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Use of Mobile Phone Services in Accessing Agricultural Market Information Among Smallholder Farmers in Bahi and Mvomero Districts, Tanzania

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Ikisiri

*Tanzanaia imefanya jitihada kubwa kuboresha matumizi ya simu za mkononi nchini. Takwimu zinaonesha kuwa zaidi ya asilimia 60 ya wakulima wadogowadogo nchini wanatumia simu za mkononi. Hii imefanya Tanzania iwe ni miongoni mwa nchi za kiafrika ambayo ina idadi kubwa ya watumiaji wa simu za mkononi kwenye sekta ya kilimo. Majukwaa mbalimbali ya kutumia simu za mkononi kupata taarifa za kilimo na masoko ya mazao ni pamoja na Jukwaa la Rununu Kilimo, T-Hakiki kwa kupiga *148*52#, Z-Kilimo kwa kupiga *149*50#, Tigo Kilimo, na M-Kilimo kwa kupiga *152*00#. Utafiti huu ulifanya tathmini juu ya mambo yanayochagiza matumizi ya huduma za simu rununu katika kufikia taarifa za masoko ya mazao ya kilimo kwa wakulima wadogowadogo katika Wilaya za Mvomero na Bahi. Utafiti ulitumia sampuli ya washiriki 210 (wahojiwa 207 na watoa taarifa muhimu 3). Utafiti huu umetumia njia ya kuhoji watu maramoja kwa wakati mmoja ikichanganya mbinu za takwimu na maelezo. Takwimu zilikusanywa kutoka chanzo cha awali na upili. Mbinu za kitakwimu na za maelezo zilitumika kuchakata taarifa. Matokeo ya utafiti huu yanaonesha kuwa matumizi ya jukwaa la huduma za simu rununu katika kufikia taarifa za kilimo na masoko kwa wakulima wadogowadogo kwa uzito mkubwa umechagwizwa na upatikanaji wa mtandao, lugha inayotumika, elimu ya kidigitali, jinsi ya mkulima, na uzoefu wa mkulima. Aidha, utafiti umebaini kuwa elimu ya mkulima ina uzito mdogo kwenye kuchagiza matumizi ya jukwaa la huduma ya simu rununu katika kufikia taarifa za kilimo na masoko kwa wakulima wadogowadogo.*

Abstract

*The government of Tanzania plays a great role in promoting mobile phone use in the country. Available statistics show that more than 50 million sim cards were registered by June 2022. Also, over 60% small-scale farmers have a mobile phone, which makes Tanzania one of the countries in Africa with the highest number of mobile phone users in the agriculture sector. Various mobile phone services platforms have been established to link farmers to market information, including the Mobile Kilimo Platform, the T-Hakiki (TCCL) by dialling a USSD code *148*52#, Z-Kilimo (Vodacom) by dialling *149*50#, and Tigo Kilimo, and M-Kilimo by dialling *152*00#. Therefore, this paper examined factors for using mobile phone services to access agricultural market information among smallholder framers in Bahi and Mvomero Districts, taking Mkindo and Bahi wards as a case. A sample of 210 participants was used (207 respondents and three key informants). The study used a cross-sectional design that blended qualitative and quantitative methods. Data were collected from primary and secondary sources. The logistic binary regression model was used to analyze quantitative data. The*

qualitative data were analysed through thematic (content) analysis. The findings from the study indicate that the use of mobile phone platforms to access market information among smallholder farmers was significantly associated with network availability, language, digital knowledge, sex, and farmer's experience than the farmer's education level.

Keywords: Mobile phone services, Platform, Agricultural market information, smallholder farmers.

