Use of mobile phones for market accessibility and price transparency among smallholder farmers in Tanzania: A case of Mbarali District

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Abstract

This study examines the impact of mobile phone use on market accessibility and price transparency among smallholder farmers in Mbarali District, Tanzania. In rural areas where agriculture is the primary livelihood, farmers often face challenges such as limited access to market information, fluctuating prices, and reliance on intermediaries. The widespread adoption of mobile phones has emerged as a crucial tool for overcoming these barriers. By leveraging mobile-based services like SMS price notifications and mobile applications, farmers gain real-time information on market prices, weather forecasts, and agricultural advice, enabling them to make informed decisions and reduce dependence on middlemen. Additionally, mobile phones facilitate mobile banking and mobile money services, enhancing financial inclusion through efficient transactions and faster payments. The research, combining qualitative and quantitative data, reveals that mobile phone technology improves market efficiency, increases farmers' bargaining power, and contributes to better income stability. Improved access to financial services also allows farmers to manage their finances more effectively. The findings explore the transformative role of mobile phones in the agricultural sector, suggesting that further expansion of mobile technology and services can foster agricultural growth, improve livelihoods, and promote equitable market access, contributing to sustainable rural development in Tanzania.

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1. Introduction

The use of mobile phones has spread to every corner of the universe. In today's world, communication has been made simple so that most people can own the modern means of communication. Mobile phone-based communication has rapidly grown recently and has become the most used communication tool among all ICTs of the current age (Khan et al., 2019). The Further Africa Organization survey results showed mobile phone subscribers stood at 46 percent in Sub-Saharan Africa, while smartphone adoption was at 64 percent. This is expected to grow to 50 percent and 75 percent respectively by 2025. "By the end of 2020, 495 million people subscribed to mobile services in Sub-Saharan Africa, representing 46 percent of the region's population – an increase of almost 20 million from 2019. 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). According to a report by GSMA Intelligence, as of 2020, there were over 186 million unique mobile subscribers in East Africa, which is equivalent to a penetration rate of 45%. This represents an increase of over 30% since 2016. In terms of individual countries, Kenya has the highest mobile phone penetration rate in East Africa at 97%, followed by Tanzania (86%) and Uganda (69%). Rwanda and South Sudan have lower penetration rates, but they have also seen significant growth in recent years. Mobile money services have been a major driver of mobile phone adoption in East Africa. As of 2020, there were over 500 million registered mobile money accounts in Sub-Saharan Africa, with a large portion of these coming from East African countries like Kenya, Tanzania, and Uganda. The COVID-19 pandemic has further accelerated the shift towards digital payments and online transactions, leading to increased demand for mobile phones and internet connectivity in East Africa. Despite this progress, challenges remain, including limited network coverage and affordability issues in rural areas, as well as concerns around cybersecurity and data privacy. However, ongoing investments in infrastructure and innovation are expected to continue driving the growth of mobile phone usage in East Africa.

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.

According to Aker et al (2010), Access to and use of mobile telephony in sub-Saharan Africa has increased dramatically over the past decade. Mobile telephony has brought new possibilities to the continent. Across urban-rural and rich-poor divides, mobile phones connect individuals to individuals, information, markets, and services. These effects can be theatrical in rural Africa, where in many places mobile phones have represented the first modern telecommunications

infrastructure of any kind. Mobile phones have greatly reduced communication costs, thereby allowing individuals and firms to send and obtain information quickly and cheaply on a variety of economic, social, and political topics.

