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Veritable mobile phone applications for affecting the exchange of agricultural information among farmers in Tanzania

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Abstract

The importance of mobile phones in communication cannot be overemphasized. This study investigated farmers' usage of mobile phones in exchanging agricultural information. Specifically, it compared the level of usage of mobile phones and other communication channels in exchanging agricultural information among farmers; found out the most usable mobile phone applications for exchanging agricultural information among farmers, and determining factors influencing the usage of mobile phones in exchanging agricultural information. The study was guided by the Task-Technology Fit model. A sample of 188 farmers owning mobile phones was purposively selected. A structured questionnaire and a focus discussion guide were used for collecting data. Content analysis and SPSS software were used for analysing data. Results indicate that mobile phone calls and SMS were mostly used by farmers. The limited power supply in rural areas, unaffordable mobile phone tariffs, and poor mobile phone infrastructure in rural areas were mentioned to lower the usage of mobile phones in exchanging agricultural information. The study concludes that when used efficiently, mobile phones have the potential of transforming the agricultural sector. It is recommended that mobile phone service providers should reduce the costs of their services for more farmers to use them.

Keywords: Mobile phone, mobile phone services, agricultural information, farmers, Tanzania.

Introduction

Agricultural information services are of great importance because they help in making rational decisions on agricultural production and post-harvest practices. For the information services to be used they must be made available and accessible to users in the agricultural sector. Scholars (Mwantimwa, 2017, Adeniyi and Ojo, 2015; Ganesan, Umadikar & Prashant, 2015) describe agricultural information services to enhance access to agricultural knowledge among agricultural stakeholders. Generally, agricultural information services are meant to meet the agricultural information needs of farmers and other stakeholders in the sector.

Timely access to agricultural information requires an effective link between agricultural information sources and agricultural information seekers. In communication processes, communication channels are used to link information sources and information seekers. Some common examples of communication channels include telephone, text messaging and e-mail, face-to-face oral communication, and web-based channels like social media and websites (Sanina, Balashov, Rubtcova & Satinsky 2017).

Farmers and other stakeholders in the agricultural sector can access agricultural information via different channels. In most developing countries, farmers access agricultural information orally through face-to-face communication (Mubofu & Elia, 2017). Agricultural advisory and extension services in developing countries use this channel in enhancing access to agricultural information. Face-to-face communication requires communicators to be in the same geographical location when communicating. Due to the limited number of agricultural extension agents and a large number of farmers in most developing countries, it is difficult to meet most farmers through this communication channel (Elias, Nohmi, Yasunobu & Ishida, 2015). This has resulted in unequal access to agricultural extension services among farmers.

To limit dependence on oral and face-to-face communication, the Rural Resource Centres (RRCs) model was introduced by international organizations like the Food and Agricultural Organization (Ndinde & Kadodo, 2014). The RRCs are meant to provide farmers with agricultural extension services, link them with market actors; enhance access to market information and micro-finance opportunities and act as a forum for exchanging information among farmers and between farmers and other stakeholders (Ndimbwa, Ndumbaro, & Mwantimwa, 2019). Some of these centres are set up to enhance access to internet services among rural people. They are meant to bridge the information and knowledge gap resulting from the rural-urban information divide (Mwantimwa, 2017). Despite their potential, most of the rural resource centres are not operational due to poor management (Kapondera & Hart, 2016).

Newspapers are also used as a channel for enhancing access to agricultural information. They are used to provide agricultural extension and advisory services, market updates, weather information, and agricultural education content (Apata, 2010). However, very few newspapers are reported to contain agricultural information (Ogessa & Sife, 2017; Awojobi & Adeokun, 2012). Moreover, for newspapers to provide these services to farmers they must be made accessible in rural area settings where most farmers dwell. Unfortunately, poor and impassable roads hinder the delivery of newspapers in most rural areas in developing countries (Odini, 2016). This has been limiting the potential of newspapers in enhancing access to agricultural information.

Another strategy adopted for enhancing access to agricultural information is the usage of Information and Communication Technologies (ICTs). Radio, television, and mobile phones are among ICTs commonly used by farmers (Kaske, Mvena & Sife, 2017; Msoffe & Ngulube, 2016). Radio and television stations enhance access to agricultural information through the broadcasted agricultural programs. Agricultural radio and television programs are educative; they provide information on topical issues needed by farmers (Emmanuel & Olabode, 2015). However, there are few radio and television stations dedicated to broadcasting agricultural programs (Yahaya., Adamson & Kareem., 2018). Moreover, most other radio and television stations have very few agricultural programs and the majority of them are aired when farmers are attending farm activities (Mtega, 2018). This limits the usefulness of radio and television as channels for enhancing access to agricultural information among farmers.