1.0. Introduction

Generally, Information and Communication Technologies (ICT), particularly the mobile phone, have immensely penetrated every field of life, like education, business, commerce, and agriculture. Mobile phone-based communication has rapidly grown in the recent past and has become the most used communication tool among all ICTs of the current age (Khan *et al*., 2019). The global trend of the use of mobile phones has shown tremendous increases from time to time. Statistics showed that 62.9 % of the worldwide population already owns a mobile phone, with 4.68 billion users on the planet in 2019; while recent statistics indicate that by the end of 2022, mobile phone users will be 7.26 billion, which makes up 91% of the world's cellphone owners (Statista, 2022). This rapid growth of mobile telephony has emerged as a successful communication tool that has transformed the working styles of many sectors and created new professional dimensions in various businesses, including agriculture (Sullivan and Omwansa, 2013; Asongu and Asongu, 2018). Studies have shown that an increase in the use of mobile phones results in an expansion of farmers' information and faster access to agricultural information. In the Philippines (Kaewprasert, 2018) found that improvements for commercial farmers using mobile phones resulted in an expansion of their information network and faster access speed, impacting their business profits positively. Among new ICTs, mobile phones were widely available to access markets or price information or increase production efficiency. This indicates that ICT can make the entire agricultural supply chain more efficient. About 44.4% of farmers who use ICT are advantageous because they gain information to develop their products and producers and consumers to meet and learn about demand and supply (Kaewprasert, 2018).

According to Rumanyika *et al*. (2019) in Nigeria, more than half of the respondents interviewed in the study accepted that mobile phone use has simplified communication compared to earlier media, such as radio, fixed-line phones, television, magazines, newspapers, and posters. This is because mobile phones are real-time information-delivering devices. The use of mobile phones has changed the micro-trading activities of Nigerian market women, showing that the women who innovatively integrated mobile services, such as voice calls and SMS, could communicate about agricultural yields in rural areas and make timely harvests and transport arrangements with customers in urban areas. The preference for mobile phone use is attributed to the devices being easy to operate, durable, and user-friendly for

text messaging. In Ethiopia, Mansingh *et al*. (2016) reported that many mobile technology projects are working to empower and enhance the agriculture business, and the projects have a big effect. Mobile phone usage by farmers can reduce information search cost, and the mobile phone provides privacy, are accessible anytime and anywhere, and the user carries personal item. Reddy *et al*. (2017) also indicated that smallholder farmers in India were widely using mobile phones to interact with extension services through mobile phones, and there is high mobile penetration in India, reaching above 75% of farmers. Mobile-based ICT plays a key role in promoting economic growth and reducing poverty because mobile technology is one ICT experiencing rapid development in rural areas. The internet and mobile networks can provide agriculture market information and can also be used to share the farmer's practical experience and knowledge. Further, solid devices to communicate this new technology can empower the farmers with knowledge and enhance their living standards.

This trend is similar in Tanzania, as the country has seen an abrupt rise in mobile phone users. In 2022, about 65% of individuals and 80% of households owned a mobile phone, respectively. (McCabe *et al*., 2020). More recently, according to the Tanzania Communication Regulatory Authority report, the number of registered sim cards has reached 56.3 million by June 2022, meaning that telecommunication services have continued to penetrate various areas of the country (URT, 2022). This indicates that in Tanzania, Mobile phone technology has been the fastest growing in recent years compared to other ICTs like radio, television, and newspapers (Sanga, 2018). In 2018 the percentage of small-scale farmers with mobile phones in Tanzania was 66% to 78% (TCRA, 2018). Similarly, as reported by Hendi (2019) and shared in a report by the World Bank, the percentage of small-scale farmers in Tanzania with mobile phones reached 66% to 78% to access market information. This makes Tanzania one of the countries in Africa with the highest number of mobile phone users in the agriculture sector, and 96% of the population has access to cell phones. Nevertheless, the way mobile phone platforms technology has been integrated into the design of agriculture projects in Tanzania, the benefits accrued from using mobile phone farmers get tips on how to grow major crops and market prices in selling their rice.

In the agriculture sector, a smooth exchange of information is a key to the successful adoption of farm innovation needed for agricultural development, but due to a lack of resources and poor infrastructure in many developing countries, a huge communication asymmetry exists between the latest agricultural knowledge and farmers (Baloch and Thapa, 2014). In this scenario, ICT, particularly the mobile phone, has shown great potential to facilitate communication by enabling the smooth exchange of knowledge between the various stakeholders in agriculture (Aker, 2011). In this regard, in the agricultural context, the cellular phone has empowered the farmers to communicate from local to administrative

levels regarding the agricultural trade, information exchange, and buying and selling of inputs and farm commodities (Ogutu *et al*., 2014). This has reduced the cost of travelling and improved farming communities' production efficiency in remote areas. The mobile phone has tremendously been diffused even into the marginalized and underdeveloped farming communities because of its flexibility, affordability, and user-friendly nature has been diffused even into marginalized and underdeveloped farming communities because of its flexibility, affordability, and user-friendly nature compared to other ICT tools (Osabutey and Jin, 2016).