Mobile technology adoption in Tanzania has grown so fast that every household at least has one handset. Currently, statistics show that about 50 million SIM cards have been registered since June 2022. Also, studies indicate that over 65% of smallholder farmers own mobile phones which makes Tanzania one country in Africa that has faster growth in mobile phone usage in the farming sector. Mobile communications offer the majority of opportunities to advance human development from providing access to education and health information to helping boost productivity in the agriculture sector. In this case, mobile services are being used to enhance farmers' lives and transform business performance at all points of the agricultural value chain. More than 1.3 million farmers in Tanzania are now digitally profiled, thanks to collaboration involving the Ministry of Agriculture, Tanzania Fertilizer Regulatory Authority (TFRA), and Vodacom's multiplayer digital platform M-KULIMA (source IPP MEDIA site). Through the platform, multiple stakeholders in the agricultural sector can connect and communicate with smallholder farmers while providing them with a wide variety of services. The services include market linkages (among them buyers, processors, and mechanization), insurance, payments, and loans – all to increase farmers' incomes, production, food security, inclusiveness and resilience to climate change. Rumanyika et al (2019), say that there is an exponential increase in the use of mobile phones in Tanzania especially adopted by street traders. Africa mostly sub-Saharan Africa has great pace in mobile phone use adoption in recent years, as is seen there is the introduction of several mobile applications that are now used in online businesses. So small-scale businesses are one of the major drivers for the adoption of mobile phones in many African countries. Popular applications like *Jumiya*, used for online shopping in Tanzania, and *mkulima market* used for connecting farmers especially livestock farmers to be connected to different markets and price transparency. But also we witness the conduction of different businesses on other online platforms and social media where people post businesses on their accounts and display to followers and friends to be seen for business. Applications like WhatsApp, Instagram, and Facebook are highly used for business activities nowadays. Kwayu (2020) explains how important it is for organizations to have structures within that will help or make it easy to merge their business with the use of social media. business organizations in Tanzania are interested in the use of social media platforms for the betterment of their business regardless of some obstacles they face. In the last two decades, business organizations have seen the emergence and rise of social media platforms that are fundamentally different from traditional Information Technologies. During this time, the use of social media by organizations has advanced from experimentation to becoming a mainstream activity within the organization. Despite the influence and advancement in the use of social media in business organizations, the existing literature suggests that organizations are struggling with organizing and managing social media as well as understanding what broader changes in the organizational structure and processes are necessary for implementing social media in the organization (Kwayu, S. 2020). Social media and other mobile apps have made the means of communication to be more simple and easier hence the rise in the use of mobile phones among individuals in Tanzania. The Tanzania Communications Regulatory Authority (TCRA) statistics show that by the financial year 2022/2023 there were about 60,277,027 mobile phone service subscribers, which is equivalent to

the number of SIM cards circulating the market. TCRA report also shows the trend of mobile service subscriptions, as it grows each year. This significant increase is motivated by the following factors; Affordability: The availability of affordable mobile phones, including feature phones and smartphones, has made them accessible to a wider segment of the population. The declining prices of mobile devices have significantly contributed to the increased ownership and use of mobile phones in Tanzania. Infrastructure Development: Investments in telecommunications infrastructure, particularly the expansion of mobile networks and internet connectivity, have improved access to mobile services across Tanzania. The deployment of mobile towers and the expansion of 3G, 4G and 5G networks have facilitated greater coverage and reliability of mobile services, encouraging more people to adopt mobile phones. Mobile Money: The proliferation of mobile money services, such as M-Pesa, Tigo Pesa, and Airtel Money, has played a pivotal role in driving the adoption of mobile phones in Tanzania. Mobile money services have transformed how people conduct financial transactions, allowing them to send and receive money, pay bills, and access banking services directly from their mobile phones. Social Connectivity: Mobile phones serve as a vital tool for social connectivity in Tanzania, enabling individuals to stay connected with friends, family, and communities. The ability to make calls, send text messages, and use social media platforms has fueled the demand for mobile phones as a means of communication and social interaction. Access to Information: Mobile phones provide access to a wealth of information and resources, including news, educational content, health services, and market information. The availability of information at one's fingertips has incentivized more people to own and use mobile phones as a tool for learning, decision-making, and empowerment. Economic Opportunities: Mobile phones have created economic opportunities for individuals and businesses in Tanzania. They serve as a platform for entrepreneurship, enabling small businesses to reach customers, manage transactions, and access financial services. Mobile phones also facilitate access to online marketplaces and digital platforms, opening up new avenues for commerce and employment. Government Policies: Government policies and initiatives aimed at promoting digital inclusion and expanding access to mobile technology have contributed to the rapid increase in mobile phone usage in Tanzania. Policies that promote competition among mobile operators and encourage investment in telecommunications infrastructure have helped drive down costs and improve access to mobile services. The growth of mobile phone services over the past few years reflects the enormous potential of Tanzania’s wireless communications market. While data transfer is not very popular in this market, the wireless system plays a significant role in meeting the public’s demand for quality point-to-point and point-to-multipoint-content communications (Mtenzi et al, 2008).