Like other ICTs, mobile phones can be used as a communication channel to enhance access to agricultural information (Kiberiti, Sanga, Mussa, Tumbo, Mlozi, & Haug, 2016). They can limit barriers caused by differences in geographical location between communicators (Kabbiri, Dora, Kumar, Elepu & Gellynck., 2018). Mobile phones facilitate the delivery of information services through voice, text, graphics, image, and video (Mibei, Karanja & Sones, 2017). Moreover, mobile phones can facilitate access to internet services (Aker, 2010). Generally, mobile phones reduce costs

associated with the communication process by limiting the impacts brought by differences in geographical locations and time (Aker, 2011). Therefore, as communication channels, mobile phones have relatively more advantages than other communication channels.

Despite the potentials of mobile phones in the delivery of information, access to agricultural information among farmers in Tanzania is still a challenge (Abswaidi, Anael & Khamisi, 2017; Magesa, Michael, & Ko, 2014; Lwoga, Stilwell & Ngulube, 2011). A study by Ndimbwa, Ndumbaro and Mwantimwa (2019) indicates that the major problem with access to agricultural information is not associated with inadequacy creation of agricultural information but rather with the linkage between agricultural information sources and seekers of agricultural information. The poor linkage between farmers and agricultural information sources limits accessibility and usage of agricultural information which in turn leads to irrational decisions on agricultural activities thus lowering agricultural productivity (Lugamara, Urassa, Nguezet & Masso,, 2019). Therefore, this study investigates how farmers use mobile phones in enhancing access to agricultural information**.** Specifically, the study was set to:

i. Identify all communication channels used in exchanging agricultural information among farmers.
ii. Determine the most usable mobile phone applications for exchanging agricultural information among farmers.
iii. Determine factors influencing the usage of mobile phones in exchanging agricultural information.

Literature review

Access to agricultural information is important for optimizing agricultural production and benefits for farmers. Communication channels are the means to enhance access to agricultural information. Usually, the effectiveness of the communication process in agriculture depends on the communication channels used (Lugamara et al., 2019).

Communication channels used by farmers

Communication channels link senders and receivers of messages. Usually, a communication channel can be the most preferred in certain situations and ignored in others; moreover, communication channels may be used separately or combined (Ndimbwa et al., 2019; Sanina et al., 2017). Communication channels may either support one-way or two-way communication (Ndimbwa et al., 2019). Face-to-face oral communication, mobile phone communication, and letters seeking a reply are examples of two-way communication while communication through the newspaper is in most cases one-way.

Communication channels supporting two-way communication create a better understanding of communicated messages among receivers. A communication channel can support both synchronous and asynchronous communication. It is synchronous communication when (Rettie, 2009). Mobile phones support synchronous communication through calls and replied SMS, they can support asynchronous communication when received messages are not replied to. Thus, this study determines the preference of communication channels for exchanging agricultural information among farmers.

Mobile phone information services

Mobile phones are handheld communication devices that are connected to the phone system by radio instead of a wire, and can be used anywhere their signals could be found (Cambridge University, 2016). These devices cut down barriers associated with the difference in location between the sender and receiver of the message, and reduced communication costs (Aker, 2011). In agriculture, mobile phones can be used for providing agricultural information services to farmers. Services provided through mobile phones can be accessed remotely from a distance. Mobile phones are the easiest, fastest, and most convenient way to communicate and get prompt answers to problems (Razaque, 2013). The communication device enhances instant access to weather information and extension services, they provide avenues for information sharing among farmers (Mittal, 2016; Sanga, Mlozi & Haug, 2016).

Studies indicate that access to mobile phones is either by owning, sharing, or usage in mobile phone kiosks (Cibangu, Hepworth & Champion, 2017; Kiberiti et al., 2016). Those owning mobile phones may have more usage opportunities than non-owners because they always have devices with them. Therefore, ownership and easy access to mobile phones tell about the level of usage of mobile phones (Tadesse & Bahiigwa, 2015).