Another dimension of mobile phone applications in agriculture is "e-extension", which has simplified the mode of extension and advisory services through effective communication between farming communities and research organizations (Aker and Ksoll, 2016). Generally, farm advisory services in many countries are delivered through conventional extension methods such as farmers' meetings, personal visits, mass discussions, etc. But unfortunately, the current ratio of extension agents to farmers cannot satisfy the information needs of the farming communities (Baloch and Thapa, 2014). For instance, in many developing countries, the existing agriculture extension system cannot fulfil the farmers' information needs due to limited resources (Aker, 2011). The emerging trend of using ICTs for extension and advisory services is common in many developed and developing countries (Aker and Ksoll, 2016). The argument that "communication technologies are the future of agricultural extension and countries cannot afford the cost of face-to-face extension anymore" commonly prevailed because the cellular phone has the potential to replace the face-to-face extension system (Aldosari *et al*., 2017). In this context, the mobile phone's role becomes very crucial for the agriculture sector of many developing countries like Tanzania.

In recognition of the importance of reliable network availability in the country the Tanzanian government implemented a National ICT Broadband Infrastructure Fibber Optic Backbone (NICTBB) in 2009. The NICTBB was constructed using optical fibre technology that connected all regions and districts, giving them access to the 10,000 km-length national and regional broadband infrastructure. The project was implemented in four phases using an optical Dense Wavelength Division Multiplexing (DWDM) network technology in collaboration with the Chinese government through the Chinese International Telecommunications Construction Corporation (CITCC) under a bilateral agreement. Similarly, in promoting farmers access to market information the government has taken various interventions in improving the access to market information to farmers such as introduction of the second Agricultural Sector Development Program (ASDP- II) with the aim of improving farmer access to market information through the use of innovative technology dissemination including traditional communication and modern ICT such as internet and mobile phones (ASDP-II,

2016), introduction of National Agricultural Policy (2013) with the aim of strengthening agriculture information coordination and linkages in order to increase effectiveness of agriculture information services, introduction of Agriculture Marketing Policy (2008) with the aim facilitating strategic marketing of agricultural products that ensure fair returns to all stakeholders based on a competitive, efficient and equitable marketing system and ICT policy (2016) with the aim of ensuring accelerated development of telecommunication infrastructures and services so as to accelerates access to telecommunication services by all sectors of the national economy as part of the national development strategy.

In promoting the farmers' use of the mobile phone to access market information in Tanzania, the government initiated various interventions to improve farmers' access to market information. The Economic and Social Research Foundation (ESRF), with support from the Government of Tanzania and the United Nations Development Program (UNDP), launched the Mobile Kilimo Platform in Tanzania in May 2015. The Mobile Kilimo Platform is an innovative mobile phone-based platform which aims at helping farmers access markets for agriculture products and promoting knowledge sharing by enabling extension officers to share knowledge among themselves and with farmers. Once registered for the service, farmers and buyers of crops can meet online and do business. Other established mobile phone services that link farmers to market information include the T-Hakiki (TCCL) by dialing a USSD code *148*52#, Z-Kilimo (Vodacom) by dialing *149*50#, and Tigo Kilimo (TCRA, 2018). Also, the Ministry of agriculture livestock and fisheries introduced the M-Kilimo by dialing *152*00#, which links farmers in getting market prices, selling products and news, and asking questions (MoA, 2020). The objective of mobile phone services is to generate an opportunity for farmers to get relevant information, improve productivity, crop price, and marketing, and improve their welfare. The specific question under this enquiry was what were the factors for the use of mobile phones platforms in accessing agricultural market information among smallholder farmers? This study, therefore, examined factors influencing the use of mobile phone services to farmers in accessing agricultural market information taking Mvomero and Bahi districts as the case.

