and sharing agricultural marketing information. The respondents stated the types of mobile phones they owned for basic communication. The findings in Table 2 show that the vast majority of respondents owned feature phones.

Table 2 indicates that 78% of the respondents owned feature phones while 11% owned only smartphones and 11% owned both smartphones and featured phones. Ownership of feature phones is attributed to

durability, cheapness, extended battery life, education level, and user friendliness. The findings imply that feature phones are not complex to use and are regarded as the principal means of communication. On the other hand, while smartphones hold the future of agriculture, they are scarcely owned by grape smallholder farmers. The findings support the DOI theory, stating that an innovation is first adopted by a few early adopters and spreads out to the society depending on the perceived relative advantage. With a few grape smallholder farmers using smartphones, it will motivate others to own and use smartphones for accessing agricultural marketing information. Participants in FGDs reported that they owned feature phones because of convenience, easy of calling, and accessibility. They further pointed out that non-owners of mobile phones accessed them through friends, relatives, and neighbours. The sharing of mobile phones exists because of the shared farming experience and other social ties. This indicates that social networking supports access to mobile phones as a collective means of communication. The sharing of mobile phones would create a multiplier effect by spreading out to several farmers. The findings were in line with Raza et al. (2020) and Sennuga et al. (2020), who found that mobile phones were mostly owned by farmers in Sub-Saharan African communities. The findings suggest that simple and cheap technologies are more easily adopted than complex and expensive technologies.

**Table 1.** Variable description and measurement.

Variable	Description	Measurement	Sign
Dependent variable			
The extent of mobile phone use (Y)	The level mobile phone use	1 = Never, 2 = Rarely, 3 = Occasionally, 4 = Frequently, 5 = Very frequently	
Independent variables (X)			
Illiteracy	Respondents perception on illiteracy as a constraint for mobile phone use	4 = major constraint, 3 = moderate constraint, 2 = minor constraint and 1 = not at all a constraint	±
Cost	Respondents perception on high cost as a constraint for mobile phone use	4 = major constraint, 3 = moderate constraint, 2 = minor constraint and 1 = not at all a constraint	±
Lack of electricity	Respondents perception on lack of electricity as constraint for mobile phone use	4 = major constraint, 3 = moderate constraint, 2 = minor constraint and 1 = not at all a constraint	±
Lack of time	Respondents perception on lack of time as a constraint for mobile phone use	4 = major constraint, 3 = moderate constraint, 2 = minor constraint and 1 = not at all a constraint	±
Lack of training	Respondents perception on lack of training as a constraint for mobile phone use	4 = major constraint, 3 = moderate constraint, 2 = minor constraint and 1 = not at all a constraint	±
Inadequate skills	Respondents perception on lack of skill as a constraint for mobile phone use	4 = major constraint, 3 = moderate constraint, 2 = minor constraint and 1 = not at all a constraint	±
Network problem	Respondents perception on network problem as a constraint for mobile phone use	4 = major constraint, 3 = moderate constraint, 2 = minor constraint and 1 = not at all a constraint	±
Language barrier	Respondents perception on language difficult as a constraint for mobile phone use	4 = major constraint, 3 = moderate constraint, 2 = minor constraint and 1 = not at all a constraint	±

**Table 2.** Mobile phone ownership among respondents (n = 400).

Mobile phone type	Frequency	Percentage
Feature phones	312	78
Smartphones	44	11
Both feature phones and smartphones	44	11

### *The extent of mobile phone use in accessing agricultural marketing information*

Mobile phone ownership does not necessarily mean usability. Mobile phone usage impacts farmers access to agricultural marketing information. The study examined the extent of mobile phone use for accessing agricultural marketing information. This gave insight on mobile phone usage in grape farming context. The findings in Table 3 indicate that most farmers used mobile phones for accessing buyers and sharing of price information.