Mobile phones may transfer voices, graphics, texts, images, and videos. Smartphones, which form the current generation of mobile phone technology have more computing abilities, powerful onboard computing capability, capacious memory, large screen, and open operating system and so considered to be handheld computers (Vora, 2015; Boulos, Wheeler, Tavares, & Jones, 2011). These advancements have made it possible for people to access the internet and of course web-based information via mobile phones. This has provided new sources of agricultural information among farmers. Thus, the current study is set to establish how farmers optimize the use of mobile phones in enhancing access to agricultural information

Delivery of agricultural information through mobile phones

In agriculture, mobile phones may be used for delivering agricultural information to different agricultural stakeholders. This is made possible through the usage of different mobile phone applications including Short Messaging Service (SMS), Multimedia Messaging Service (MMS), calls, internet services, and social network applications (Kaske, Mvena, & Sife, 2017). Through these applications, farmers and other stakeholders may be informed on different topical agricultural issues (Szilágyi, 2015; Katengeza, Okello & Jambo, 2011). Farmers may use these applications to consult experts and fellow farmers and share personal experiences with others. Mobile phone operators and other agricultural services providers may use these applications for providing updates on weather, market prices, and other topical issues in farming (Alakpa, Afolabi & Ighalo, 2019; Ogbeide, Service & State, 2015).

Mobile phones, smartphones, in particular, are equipped with physical sensors (cameras) that can instantly capture observations in crops and send captured data for analysis (Pongnumkul, Chaovalit, & Surasvadi, 2015). Moreover, the Global Positioning Systems (GPSs) installed in these phones can be used to determine the location of the farm (Drill, 2012). In this way, mobile phones may be used for capturing observations and sharing with experts. Moreover, mobile phones have some other in-built applications like the blue-tooth sensor, Radio Frequency Identification (RFID), and Near-Field Communications (NFC) which may also be used for transferring captured

observations provided that the mobile phone is programmed for that (Pitsillides, 2017). Therefore, this study intends to find out the most usable mobile phone applications.

Factors influencing the usage of mobile phones

There are several factors that may affect the usage of mobile phones. Mobile phone ownership, individual income, and one's literacy level may influence the level of usage of mobile phones. Moreover, those owning mobile phones may use them more frequently than non-owners (Barakabitze, et al, 2015). Moreover, poor network coverage affects the communication process through mobile phones while unaffordable mobile phone prices affect the ownership of mobile phones (Nyamba & Mlozi, 2012). Furthermore, the ability to use certain mobile phone applications, social influence, and perceived usefulness of mobile phones in exchanging agricultural information affect the level of usage of mobile phones among farmers (Lubua, 2017). Tanzania had improved and extended mobile phone networks and the number of mobile phone subscribers has increased (TCRA, 2020a), moreover, the power infrastructure has been extended too (Rocco, Tonini, Fumagalli, & Colombo, 2020). Despite having the basic infrastructure for the usage of mobile phones and improve access to agricultural information among farmers, studies indicate the accessibility of agricultural information among most farmers is still a challenge (Mkenda, et al., 2020; Mwantimwa, 2020; Nyamba & Mlozi, 2020). This study is set to determine factors influencing the usage of mobile phones for exchanging agricultural information among farmers in Tanzania.

Conceptual framework

This study was set to investigate the usage of mobile phones for effecting agricultural information exchange by farmers in Tanzania**.** The study was guided by the Task-Technology Fit (TTF) Model which helped in investigating issues of fit of technology to the task (D'Ambra, Wilson, & Akter, 2013). The Task-Technology Fit model explains the degree to which technology assists an individual in performing tasks (Goodhue & Thompson, 1995). The core of a Task-Technology Fit Model is a formal construct known as Task-Technology Fit (TTF), which is the matching of the capabilities of the technology to the demands of the task, it is the ability of the technology to support a task (Goodhue & Thompson, 1995). TTF model has four key constructs, Task Characteristics, Technology Characteristics, which together affect the Task-Technology Fit, which in turn affects the last construct the outcome variable, either performance or utilization (Goodhue & Thompson, 1995). TTF model posits that technology will be used if, and only if, the functions available to the user fit the activities of the user; experienced users will choose those tools and methods that enable them to complete the task with the greatest net benefit (Dishan, Strong & Bandy, 2002).

In this study, the Task-Technology Fit (TTF) model was used to investigate how mobile phones facilitate agricultural information exchange among farmers. This model guided the study in identifying the applications suitable for agricultural information exchange among farmers and investigating critical factors for efficient usage of mobile phones for agricultural information exchange.