2.0. Methodology

The study was conducted in the Mkindo ward in the Mvomero district and the Bahi ward in the Bahi district. The two districts were purposively selected because agriculture is the main economic activity of the Mvomero district's residents, accounting for about 90% of the economy (MSEP, 2014), while in Bahi, farming accounts for approximately 80% of the Bahi district's economy. Smallholder farmers manage the sector (BSEP, 2010). Both probability and non-probability sampling techniques were used in the study. In probability sampling, the clustered sampling technique was employed to cluster small-scale farmers with cell phones from which simple random sampling was applied to get respondents for an interview to represent

a sampled population from which primary data were collected. This helped to avoid subjectivity and personal biases. Nonprobability sampling, specifically judgemental sampling, was used in selecting key informants: the Ward Executive Officer (WEO), Agriculture Extension Officer (AEO), and the District Agricultural Officer. This assisted in acquiring additional information from key respondents based on their characteristics for triangulation purposes.

The target population for this study was the community members from the selected wards in which an individual smallholder farmer, preferably the head of household, constituted the unit of analysis. A sample frame for this study comprised a total of 350 for Mkindo ward and 325 for Bahi ward as an entire population from which the sample size was drawn. A sample size of 210 participants was used in the study, whereby 207 were respondents from heads of households, and 3 were key informants selected purposively based on their importance, knowledge, and influence in the study area. Hence, by using the sample size estimation formulae with a finite population from Kothari (2004), the following sample size estimation was used

$$n = \frac{\left(\frac{Za}{2}\right)^2 p.q.N}{(N-1)e^2 + (\frac{Za}{2})^2 pq}$$

Where by:
n = Sample size
N =Total population
e = Marginal /sampling error, which from this study will be considered to be 5% =0.08
p = Proportion of success of farmers who use mobile phone services (50%=0.5)
q = 1 – p; (1-0.5) = 0.5
$Z \propto/2$= standard variates at a given confidence level. (95% = 1.96)

The sample size for the Mkindo ward in Mvomero District

$$n = \frac{(1.96)2\times0.5\times0.5\times350}{(350\text{-}1)\ (0.08)^2 + (1.96)^2 \times0.5\times0.5}$$

$$n = \frac{3.84\times0.25\times350}{2.2336+ 0.96}$$

n = 105 smallholder farmers in Mkindo Ward

The Sample size for Bahi Ward in Bahi District

$$n = \frac{(1.96)^2\times0.5\times0.5\times325}{(325\text{-}1)\ (0.08)^2 + (1.96)^2 \times0.5\times0.5}$$

$$n = \frac{3.84\times0.25\times325}{2.0736 + 0.96}$$

n=102 smallholder farmers in Bahi Ward in Bahi District

Therefore, number of respondents (sample size) was (105 +102) = 207 smallholder farmers +3Key informants = 210 participants.

The study adopted a cross-sectional design that blended qualitative and quantitative (mixed) methods. Data for this study were collected from both primary and secondary sources. During a field survey, preliminary data were collected from the smallholder farmers using cell phones to access market information as the key respondents.

Secondary data were obtained through a review of relevant documentary sources from the archives of various organizations, including the Ministry of Agriculture, Mvomero and Bahi District Council office as well as reports from cell phone companies, including the T-Hakiki (TCCL), Z-Kilimo (Vodacom), Tigo Kilimo (Tigo) and M-Kilimo. Qualitative and quantitative data were marshalled to analyse the study problem comprehensively. In this design, both forms of data were collected and then integrated into interpreting the overall results (Creswell, 2014). Primary data were collected through interviews, observation, and focus group discussion using questionnaires and checklists. Secondary data were collected through the documentary review method.

The collected data were edited to detect errors and omissions before being classified and coded to enable them for analysis. Quantitative data were analysed through inferential statistics, in which the regression analysis was used, where a multi-collinearity test was run to measure the correlation between variables. More specifically, the binary logistic regression analysis model was employed to examine the relationship between the use of mobile phone services to farmers in accessing market information using the following statistical logistic regression model:

$$\ln\left(\frac{P(Y,=1)}{1-P(Y,=1)}\right) = a + \beta_1 Education\ level_i + \beta_2 Availability\ of\ network_i + \beta_3 Language_i + \beta_4 Digital\ knowledge_i + \beta_5 Sex_i + \beta_6 Farming\ experience_i$$

Where:

- P (Y, =1) = probability that farmers use mobile phone services to access market information
- Y coded as (1=Use mobile phone services 0=Do not use mobile phone services)
- α=Regression constant
- β1 and β5. =Regression coefficients

Besides, descriptive statistics were used where numbers assigned to variables were used to summarize and describe data, frequencies, and percentages and mean were the main types of descriptive statistics used in verifying the relationship between variables. The qualitative data were analysed through thematic (content) analysis. The themes/contents of interviews and observational field notes were analysed by identifying the main themes, assigning codes to the main themes, classifying responses under the main themes, and integrating articles and responses into the text.