Also, according to the TCRA annual report (2023), Mbeya region is one of the leading regions in the adoption of mobile phones for communication having 3,591,274 subscriptions, being preceded by Arusha with 3,591,274 subscriptions, Mwanza regions with 3,958,286 subscriptions and the leading region Dar es salaam with 10,936,342 subscriptions. As the statistics show, the subscription number is higher in regions where trading activities and production rates are higher compared to others, for example; the Mbeya region is highly dominated by agricultural activities, as one of the major production sectors. Farmers use mobile phones as a major means for market search of their farm produce, and following closely the market trends and price transparency and fluctuations. Mobile phone ownership was positively associated with access to market information, higher selling prices, and lower search costs for maize farmers in Tanzania (Aker, J. C. & Minde,

I, 2011). James Thurlow et al. (2015), says that mobile phone use led to an improvement in sorghum prices received by farmers due to better access to market information and negotiation capabilities. Many studies show that the use of mobile phones for market search and price transparency is of great significance to smallholder farmers although some of the studies, still ask for transparency in the market. Kweyunga et al (2019) evaluated different mAgri services providing market information to smallholder farmers in Tanzania and concluded that while there were improvements in price awareness, further efforts were needed to enhance price transparency fully. However other ICT tools can be included to soften the market access by smallholder farmers. Katengeza et al (2011), discussed the support governments should work on to improve access to mobile phones for agricultural marketing, which could be leveraged to promote market efficiency and price transparency in African agriculture markets, using the case of the Malawi government. Katengeza suggests the need to improve farmers' access to mobile phones for agricultural marketing. It recommends that government, in collaboration with mobile network operators, should reduce calling tariffs to enhance use, gender disparities in accessing assets should be minimized, and investment in supporting infrastructure must be enhanced. Heinzelmann (2021) highlights the role of digital financial services, enabled by mobile phones, in promoting women's participation in agricultural supply chains and improving their access to market information in Tanzania. Similarly, according to findings by Hendi (2019) and information presented in a report by the World Bank, the proportion of small-scale farmers in Tanzania equipped with mobile phones surged from 66% to 78%, enabling them to access crucial market information. This statistic positions Tanzania among the African countries with the highest mobile phone penetration rates in the agricultural sector. Moreover, an impressive 96% of the population in Tanzania has access to cell phones. These studies demonstrate that mobile phone technology is crucial in enhancing market search and price transparency for smallholder farmers in Tanzania and also in deciding which crop to go within the market. They showcase the successes and ongoing challenges faced in implementing and scaling up these technologies to fully benefit larger numbers of farmers .

In agribusiness, information sharing is very important as farmers get access to the current status of the market and its trends. Information sharing, data exchange and related problems are some of the key issues to be solved. A smooth exchange of information was noted to be needed across all sectors. While the different strategic platforms and networks have different visions, the analysis showed that they have a lot of similarities (Agri Exchange, 2012). Agricultural information is an important factor that interacts with other production factors. Productivity of these other factors, such as land, labour, capital, and managerial ability, can arguably be improved by relevant, reliable, and useful information. Information supplied by extension research, education, and agricultural organizations helps farmers make better decisions (Vidanapathirana, 2019). According to Vidanapathirana, (2019) discussion, the majority of the rural farmers do not have access to most of the required agricultural information. Therefore, the application of ICT-based agriculture information support systems is very important for the dissemination of agricultural information and technological know-how by the rural farming community. 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). Konkuva K. and Jensen R. (2015), in their study, examined the extent to which mobile phones are used to access market information in rural Tanzania, finding that mobile phones have helped

reduce information asymmetries and lowered transaction costs for farmers seeking to sell their goods. Mobile money has expanded access to financial services for rural populations, allowing them to invest in productive assets and manage risk more effectively (Desai J. & Valley, P. 2017). These various studies show how mobile phones are important in farming, especially the smaller farmers. More than 1.3 million farmers in Tanzania are now digitally profiled, thanks to collaboration involving the Ministry of Agriculture, Tanzania Fertilizer Regulatory Authority (TFRA), and Vodacom's Multiplayer Digital Platform M-KULIMA (source IPP MEDIA site). Mobile phones at most are there to simplify life of individuals by making communication so simple, easy, and affordable to every mankind. The important thing in this study is the question, how impactful are mobile phones in accessing markets and price transparency by smallholder farmers? Therefore this study examined the impact of mobile phones on farmers in accessing markets and price transparency in Tanzania, taking the case of Mbarali district in Mbeya region.

The novelty of this study lies in its examination of how mobile phones impact market accessibility and price transparency among smallholder farmers in Mbarali District, Tanzania. By integrating socio-demographic factors (such as gender, language, and experience) with technological variables (like network availability and digital knowledge), the study provides new insights into how mobile technology empowers farmers, improves market information access, and reduces price disparities. It also addresses the role of mobile phones in bridging information gaps and promoting economic empowerment in rural agricultural communities, offering valuable implications for policy and technology adoption.