The methodology of the study

This study investigated the usage of mobile phones in exchanging agricultural information among farmers in Tanzania. It used a cross-sectional research design where data were collected at one point in time. It employed quantitative and qualitative research approaches. The study involved farmers

from Morogoro region which is one of the national grain basket regions in the country. The study involved three districts that were purposively selected from the seven districts of Morogoro region based on coverage of the mobile phone network. Kilombero, Kilosa, and Mvomero districts were selected as the study area. Three villages from each district were chosen based on the quality of the mobile phone network. Thus, nine villages namely: Chanzuru, Kimamba B, and Rudewa Mabatini from Kilosa district, Mvomreo village, Wami Dakawa, and Hembeti from Mvomero district, and Mlimba A, Michenga, and Mgudeni from Kilombero district were included in the study. A sample of 188 farmers owning mobile phones was purposively selected through snowballing. Among the 188 farmers, 66 (43 males and 23 females) were from Kilombero district, 41 (23 males and 18 females) from Kilosa, and 81 (36 males and 45 females) from Mvomero district (see Table 1 for details). The study also collected secondary data from purposively selected reports from the Tanzania Communication Regulatory Authority (TCRA) to supplement the primary.

Table 1: Respondents for the study

Name of village	**District**	**Sex of the respondent**		
		Male	**Female**	**Total**
Chanzuru	Kilosa	7	5	12
Kimamba B		9	6	15
Rudewa Mabatini		7	7	14
Mvomero	Mvomero	15	11	26
Wami Dakawa		13	24	37
Hembeti		8	10	18
Mlimba A	Kilombero	20	10	30
Michenga		18	10	28
Mgudeni		5	3	8
Total		**102**	**86**	**188**

A structured questionnaire was used for data collection from 188 farmers. Three focus group discussions (one in each district) were conducted to collect data that could not be captured through the structured questionnaire. A codebook was used for collecting data from reviewed reports from the TCRA. The SPSS Statistics was used for analysing quantitative data where cross-tabulations were mainly used for creating relationships between and among variables. Qualitative data were analysed through the constant comparison analysis technique where qualitative data were systematically and inductively reduced into codes and themes developed from codes. Thus, related contents were grouped into the same theme. Quantitative and qualitative results are presented in tables and descriptions respectively.

Results of the study

This section presents the results of the study by specific objectives. Quantitative results are presented in tables while qualitative results are in the form of descriptions.

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Demographic characteristics of respondents

Table 2 presents the age groups of the farmers involved in the study. Among the 188 respondents, the majority were in the 26 to 35 age group followed by those in the 36 to 45 age group. Results in Table 2 indicate that most of the respondents were below 45 years of age. Moreover, the study involved 102 (54.3%) male and 86 (45.7%) female respondents. In Tanzania, more females are involved in agriculture.

Table 2: Demographic characteristics of the farmers n=188

Age of the farmers	
Age group	**Frequency**
15 to 25	13 (6.9%)
26 to 35	48 (25.5%)
36 to 45	47 (25.1%)
46 to 55	29 (15.4%)
56 to 65	29 (15.4%)
66 and above	22 (11.7%)
Sex of the farmers	
Male	102 (54.3%)
Female	86 (45.7%)
Level of education of the farmers	
Informal education	20 (10.6%)
Primary education	140 (74.5%)
Secondary education	28 (14.9%)

Results in Table 2 indicate that majority (74.5%) had primary education, 14.9% had secondary level of education and 10.6% had informal education. In Tanzania, primary education is the basic education attained for seven years. Secondary education follows after primary education; it is subdivided into ordinary level secondary education (taken for four years after primary education) and advanced level education which takes two years after secondary education. In Tanzania, informal education is acquired through passing knowledge and skills informally from a generation to the other or through other informal means outside the formal education system.

Communication channels used for exchanging agricultural information among farmers

Results in Table 3 indicate that all respondents used face-to-face oral communication for exchanging agricultural information. Others, 96.3% used mobile phones while 75.5% used radio sets. Results indicate further that other respondents (38.8%) used television sets while few (17%) used print media for exchanging agricultural information.

Table 3: Communication channels used for exchanging agricultural information n=188

Channels used	Frequency
Face-to-face oral communication	188 (100%)
Mobile phone	181 (96.3%)
Radio set	142 (75.5%)
Television set	73 (38.8%)
Print media	32 (17%)

These results show that face-to-face oral communication, mobile phones, and radio sets were used by the majority of the farmers for exchanging agricultural information. When compared to other mediated communication tools, mobile phones were used by the majority.

Usage of mobile phones for exchanging agricultural information

Results in Table 4 show that mobile phones were used by the majority (96.3%) of the farmers for exchanging agricultural information. This communication device ranked number two in terms of being used by more farmers for the purpose.