3.0 Results and Discussion

3.1 Characteristics of Respondents

This section describes the characteristics of respondents in the study area. The main demographic parameters examined in the inquiry were: the age of the respondents, marital status, education level, and number of years in farming. The results in Table 1 indicate that, on age, the majority of the respondents were aged

between 40-49 years (36.2%) where (19.8%) were from Bahi, while (16.4%) were from Mvomero with very few aged between 60 and above (8.2%) whereby (1.9%) were from Bahi while (6.3%) were from Mvomero. Others were aged between 30-39 years (28.0%), aged 50-59 (16.9%), and aged 20-29 years (10.6%). Furthermore, there was a significant association between Bahi and Mvomero respondents regarding the age of respondents ($\chi 2$ =9.418, P=0.051). This finding implies that most of the respondents interviewed in both Bahi and Mvomero districts had experience in farming activities, which might influence them to use mobile phones to access agricultural market services.

Table 1: Characteristics of the respondents (n = 207)

Variables	Response	Bahi	Mvomero	Total	Chi-Square
Age	20-29	7(3.4)	15(7.2)	22(10.6)	
	30-39	33(3.4)	25(12.1)	58(28.0)	$\chi 2$=9.418
	40-49	41(15.9)	34(16.4)	75(36.2)	df = 4
	50-59	17(8.2)	18(8.7)	35(16.9)	p= 0.051
	60+	4(1.9)	13(6.3)	17(8.2)	
Sex	Male	71(34.3)	51(24.6)	122(58.9)	$\chi 2$=9.461
	Female	31(15.0)	54(26.1)	85(41.1)	df = 1
					p=0.002
Marital status	Married	79(38.2)	82(39.6)	161(77.8)	
	Single	12(5.8)	10(4.8)	22(10.6)	$\chi 2$=3.573
	Divorced/Separated	9(4.3)	6(2.9)	15(4.3)	df = 3
	Widowed	2(49.3)	7(3.4)	9(4.3)	p=0.311
Level of education	No Formal education	10(4.8)	0(0.0)	10(4.8)	
	Primary education	77(37.2)	88(42.5)	165(79.7)	
	Secondary education	13(6.3)	16(7.7)	29(14.0)	$\chi 2$=12.003
	Post-secondary training education (Certificate/diploma)	1(0.5)	0(0.0)	2(1.0)	df = 4
	Bachelor's degree or above	1(0.5)	0(0.0)	1(0.5)	p=0.017
Number of years in farming	2-11	47(22.7)	23(11.1)	70(33.8)	
	12-21	47(22.7)	61(29.5)	108(52.2)	$\chi 2$=15.831
	22-31	8(3.9	21(10.1)	29(14.0)	df = 2
					p=0.000

Figures in brackets are the percent

On sex, the analysis of respondents by sex in the study areas showed that about 58.9% of respondents were male, whereby 34.3% were from Bahi while 24.6% were from Mvomero, and 41.1% were female, whereby 26.1% were male, 15.0% were in Bahi district. Also, this percentage shows a statistically significant association between Bahi and Mvomero respondents regarding the sex of respondents ($\chi 2$=9.461, P=0.002). This implies that many respondents were male, indicating that males seem to be more involved in farming activities than their

female counterparts, this was due to the cultural system of the communities in the study areas where men as household heads were responsible for farming activities and feeding the family while the female was mainly doing domestic activities. On marital status, about half, 77.8% of the respondents were married, whereby 38.2% of respondents were from Bahi district while 39.6% were from Mvomero district, 10.6% were single, 7.2% were divorced or separated, and 4.3% were widowed. The findings indicate that the majority of the respondents were married; this is because the majority of the respondents ranged in age between 40-49. The percentage shows that there was no statistically significant association between the marital status of respondents ($\chi 2$ =3.573, P=0.311). This means that most of the respondents in Mvomero and Bahi were married due to their age.