2. Methodology

The study was conducted in three wards of the Mbarali district in the Mbeya region, namely, Mswiswi, Chimala, and Ubaruku. The three wards were purposively selected because agriculture is the major economic activity in the mentioned yards. Igawa word was selected because of its importance as a center of rice business for villages around it although the ward does not contain many farms as compared to others. So the study combined Ubaruku ana Igawa as one ward. The wards selected are those rich in rice production, and also rice business is higher compared to other wards of Mbarali district. The sampling methods employed in this study were both probability and nonprobability. With probability sampling, the researcher put the respondents with mobile phones in groups which were obtained randomly to collect primary data from the smallholder farmers. The researcher had to do this to be free from any form of subjectivity and bias from the respondents. On nonprobability sampling, stratified sampling was employed to get secondary data. Here, the Ward Executive Officers (WEOs), Ward Agricultural Officers (WAOs), and District Agricultural Officers (WAO) are the key respondents who helped in collecting secondary data. A sample of 200 was selected from each of the two wards, Mswiswi and Chimala, and 300 respondents from the Ubaruku and Igawa wards combined. The target group in this study was a mere smallholder farmer who lived and farmed in the chosen wards. The following sample size estimation formula was used, to get respondents from the proposed population;

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

Where by:

n= sample size

N= total population

e= marginal/sampling error, which from our will be around 5% = 0.05

p= proportion of success of farmers who use mobile phones and the services (50% = 0.5)

q= 1-p; (1-0.5) = 0.5

$\frac{z\alpha}{2}$= standard variates at a given confidence level. (95% = 1.96)

Now the sample size for the Mswiswi ward

$$n = \frac{(1.96)^2 \times 0.5 \times 0.5 \times 200}{(200-1)(0.08)^2 + (1.96)^2 \times .0.5 \times 0.5}$$

$$n = \frac{192.08}{2.234}$$

$n = 86$ the number of respondents/smallholder farmers in Mswiswi ward 0.9604

And the same number (86) was taken for the Chimala ward. 1.9136

The sample for Ubaruku ward combined with Igawa ward

$$n = \frac{(1.96)^2 \times 0.5 \times 0.5 \times 300}{(300-1)(0.08)^2 + (1.96)^2 \times .0.5 \times 0.5}$$

$$n = \frac{288.12}{1.9136 + 0.9604}$$

$$n = \frac{288.12}{2.874}$$

$n = 100$ the sample size for Ubaruku combined with Igawa wards

Therefore the study had a total of 86 + 86 + 100, equal to 272 respondents for the three selected wads of Mbarali districts. But also the study had other key informants/respondents selected for the position they hold in the respective ward, WEO and WAO on each ward, who sum up to eight (8), and the District Agricultural Officer (DAO). Hence the study had a total of 272 + 8 +1 = 301 respondents.

The study employed a mixture of both qualitative and quantitative methods. Data was collected through interviews, on the use of mobile phones for market access and price transparency for their farm produce. Group discussions and observation methods were used in data collection. The study dealt with rice smallholder farmers, that is interviews were conducted with smallholder rice farmers. Data were collected from both primary and secondary sources. Primary data were collected from smallholder rice farmers using mobile phones for market access and price

transparency. Secondary data were obtained through a review of different documents from the Ministry of Agriculture, Mbarali district council as well as from cell phone companies, M-KULIMA for Vodacom, Tigo Kilimo for Tigo, and TTCL. Interviews, focus group discussions, and observation were used in collecting primary data. Questionnaires were little used for primary data collection in village marketplaces. Secondary data were collected through the review of various documents.

Quantitative data were analyzed through statistical methods (inferential statistics), and regression analysis was used. According to Othari (2004), regression analysis models the relationship between a dependent variable and one or more independent variables. Here is the multiple linear regression that was used

$Y = \beta0 + \beta1*X1 + \beta2*X2 + ... + \beta p*Xp + \varepsilon$

- Y is the dependent variable.
- β0 is the intercept, representing the predicted value of Y when all independent variables are zero.
- β1, β2, ..., βp are the regression coefficients that indicate the change in Y associated with a one-unit change in the corresponding independent variable, holding all other variables constant.
- X1, X2, ..., Xp are the independent variables.
- ε represents the error term, capturing the variability in Y that the model cannot explain.