Table 4: Mobile phone applications used for accessing agricultural services n=188

The mobile application used by the farmers	Frequency
Calls	181 (96.3%)
Short Message Service (SMS)	176 (93.6%)
Multimedia Messaging Service (MMS)	119 (63.3%)

Results in Table 4 indicate that 96.3% of the farmers used calls for exchanging agricultural information. Others, 93.6% used SMS for exchanging agricultural information. Results indicate further 63.3% of the farmers used MMS for exchanging agricultural information.

Farmers' level of education and usage of mobile phone applications for exchanging agricultural information

The usage of calls for exchanging agricultural information was influenced by farmers' demographic characteristics. Results in Table 5 indicate that usage of mobile phones for accessing agricultural information increased by age of the farmers. Results indicate that 90% of the farmers with informal education calls for exchanging agricultural information. Others, 92.1% and 96.4% of the farmers with primary and secondary education respectively used calls for exchanging agricultural information.

Results in Table 5 indicate further that 80% of the farmers with informal education used SMS for exchanging agricultural information. Others, 90% and 96.4% of the farmers with primary and secondary levels of education respectively used SMS for exchanging agricultural information. These results indicate that level of education of the farmers has a limited influence on the usage of calls for exchanging agricultural information. Moreover, the level of education had a slight influence on the usage of SMS for exchanging agricultural information.

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Table 5: Mobile phone applications by farmer's level of education n=188

	Frequency by Mobile phone application used		
Level of education	**Voice calls**	**SMS**	**MMS**
Informal education	18 (90%)	16 (80%)	9 (45%)
Primary education	129 (92.1%)	126 (90%)	82 (58.6%)
Secondary education	27 (96.4%)	27 (96.4%)	22 (78.6%

Results in Table 5 indicate further that 45% of the farmers with information education and 58.6% with primary education respectively used MMS for exchanging agricultural information. Others, 78.6% of the farmers with secondary education used MMS for exchanging agricultural information.

Generally, farmers' level of education had an influence on the usage of mobile phone applications for exchanging agricultural information. The level of usage of mobile phones for exchanging agricultural information increased with an increase in the level of education.

Farmers' age and usage of mobile phone applications for exchanging agricultural information

Results in Table 6 indicate that the age of the farmers had an influence on the usage of mobile phone applications for exchanging agricultural information. Results indicate that the usage of calls for exchanging agricultural information decreased by an increase in the age of the farmer. All of the farmers below 35 years of age used mobile phone calls for exchanging agricultural information. Results indicate that 95.1% of the farmers aged 36 to 45 years and 93.1% of the farmers aged 46 to 55 years of age used mobile phones. Others, 82.8% of the farmers aged between 56 and 65 years and 77.3% of the farmers aged above 65 used mobile phone calls for exchanging agricultural information too.

Table 6: Usage of mobile phone applications by age of the farmers n=188

	Mobile phone applications by age		
Age group	**Calls**	**SMS**	**MMS**
15 to 25	13 (100%)	13 (100%)	09 (69.2%)
26 to 35	48 (100%)	45 (93.8%)	30 (62.5%)
36 to 45	45 (95.1%)	46 (97.9%)	32 (68.1%)
46 to 55	27 (93.1%)	25 (86.2%)	19 (65.5%)
55 to 65	24 (82.8%)	23 (79.3%)	13 (44.8%)
>65	17 (77.3%)	17 (77.3%)	10 (45.5%)

Results in Table 6 indicate further that the usage of SMS for exchanging agricultural information also decreased with an increase in the age of the farmer. Results show that all of the farmers (100%) aged between 15 and 25 years and 93,8% of the farmers aged between 26 and 35 years used SMS for exchanging agricultural information respectively. Others, 97.9% and 86.2% aged between 36 and 45 and 46 and 55 years used SMS for exchanging agricultural information respectively. Results indicate further that 79.3% and 77.3% of the farmers aged between 56 and 65 and above 65 years used SMS for exchanging agricultural information.

Results in Table 6 indicate also that the usage of MMS for exchanging agricultural information decreased with an increase in age. Results show that 69.2% of the farmers aged 15 to 25 years and 62'5% of the farmers aged 26 to 35 years used MMS for exchanging agricultural information. Others, 68.1% and 65.5% of the farmers aged 46 to 55 and 56 to 65 years used MMS for exchanging agricultural information. Results indicate that few of the farmers (45.5%) aged above 65 years used mobile phones for exchanging agricultural information.

Generally, calls were the most used mobile application for exchanging agricultural information followed by SMS while MMS was the least used phone application. Moreover, the usage of all mobile phone applications decreased with an increase in age, however, the usage of MMS decreased more than other applications with an increase in farmers' age.