Concerning the education level of the respondents, it was found that the majority of them, 79.7% completed primary education were by 37.2% were in Bahi district, and 42.5% were from Mvomero district. 14.0% completed secondary school, 4.8% of the respondents did not attend formal education, while a few 1.0% and 0.5% were post-secondary training (certificate/diploma) and bachelor's degree or above, respectively. This implies that the majority of the respondents attend at least primary school. Respondent's education will likely increase awareness and influence farmers to use a mobile phone to access agricultural market information. This percentage shows a statistically significant association between the education level of respondents in Bahi and Mvomero ($\chi 2$ =12.003, P =0.017). On the number of years in farming, the result shows that the majority of the respondents, 52.2% had between 12-21 years, whereas 22.7% of respondents were from Bahi district while 29.5% of respondents were from Mvomero district, 33.8% of respondents had between 2-11 years in farming and a few of them 14.0% of respondents had between 22-31 years. This percentage shows a statistically significant association between the number of years in farming of respondents in Bahi and Mvomero ($\chi 2$ =15.831, P=0.000). This implies that most of the respondents in the study areas had experience in farming because most of their years in farming influenced them to use their mobile phones to access agricultural market information.

3.2. Factors influencing the use of mobile phone services to access agricultural market information

A farmer's decision to use a particular type of technology depends on various factors that reduce uncertainties in achieving the desired objective of respective farmers. In determining factors influencing small-scale farmers' use of mobile phone services in accessing market information, the inquiry used four variables: network availability, language used, digital knowledge, education level, sex, and the farmer's experience. Using binary logistic regression analysis results in the Table 1 indicate that the independent variables included in the model are a moderately good predictor of the accessibility of agriculture market information to farmers through mobile phones (Nagelkerke R2=26.9%).

Table 1: Factors influencing the use of mobile phone services to farmers in accessing market information(n=207)

Independent variable	B	S. E	Wald	Sig	df	Exp(B)	95% C.I. for Exp(B)	
							Lower	Upper
Network availability	-1.587	0.691	5.276	0.022***	1	0.204	0.053	0.792
Language	2.481	0.599	17.188	0.000***	1	11.958	3.700	38.650
Digital knowledge	-1.384	0.681	4.129	0.042***	1	0.250	0.066	0.952
Education level	0.666	0.618	1.159	0.282	1	1.946	0.579	6.537
Sex	2.421	0.771	9.860	0.002***	1	11.262	2.484	51.055
Farmer's experience	2.379	0.692	11.818	0.001***	1	10.797	2.781	41.921
Constant	-1.44	1.050	1.885	0.170	1	0.237		

Significant at (P<0.05) Non-Significant at(P>0.05), X2=33.463, Cos and Snell R2=0.149, Nagelkerke, R square (R2) =0.269

The chi-square test indicates that network availability, language, digital knowledge, sex, and farmers' experience are associated with the access to agriculture market information by farmers, while the level of education has no association with the use of mobile phones in accessing agriculture market information by farmers.

Results of the study, as presented, indicate that network availability has a significant positive relationship with accessibility to agriculture information to farmers (P<0.05), which implies that access to agriculture market information depends on network availability. Besides, using Odds Ratio (OR), network availability had a high possibility of influencing smallholder farmers' access to agricultural market information (OR=0.204,95% C.I 0.053-0.792). This implies that accessing agriculture market information depends on the network stability in the areas where smallholder farmers were residing. The study results reflect the government's efforts of connecting all regions and districts through the National ICT Broadband Infrastructure Fibber Optic Backbone and other ICT policies, and programmes have accelerated the availability of a reliable network to villages that provide a smooth environment to farmers in accessing agricultural market information.

Moreover, language is also deemed to be a vital part of smallholder farmers' connection. If farmers have mastered cognitive language communication, it allows them to share ideas, thoughts, and feelings with others that may influence rational decision-making concerning the market for agricultural procedures. Results in Table 1 indicate that language used in platforms had a significant

positive relationship with accessibility to agriculture information for farmers (P<0.05), which implies that accessing agriculture market information for farmers was associated with the language used as a media of communication in the respective agricultural information platform. In a focus group discussion, farmers had the opinion that the use of the Kiswahili language in the agricultural information platforms of the T-Hakiki (TCCL), Z-Kilimo (Vodacom), Tigo Kilimo (Tigo) and M-Kilimo influenced their ability to send SMS and access the required agricultural market information. Besides, using Odds Ratio (OR) also indicated that language was associated with access to agricultural market information for farmers twelve times (OR=11.958, 95% C.I 3.700-38.650). This implies that accessing agricultural market information in the study area depends on the Kiswahili language for easy understanding of agriculture information by farmers. Language provided farmers with information on crops' current and future prices, helping them decide when to sell their crops and at which market to sell their crops where the market offers better prices. Also, language assists in getting correct information at the hands of the farmers, which means empowerment through control over their resources and decision-making processes. Information in clear language facilitates the farmer's critical role in decision-making toward improved agricultural production, processing, trading, and marketing.