The regression model was then used to find the relationship of variables used in the study to find out how impactful the use of mobile phones for market searching and price transparency by smallholder farmers in the Mbarali district.

Hypothesis:

The hypothesis for this analysis is that there is a positive relationship between the use of mobile phones by smallholder farmers and improved market access and price transparency. In other words, as the use of mobile phones increases, we expect to see a corresponding increase in market access and price transparency.

Variables:

The dependent variable is Market Access and Price Transparency, it was measured by taking into account factors such as the number of times the farmer has used the phone in search of the market and the proper price for the goods, while the independent Variable is the Use of Mobile Phones, and the measure of this was by the percentage of smallholder farmers in a population who own and actively use mobile phones.

Y is the dependent variable (Market Access and Price Transparency) = β0 + β1(Use of Mobile Phones) + ε

$ln = (\frac{p(y,=1)}{1-p(y,=1)})$ $=\alpha + \beta1 \times \text{Education level} + \beta2 \times \text{availability of network} + \beta3 \times \text{language} + \beta4 \times \text{digital knowledge} + \beta5 \times \text{Gender} + \beta6 \times \text{farming experience}$

Descriptive statistics was employed in analyzing data in which numbers were assigned to different variables. This was done to summarize and assign meaning to data. That is, describe the data with its frequencies and percentages. Mean, percentages were the main descriptive parameters employed in the analysis. The qualitative data were analyzed through the use of thematic (content) analysis. Contents from interviews and observations were analyzed by identifying the main themes, something that was repetitively mentioned in interviews or recorded in a series of observations. Integrations were made from observations from different respondents, so observation field notes were used in judging the themes.

2.1 Reliability Tests

In this study, the Cronbach's Alpha Coefficient was employed to assess the instrument's capacity to provide the required findings. The factors influencing smallholder farmers in the use of mobile phones in search for market and price transparency for agriculture production were investigated using the Cronbach coefficient's Alpha. For Cronbach Alpha values, George and Maleri (2003) offer the following thumb rules: > 0.9 = excellent, > 0.8 equals good, > 0.7 equals acceptable, > 0.6 equals doubtful, > 0.5 equals poor, and > 0.5 equals unacceptable in terms of reliability and validity. As presented in Table 1 below, about 13 items were used in this analysis to analyze the determinants of smallholder rice farmers on credit accessibility. The Cronbach's alpha of 0.928 indicates an excellent internal consistency of the scale data.

Table 1: Overall Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.928	.902	10

3. Results and Discussion

3.1 Characteristics of the Respondents

In this part, the study used the parameters; of Age, gender, and farming experience to describe and categorize the respondents as indicated in Table 1 below. The results from Table 2, show that the majority of respondents were aged between 35 – 45, taking 44.5% of the whole population sample. Mswiswi had 13.2%, Chimala 15.1%, and Igawa 16.2%. The fewest respondents were those aged between 18 – 35, with 23.1%, by which Mswiswi was 7.7%, Chimala 6.6% and Igawa 8.8%. The other respondents were aged 45 – 65, who had a percentage of 32.4%, in which there were 11% from the Mswiswi ward, 9.4% from the Chimala, and 12% from the Igawa ward. The findings show that the largest number of respondents involved were aged between 35 and 45. Also, the findings imply that most of the respondents have experience in farming since most of them lie in years above 10 years, hence also have experience in using mobile phones to access the market and price transparency.

On gender, the study had 59.6% males involved which Mwsiswi ward had 21%, Chimala ward 18%, and Igawa ward 20.6% and 40.4% of the respondents were female, in which 10% from Mswiswi, 14,4% from Chimala ward, and Igawa ward was 15%. This suggests that the study area has a large number of males involved in agricultural activities, but also indicates that mobile phones are mostly owned by men.

On the educational level, the analysis shows that 42.5% of the people involved in the study completed secondary education. 15% were from Mswiswi ward, 13.2% from Chimala and 14.3% from Igawa ward. Only 2.4% of the respondents did not attend any formal school, 1.7% from the Mswiswi ward, 0.7% from the Chimala ward, and 0% from the Igawa ward. 29.8% of the respondents completed primary school which, the Mswiswi ward hard 8.8%, in the Chimala ward 11% and 9.9% from the Igawa ward, and also 17.4% of respondents completed advanced secondary education, 4% from the Mswiswi ward, 5.9% from Chimala ward, and 7,4% from Igawa ward. Respondents with an education level of college (ordinary certificates), degree, and above were 8% of the population sample, 1.8% from the Mswiswi ward, 0.7% from the Chimala ward, and 5.5% from the Igawa ward.