Farmers' sex and usage of mobile phone applications for exchanging agricultural information

Results in Table 7 indicate that 93.1% of the male and 91/8% of the female farmers used calls for exchanging agricultural information. Others, 93.1% and 86% of the male and female farmers respectively used SMS for exchanging agricultural information. Moreover, 67.6% and 51.2% of the male and female farmers used MMS for exchanging agricultural information.

Table 7: Usage of mobile phone applications by sex of the farmers n=188

Sex of the respondent	Mobile phone application for accessing agricultural information services		
	Calls	**SMS**	**MMS**
Male	95 (93.1%)	95 (93.1%)	69 (67.6%)
Female	79 (91.9%)	74 (86%)	44 (51.2%)

Generally, there was a very slight difference in terms of usage of calls for exchanging agricultural information by sex of the farmers. However, more male than female farmers reported using the other two mobile phone applications for exchanging agricultural information.

Agricultural services providers consulted through mobile phones

Results in Table 8 indicate that calls were the most used mobile phone application for consulting agricultural information service providers. Results indicate that majority (96.3%) of the farmers used calls to consult fellow farmers while others, 63.8%, and 60.6% used calls to consult agricultural extension officers and farmers' associations respectively. Moreover, 56.9% of the farmers used calls for consulting agricultural input suppliers while few (28.7%) consulted agricultural researchers through calls.

Table 8: Sources of agricultural information consulted by mobile phone n=188

Source	Frequency		
	Calls	**SMS**	**MMS**
Fellow farmers	181 (96.3%)	131 (69.7%)	87 (46.3%)
Agricultural extension officers	120 (63.8%)	34 (18.1%)	21 (11.2%)
Farmers' associations	114 (60.6%)	23 (12.2%)	11 (5.9%)
Input suppliers	107 (56.9%)	10 (10.6%)	05 (2.7%)
Agricultural researchers	54 (28.7%)	07 (3.7%)	03 (1.6%)

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Results show further that 69.7% of the farmers used SMS for consulting fellow farmers while 18.1% used SMS for consulting agricultural extension officers. Results indicate further that 12.2% and 10.6% of the farmers used SMS to consult farmers' associations and input suppliers respectively. Few of the farmers (3.7%) used SMS to consult agricultural researchers.

Likewise, results in Table 8 indicate that 46.3% of the farmers used MMS to consult fellow farmers using MMS. Others, 11.2% and 5.9% of the farmers used MMS to consult agricultural extension officers and farmers' associations respectively. Few of them, 2.7% and 1.6% of the farmers used MMS to consult input suppliers and agricultural researchers respectively.

Generally, the majority of the farmers used calls to reach most of the agricultural information service providers followed by those who used SMS. MMS was least used for consulting agricultural information service providers. Moreover, among agricultural information service providers, fellow farmers were consulted more while agricultural researchers were least consulted.

Factors influencing usage of mobile phones in exchanging agricultural information

Several factors were found to influence the usage of mobile phones in exchanging agricultural information. These factors are:

Mobile phone tariffs

The farmers were asked if they afforded mobile phone tariffs. Results in Figure 1 indicate that 29% of the farmers mentioned affording mobile phone tariffs. Others, 58% mentioned to rarely afford tariffs while 13% mentioned not to afford tariffs at all.