Table 3 shows that mobile phones were most frequently used for accessing buyers (54.9%), sharing

of price information (44%), and quality information (21.4%). Quantity (14.8%) and selling time (6.3%) were the least accessed agricultural marketing information. This has been possible because of the user-friendliness of mobile phone applications like voice calls and mobile money transactions. The findings suggest that the use of mobile phones helps in agricultural marketing information searches and enhances negotiation for better prices with buyers. It was also highlighted in the FGDs, where participants showed that mobile phones aided cross-checking and sharing of prices with other farmers from neighbouring villages. They added that they trusted traders to collect grapes and transfer money using the existing mobile money services if they run out of cash. This is a clear indicator that mobile phone use has transformed communication among grape smallholder farmers. The findings tally with Bruns et al. (2022) and Kaddu et al. (2020), who revealed that price, buyers, and quality information were the most frequently accessed agricultural marketing information. The findings partly suggest that access to agricultural marketing information cements the mutual relationship with

**Table 3.** The extent of mobile phone use in accessing agricultural marketing information.

Marketing information	Extent of mobile phone use				
	Very frequently	Frequently	Rarely	Occasionally	Rarely
Price	20.6	23.4	28.6	15.8	11.6
Buyers	25.2	29.7	32.3	9.9	2.9
Quality	7.8	13.6	15.2	20.9	42.5
Quantity	4.6	10.2	13.0	18.6	53.6
Selling time	2.2	4.1	8.6	13.1	72

buyers and helps grape smallholder farmers make informed decisions.

*Factors constraining the use of mobile phone for accessing agricultural marketing information*

The study examined factors constraining the use of mobile phones for accessing agricultural marketing information. The ordinal logistic regression was applied to accomplish the purpose. The proportional odds assumption was carried out to test the model, and a chi-square value of 76.55 and  $p > .05$  was produced, suggesting that the model was standard for the analysis. The Cox and Snell  $R^2$  was 0.403 and the Nagelkerke  $R^2$  was 0.521, indicating that the predictor variables explained 52% of the variance in the outcome variable. The data were adequately fitting the model at an acceptable level, with a chi-square value of 34.326 and  $p < .05$ . Moreover, the goodness of fit information yielded Pearson and Deviance chi-square values of 286.504 and 294.602 and  $p > .005$ , indicating that the model fitted the data well. The findings in Table 4 portray that illiteracy, lack of training, and inadequate skills were the most significant constraints at  $p < .05$  significance level.

Table 4 indicates that illiteracy had a negative but significant relationship with the level of mobile phone use for accessing agricultural marketing information at  $p < .05$ , Wald = 7.681, and Exp ( $\beta$ ) = 0.908. Illiteracy reduced the level of mobile phone use by 0.908, with an odd ratio of -0.097, implying that illiterate farmers had a 0.097 low level of mobile phone use for accessing agricultural marketing information. This resulted in the rejection of the null hypotheses, which stated that illiteracy levels do not constrain the use of mobile phones for accessing agricultural marketing information. This can be attributed to the fact that the increased illiteracy level weakens the level of mobile phone use for accessing agricultural marketing information. One

**Table 4.** Factors constraints the use of mobile phone for accessing agricultural marketing information (n = 400).

Variable	B	S. E	Wald	Df	Sig	Exp( $\beta$ )
Illiteracy	-0.097	0.035	7.681	1	0.005	0.908
Cost	-0.112	0.102	1.201	1	0.046	0.894
Lack of electricity	-0.116	0.137	0.717	1	0.397	0.890
Lack of time	-0.078	0.175	0.199	1	0.654	0.925
Lack of training	-0.600	0.278	4.658	1	0.030	0.549
Inadequate skills	-0.003	0.002	2.250	1	0.042	0.997
Network problem	-0.071	0.411	0.030	1	0.843	0.931
Language barrier	-0.132	0.187	0.498	1	0.478	0.876

Model summary: Cos and Snell  $R^2 = 0.403$ , Nagelkerke  $R^2 = 0.521$ , Model fit information Chi-square 34.326 ( $p = .000$ ). Goodness of fit, Pearson and Deviance Chi-square (286.504 and 294.602,  $p = .754$  and  $.676$ ), parallel line, chi-square = 76. 545 and  $p = .074$ .

of the key informants narrated that “Some grape smallholder farmers have bought smartphones with useful applications, but they fail to use them because of low education and language barriers”. The findings confirm the DOI theory by reflecting illiteracy (lack of knowledge) level as one of the constraining factors for mobile phone use, which supports the decision to either adopt or reject the innovation. This implies that most smallholder farmers are not conversant with the use of smartphones, as they come with instructional application menus written in English, limiting the potential for accessing and sharing agricultural marketing information. The findings tally with Mapiye et al. (2023) and Shaibume et al. (2021), who asserted that illiteracy limited the potential of mobile phone use in accessing agricultural information among smallholder farmers. The findings suggest that educated farmers would be more knowledgeable about

new mobile phone applications and, hence, have a greater chance of accessing a variety of agricultural marketing information.