With regard to farmers' digital knowledge, it is evident that as technology continues to become more and more ingrained in daily life, the importance of learning digital literacy skills is becoming increasingly apparent to farmers. Results in Table 1 indicated that digital knowledge had a significant positive relationship with accessibility to agricultural market information to farmers (P<0.05), which implies that accessing agriculture market information to farmers was associated with the farmer's digital literacy concerning an individual farmer's ability to find, evaluate, and communicate information through ability to typing, an individual's grammar, composition, typing skills and ability to produce text, images, and audio using cellphone technology in various digital agricultural platforms. Similarly, using Odds Ratio (OR), digital knowledge was associated with access to agriculture market information to farmers and less likely to access agriculture market information (OR=0.250, 95% C.I 0.066-0.952). This implies that access to agriculture market information in the study areas depends on farmers' awareness of digital knowledge to access agriculture market information.

In a similar vein, farmers' experience with the use of agricultural information platforms and peer influence determines their perception of the benefits of mobile phones in agriculture activities and increased agricultural profit. Results in Table 1 reported that farmers' experience had a significant positive relationship with the accessibility of agriculture information to farmers (P<0.05), which implies that accessing agriculture market information to farmers was associated with farmers' experience with the use of diverse agricultural information platforms in accessing market information.

Similarly, using Odds Ratio (OR), farmers' experience was also associated with access to agriculture market information to farmers. Farmers with experience had eleven times more likely to access agriculture market information compared to those with no experience (OR=10.797, 95% C.I 2.781-41.921). This implies that accessing agriculture market information depends on farmers' experience since more experienced farmers are aware and influence others to access agriculture market information through different agricultural platforms. In this regard, for farmers in the study area, experience influenced their rational choice on what crops and variety to grow at a given season with the marketability of crops, to decide on the volume of crops that farmers can produce at a particular time. On the basis of sex, as indicated earlier, many respondents engaged in farming activities were male than their female counterparts. Results in Table 1 indicate that sex had a significant positive relationship with accessibility to agriculture information for farmers ($P<0.05$), which implies that accessing agriculture market information to farmers was associated with the sex of a farmer since male farmers were more active in accessing agriculture market information than their female counterparts.

However, unlike network availability, language, digital knowledge, farmers' experience, and sex, education level had no significant relationship with accessibility to agriculture information for farmers ($P>0.05$), which implies that accessing agriculture market information for farmers was not associated with the farmer's level of education. Similarly, using Odds Ratio (OR), education was not associated with access to agriculture market information (OR=1.946, 95% C. I 0.579-6.537). This implies that accessing agriculture market information in the study area does not depend on a farmer's education level.

4.0. Conclusion and Recommendations

Based on the study's findings, it is concluded that for improving the agriculture sector, various agricultural mobile platforms were established in the study areas for promoting farmers' access to agricultural market information. The established platforms were the T-Hakiki (TCCL) by dialing a USSD code *148*52#, Z-Kilimo (Vodacom) by dialing *149*50#, and Tigo Kilimo (TCRA, 2018), the M-Kilimo by dialing *152*00#, which links farmers in getting market prices, selling products, news, and asking questions. The use of agricultural information platforms to access market information among smallholder farmers was significantly associated with network availability, language, digital knowledge, sex, and the farmers' experience rather than the farmer's education level. The policy implication of this stance calls for the need for the government to strengthen the mechanism for widening the telecommunication services that have continued to penetrate various rural areas in the country. The wider coverage of the telecommunication network shall provide more agricultural platforms that promote the farmer's use of mobile phone services to access market information, generate an opportunity for farmers to get relevant information, improve productivity, crop price, and marketing, and finally improve farmers' welfare.