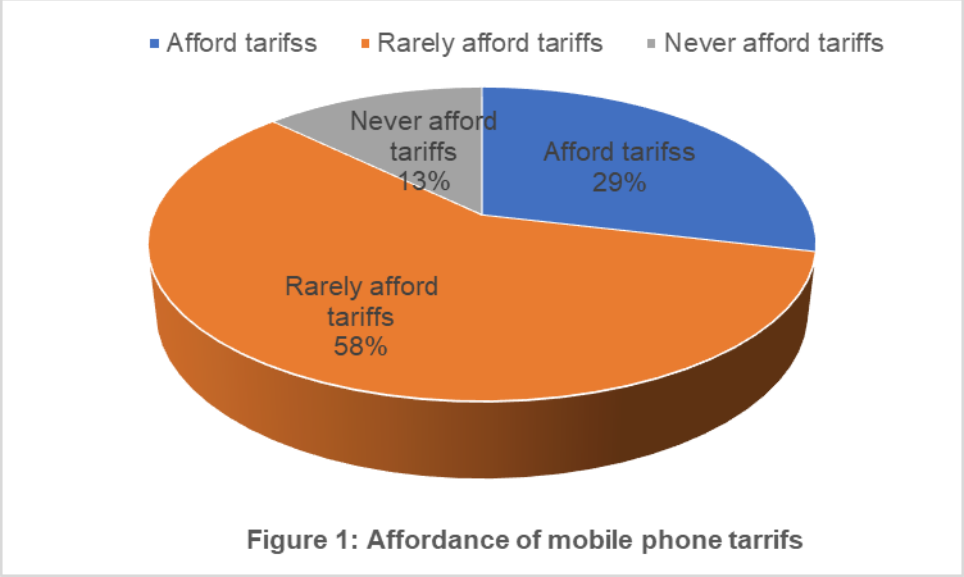

Figure 1: Affordance of mobile phone tarrifs

Results from focus group discussions revealed that it was difficult to make phone calls because costs were too high. The Tanzania Communication Regulatory Authority (TCRA) shows that the cost for making calls locally per minute ranged from Tanzanian shillings 59 to 133, moreover, costs for

sending an SMS locally ranged from Tanzanian shillings 10 to 70 (TCRA, 2020). The costs were much higher for making international calls and sending SMS outside the country.

Power infrastructure

Like other Information and Communication Technology devices, mobile phones are power-dependent. They only function when they are recharged with power. Results in Figure 2 61% of the farmers had access to reliable sources of power while 39% did not have access to reliable sources of power.

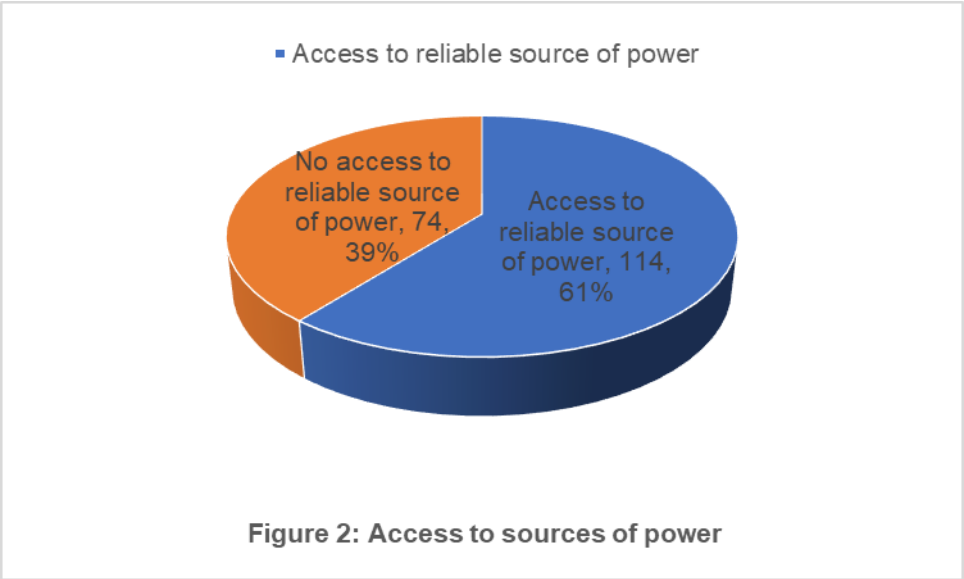

Figure 2: Access to sources of power

Moreover, results from the focus group discussions revealed that the national electric grid was the most reliable source of power. However, not all farmers were connected to it. Those not connected to the grid faced challenges whenever their mobile phone batteries drained. Some mentioned recharging their mobile phones at a cost while others had to buy solar chargers or recharge their mobile phone batteries to relatives or neighbours with access to sources of power. Those without reliable sources of power mentioned use mobile phones less frequently.

i. Quality mobile phone networks

The quality of the mobile phone network is not uniform. Results from the focus group discussions revealed that the quality of the mobile phone network was not the same and that some areas had no network at all while others had poor mobile phone networks. In Tanzania, most urban areas have somehow good mobile phone networks when compared to rural areas where most farmers reside. Farmers residing in areas with good mobile phone networks could more easily use mobile phones for exchanging agricultural information than those in areas with a poor network.