The findings indicate that lack of training was negatively and significantly related to mobile phone use for accessing agricultural marketing information at  $p < .05$ , Wald = 4.658, and Exp ( $\beta$ ) = 0.549. The finding implies that the absence/decrease of training by 0.549 units with an odds ratio of  $-0.600$  suggests a decreased level of mobile phone use by 0.600 for accessing agricultural marketing information. The findings support the rejection of the null hypothesis that training does not constrain the use of mobile phones for accessing agricultural marketing information. This is explained by the fact that a lack of training reduces confidence and motivation for mobile phone use in accessing agricultural marketing information. The findings were supported by Nugroho (2021) and Bosompem (2021), who found that a lack of practical exposure and training for the use of mobile phones limited access to agricultural marketing information. Smallholder farmers who are not adequately exposed to training are prone to reducing mobile phone use for accessing agricultural marketing information. Therefore, farmers' training on mobile phone use is crucial, and such programmes should adequately prepare them with the necessary skills to effectively integrate mobile phone technology into their farming businesses.

Inadequate skills had an inverse relationship with mobile phone use for accessing agricultural marketing information at  $p < .05$ , Wald = 2.250, and Exp ( $\beta$ ) = 0.997. This suggests that if lack of skills increases by 0.997 units with an associated odds ratio of  $-0.003$ , it implies that farmers decrease the level of mobile phone use by 0.003 and reduce the possibility of accessing agricultural marketing information. This resulted in the non-acceptance of the hypothesis that skills do not constrain the use of mobile phones for accessing agricultural marketing information. It is argued that skill is one of the key factors in improving mobile phone use. One key informant was quoted saying "A mobile phone is just like a computer; for effective use, smallholder farmers need skills". The findings have revealed useful insight on the DOI theory, which postulates that the rate at which innovation will diffuse within a social system will depend on the complexity of the innovation. The lack of skills among smallholder farmers reflects the complexity of mobile phone use in accessing agricultural marketing information. This points to the fact that

grape smallholder farmers had not received training that would empower them with the skills to fully exploit mobile phone applications. The findings concurred with those of Zheng and Ma (2023) and Daniso et al. (2020), who presented an indirect relationship between skills and mobile phone use for accessing agricultural marketing information. The findings suggest that grape smallholder farmers who are less inclined to mobile phone use due to a lack of skills reduce their chances of accessing agricultural marketing information.

The findings further indicate that cost is negatively and significantly associated with the level of mobile phone use at  $p < .05$ , Wald = 1.201, and Exp ( $\beta$ ) = 0.894. This indicates that when the cost of using a mobile phone increases by 0.894 units with an odd-ratio of  $-0.112$  it reduces the possibility of using mobile phone by 0.112 for accessing agricultural marketing information. Thus, the null hypothesis that high costs do not constrain the use of mobile phones for accessing agricultural marketing information was rejected. This implies that the higher cost of using a mobile phone creates a serious challenge when using a mobile phone to access agricultural marketing information. Effective use of mobile phones for accessing agricultural marketing information has financial implications and depends on the farmer's financial resources. The general problem facing most smallholder farmers is linked to income poverty causing low purchasing power. The FGD supported this scenario by highlighting that the high cost of purchasing and maintaining mobile phones hindered effective use. The statement is a clear indicator that the cost of using a mobile phone affects the sharing of agricultural marketing information among grape smallholder farmers. Similarly, Adeyemi et al. (2023), Sigdel et al. (2022), and Rengaraj and Shibu (2022) observed that the high cost militated farmers against the effective use of mobile phones. Grape smallholder farmers' must incur costs to ensure proper functioning of mobile phones for accessing agricultural marketing information.

## Conclusion and recommendations

In today's world, it should be possible for smallholder farmers to efficiently and effectively use mobile phones to access agricultural marketing information. The study reveals that grape smallholder farmers generally used basic mobile phone technology. This underscores the reality of the prevailing income