Reference

Aker, J. C. (2011). Dial "A" for agriculture: a review of information and communication technologies for agricultural extension in developing countries. *Agricultural economics*, 42(6), 631-647.

Aker, J. C., and Ksoll, C. (2016). Can mobile phones improve agricultural outcomes? Evidence from a randomized experiment in Niger. *Food Policy*, 60, 44-51.

Aldosari, F. O., Al-Sakran, M. S., Alkhubizi, H. F., Al-Zaidi, A. A., Baig, M. B., Muddassir, M., and Mubushar, M. (2017). Use of cell phones by the farmers as an extension tool to practice sustainable agriculture and achieve food security in the Kingdom of Saudi Arabia. *Journal of Experimental Biology and Agricultural Sciences*, 5(8).

Asongu, S., and Asongu, N. (2018). The comparative exploration of mobile money services in inclusive development. *International journal of social economics*, 45(1), 124-139.

Baloch, A. M., and Thapa, B. G. (2014). Agricultural extension in Balochistan, Pakistan: Date palm farmers' access and satisfaction. *Journal of Mountain Science*, 11(4), 1035-1048.

Creswell, J. W. (2014). Qualitative, quantitative and mixed methods approaches. SAGE Publications. London.

Hendi, H. (2019). Harnessing the Power of Mobile Phone. *African Journal of Information Systems Mobile Technology*

Khan, N. A., Qijie, G., Ali, S., Shahbaz, B., and Shah, A. A. (2019). Farmers' use of mobile phone for accessing agricultural information in Pakistan. *Ciência Rural,* 49.

Kothari, C.R. (2004). Research Methodology: Methods and Techniques (2nd Ed.). New Delhi: New Age International Limited.

Mansingh, P., and Erena, F. A. (2016). Impact of mobile phone technology on agriculture and rural development: An analysis. *International Journal of Current Research*, 8(5), 31311-31317.

Ogutu, S. O., Okello, J. J., and Otieno, D. J. (2014). Impact of information and communication technology-based market information services on smallholder farm input use and productivity: The case of Kenya. *World Development*, 64, 311-321.

Osabutey, E. L., and Jin, Z. (2016). Factors influencing technology and knowledge transfer: Configurational recipes for Sub-Saharan Africa. *Journal of Business Research*, 69(11), 5390-5395.

Pakistan Telecommunication Authority, (2018). Telecom indicators, annual report 2017-2018. Pakistan Telecommunication Authority, Headquarters, F-5/1, Islamabad, Pakistan.

Reddy, M. M., Rao, I. S., Srinivasulu, M., and Kumar, G. S. (2017). Perception and usefulness of mobile phone based agro-advisories (MBAs). *International Journal of Current Microbiology and Applied Sciences*, 6(7), 866-872.

Rehman, A., Jingdong, L., Shahzad, B., Chandio, A. A., Hussain, I., Nabi, G., and Iqbal, M. S. (2015). Economic perspectives of major field crops of Pakistan: An empirical study. *Pacific science review b: humanities and social sciences*, 1(3), 145-158.

Rumanyika, J., Tedre, M., Mikko, A. and Mramba, N.R. (2019). Mobile Technology Usage for Street Traders' Market Search in Dodoma-Urban Tanzania: An Exploratory Study. *African Journal of Information Systems Mobile Technology*. 11(4), 249-278.

Statista, (2022). Mobile phone users worldwide, technology and telecommunication statistics.

https://www.statista.com/statistics/277125/share-of-website-traffic-coming-from-mobile devices/ cited on 15th September 2022

Sullivan, N. P., Omwansa, T. K. (2018). Prepaid and pay-as-you-go models for asset financing. extreme inclusion. African Journal of Science Technology Innovation and Development. Published by Informa UK. 64, 311-321

URT. (2008). Agriculture Marketing Policy. The Ministry of Agriculture and Irrigation

URT. (2010). Mvomero District Social Economic Profile. Mvomenro District Council

URT. (2013). Tanzania Agricultural Policy. The Ministry of Agriculture and Irrigation

URT. (2014). Mvomero District Social Economic Profile. Mvomero District Council

URT. (2022). Tanzania Communication Regulatory Authority Report on Mobile Phone Users in Tanzania. Ministry of Information, Communication and Information Technology.