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ii. ***Access to contact details of agricultural information service providers***

Results from focus group discussions revealed that farmers failed to call some of the agricultural information services providers because they did not have their contact details. If contact details of services providers are not known, farmers cannot consult them.

iii. ***Easiness of usage of mobile phone applications***

The easiness of use of mobile phone applications influences the level of usage of mobile phones in exchanging agricultural information. Results from focus group discussions revealed that farmers' level of education affected one's ability to use some mobile phone applications particularly SMS and MMS. Results further revealed that making calls was easier than writing SMS or MMS. Results in Table 6 indicate that a relatively fa lower number of farmers with primary and informal education used SMS while fewer used MMS.

iv. Preference to other communication channels

Results from focus group discussions revealed that some farmers preferred to use other communication channels to mobile phones. Results further revealed that preference for other communication channels was increased with an increase in one's age (Table 5) and decreased with an increase in education (Table 6). This indicates that farmer's level of education and age influenced preference of usage of mobile phones in exchanging agricultural information.

Discussion

Agricultural information sources are often consulted by information seekers for agricultural information. Usually, farmers use agricultural information sources they are aware of and those that could be easily accessed. Moreover, the results explain that farmers mostly preferred interpersonal sources of agricultural information. It was for this reason, fellow farmers, agricultural extension officers, farmers' associations, and input suppliers were used by more farmers. Agricultural researchers were not used by many farmers because only a few farmers knew about them. This is supported by Msoffe and Ngulube (2017) who also found that farmers used agricultural information sources they were aware of.

Farmers were linked to agricultural information sources by different communication channels. Face-to-face oral communication, mobile phones, and radio sets were the major communication channels used. Among the three, face-to-face oral communication was used by all farmers, this is explained by the availability and accessibility of farmers believed to be experienced and knowledgeable within villages, does not cost anything, and is more traditional than the other communication channel. A similar observation was reported by Ndimbwa, Ndumbaro, and Mwantimwa (2019) who also found that face-to-face oral communication was used the most because it is cheap and requires just basic ability to ask a question, listen and understand the response made.

Mobile phones, radio, and television sets were mediated communication channels used in transferring agricultural information. The use of these tools helped to cut down the costs of the communication process and limited challenges brought about by differences in geographical locations and time (Aker, 2011). Comparatively, mobile phones were used by more farmers than

radio and television. When compared to radio and television sets, mobile phones are more portable and in most cases are pocket-size. They have multiple applications that facilitate both synchronous and asynchronous communication. Furthermore, advancement in mobile phone technologies has made it possible for radio and television broadcasts and internet services to be accessed via mobile phones. However, effective usage of these tools for exchanging agricultural information depends much on the quality of the mobile phone network, availability of power sources, affordability of duties, tariffs, and cost of mobile phone services (Rahmati, Qian, & Zhong, 2007).

Results from this study indicate that the farmers used some mobile phone applications for exchanging agricultural information. The majority of the farmers used calls and SMS, and few used MMS. Scholars (Khayyat, 2013; Venkatesh & Bala, 2008; Davis, 1989) mention that people prefer to use communication technologies that are easy to use. Age and level of education of the farmer were found to influence the usage of mobile phones in exchanging agricultural information. Almost all farmers made calls to exchange agricultural information because it required limited skills and literacy levels. Studies on the usage of mobile phones in agriculture have shown that calls are most used among farmers (Crandall, 2012; Odongo, 2013; Ganesan, Umadikar, & Prashant, 2015; Kiberiti et al., 2016)). This is because it is easier to make a call or receive a call than create an SMS and send it. Writing SMS and MMS requires more skills. Therefore, individual level of education plays a core role in developing individual communication skills and the ability to use communication devices Krone, Dannenberg & Nduru, 2016). Moreover, education enables farmers to use several mobile phone applications (Khan, Qijie, Sertse, Nabi & Khan, 2020) and helps farmers know different sources of agricultural information. Generally, mobile phone applications that can be easily used are more likely to be used more frequently by most farmers than those which require more skills.

Conclusion

Unlike other communication channels, mobile phones support both synchronous and asynchronous communication and have more applications to enhancing the exchange of agricultural information. This has made mobile phones to be more suitable communication channels in farm settings. Mobile phones can create linkages for exchanging agricultural information between agricultural information sources and agricultural information seekers. Using multiple mobile phone applications optimizes the potential of mobile phones in exchanging agricultural information. Mobile phone literacy, quality of the mobile phone network, availability of reliable power sources, and affordability of cost associated with usage of mobile phone services are important factors for optimizing the usage of mobile phones in exchanging agricultural information. For improving the usage of mobile phones in exchanging agricultural information, it is important to create contact lists (yellow pages) of important sources of agricultural information and make them available to farmers. It is equally important to enhance the affordability of costs associated with the acquisition and usage of mobile phones. Moreover, mobile phone companies can develop specific and dedicated services to farmers offered at lower prices.

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