poverty, high cost, and complexity associated with the use of smartphones. However, mobile phones were preferred for communicating and sharing price and buyer information. This signifies that access to such information improves decision-making when dealing with traders. Despite this fact, the use of mobile phones among grape smallholder farmers is still evolving and challenging. The study highlights that high costs, illiteracy, inadequate skills, and a lack of training are the challenges of mobile phone use for accessing agricultural marketing information. This indicates that these factors negatively impacted the extent of mobile phone use in accessing agricultural marketing information. Based on the findings, it is concluded that factors constraining the use of mobile phones for accessing agricultural marketing information are context-specific and cannot be generalised. Therefore, in order to ensure that these challenges are properly addressed, it is recommended to the Tanzania Communication Regulatory Authority (TCRA) to reduce the monetary cost of using mobile phones for smallholder farmers by reforming tariff structures to stimulate interest in the use of smartphones to access agricultural marketing information. The Ministry of Agriculture, in close collaboration with the Ministry of Information, Communication, and Technology, should conduct training for smallholder farmers by establishing ICT resource centers to increase skills and competencies in the use of mobile phones. The Ministry of Education, Science, and Technology should develop an education system that offers digital literacy by designing a competence-based curriculum from primary schools to ensure awareness of digital technologies among smallholder farmers.

### **Theoretical, practical, and policy implications**

Understanding factors constraining effective use of mobile phones among smallholder farmers cannot be underestimated. For the researchers, the study reinforces that constraining factors exist independently or together to predict mobile phone use among smallholder farmers. The study conceals distinctive constraining factors (high cost, illiteracy, inadequate skills, and lack of training), which can be tested by researchers in different contexts to enrich a better picture of the factors. This will subsequently enrich the knowledge of the DOI by postulating that external conditions may either promote or prevent the use of

mobile phones in a given context. Also, the study highlights pertinent and important practical implications for ICT developers to redesign smartphones, as they are still regarded as more complex technology than the featured phones, and this hinders individual farmers effective use of mobile phone technology. This would require considering the education level of farmers by generating a more user-friendly classification of mobile phones. Given the importance of mobile phones in accessing agricultural marketing information, policy makers should consider promoting ICTs that are used by all smallholder farmers. For instance, it is argued that using friendly and less complex mobile phone to most of the illiterate smallholder farmers would encourage uptake and use of mobile phones in accessing agricultural marketing information. There should be devoted efforts in creating awareness for the use of smartphones and their associated applications to create confidence among smallholder farmers. This is supported by the findings that illiteracy, inadequate skills, and a lack of training had a notable constraining influence on effective mobile phone use for accessing agricultural marketing information.

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### **Authors' contributions**

AIN designed the study, collected and analysed data. ASS and IK did the Critical literature review and discussions of the findings. Both authors prepared, read and approved the final manuscript

### **Availability of data and materials**

The datasets used and analyzed during the current study are available from the authors upon reasonable request.

### **Consent for publication**

Consent for participants is not applicable. The authors confirm that all the data and materials are available. The authors confirm that the manuscript is the author's original work and that the manuscript has not received prior publication and is not under consideration for publication elsewhere. Authors re-assure that they have contributed significantly to the work, have read the manuscript, attest to the validity and legitimacy of the data and its interpretation, and agree to its submission. Also, the authors of this paper confirm that the paper is not copied or plagiarized version of some other published work. Authors declare that

this paper is not submitted for publication in any other Journal or Magazine till the decision is made by journal editors.

### Ethical approval and consent to participate

The authors confirm that they have read, understand, and agreed to the submission guidelines, policies, and submission declaration of the journal. The authors confirm they have no conflict of interest to declare. A local ethics committee ruled that no formal ethics approval was required in this particular research, they only asked to have a copy of the published report after the research has been completed.

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### ORCID iD

Alex I Nyagango  <https://orcid.org/0000-0002-6322-8876>

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#### About the authors

**Alex I Nyagango** worked as an assistant lecturer and a researcher in the Discipline of Marketing under the Department of Marketing and Enterprise Management at Moshi Co-operative University (MoCU) in Kilimanjaro, Tanzania. He currently assumes a similar position under the Department of Management at Tanzania Institute of Accountancy (TIA). His research interests include marketing communication, industrial marketing, consumer marketing, service marketing, social marketing, and marketing logistics. Email: nyagango@gmail.com

**Alfred S Sife** is a professor of Library and Information Science at Moshi Co-operative University (MoCU) in Kilimanjaro, Tanzania. His research, teaching and consultancy interests center mainly on information and communication technologies for development (ICT4D), scientometrics and bibliometrics, e-resources, information literacy, records management, systems analysis and design and research methods. Email: asife@live.com

**Isaac Kazungu** is a senior lecturer, researcher and consultant in the Department of Marketing and Enterprise Management at the Moshi Co-operative University (MoCU), Kilimanjaro, Tanzania. His areas of research interest include international marketing, agriculture marketing, service marketing, entrepreneurship, small and medium enterprise performance and agripreneurship development. Email: isaackazungu@gmail.com