With farming experience, the analysis of the study was as follows; 48.9% of the respondents had an experience of years between 11 to 20. 13% from the Mswiswi ward, 15% from the Chimala ward, and 12.5 from the Igawa ward. This shows that most of the farmers in the study area are into the activity of farming for at least 5 years, as shown in the statistics respondents with farming experience between 1 to 10 years were 32.2%, 11% from Mswiswi ward, 9.5% Chimala ward, and 12% from Igawa ward. The study's analysis shows that 21.6% of the respondents had farming experience of years between 21 to 31 years, of which 8.1% were from the Mswiswi ward, 6.9% from the Chimala ward, and 6.6% were from the Igawa ward.

Table 2: Characteristics of the respondents

		Mswiswi		**Chimala**		**Igawa**		**Total**	
Age		**Frequency**	**%**	**Frequency**	**%**	**Frequency**	**%**	**Frequency**	**%**
	18 - 35	21	7.7	18	6.6	24	8.8	63	23.1
	35 - 45	35	13.2	42	15.1	44	16.2	121	44.5
	45 - 65	30	11	26	9.4	32	12	88	32.4
Gender	Male	56	21	48	18	58	20.6	162	59.6
	Female	30	10	38	14.4	42	15	110	40.4
Education level	Not gone to school	4	1.7	2	0.7	0	0	6	2.4
	Primary school	24	8.8	30	11	27	9.9	81	29.8

		Mswiswi		Chimala		Igawa		Total	
Age		**Frequency**	**%**	**Frequency**	**%**	**Frequency**	**%**	**Frequency**	**%**
	18 - 35	21	7.7	18	6.6	24	8.8	63	23.1
	35 - 45	35	13.2	42	15.1	44	16.2	121	44.5
	45 - 65	30	11	26	9.4	32	12	88	32.4
	Secondary school	42	15	36	13.2	38	14.3	116	42.5
	Adv secondary	11	4	16	5.9	20	7.4	51	17.3
	College/Degree or above	5	1.8	2	0.7	15	5.5	22	8
Farming experience in years	1 - 10	30	11	26	9.5	32	12	88	32.2
	11 - 20	34	13	41	15	50	18	125	48.9
	21 - 31	22	8.1	19	6.9	18	6.6	59	21.6

3.2 Factors influencing smallholder farmers in the use of mobile phones in search for market and price transparency for agriculture production

3.2.1 Tests for the Model

The model was tested through omnibus tests of model coefficients, model summary and Hosmer and Lemeshow tests to see how well the model fit the data when using the logistic regression analysis.

3.2.2 Omnibus Tests of Model Coefficients

The Omnibus Tests of Model Coefficients are used to check that the new model (with explanatory variables included) is an improvement over the baseline model (Zach, 2021). Therefore, as presented in Table 3 below, the chi-square of 14.516 and p-value of 0.006 are significant to the log-likelihoods of the model.

Table 3: Omnibus Tests of Model Coefficients

	Chi-square	Df	Sig.
Step	14.516	4	.006
Block	14.516	4	.006
Model	14.516	4	.006

3.2.3 Model Summary

A logistic regression model of goodness of fit was used to see the factors influencing smallholder farmers in the use of mobile phones in search of market and price transparency for agriculture production. The following Table 4 below shows the model summary of the factors influencing smallholder farmers in the use of mobile phones in the search for market and price transparency

for agriculture production included in the model. The test indicated that Cox & Snell R square and Nagelkerke R square were positive (0.166 & 0.243). These results imply that the model is explained by the total variation of 16.6% and 24.3% of coefficients of determinations.

Table 4: Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	77.589[a]	.166	.243

3.2.4 Hosmer and Lemeshow Test

The findings presented in Table 5, the Hosmer and Lemeshow test which is also used to test the model of the goodness of fit was 18.547 With P-value =0.017 and degree of freedom (df) =8. Therefore, the recommended model (logistic regression) fit well the set of data.

Table 5: Hosmer and Lemeshow Test

Step	Chi-square	Df	Sig.
1	18.547	8	.017

For the farmer to choose a certain technology to use, has to consider many factors to achieve the desired objective. To determine which factors influence the smallholder farmer to use mobile phones in searching for market and price transparency, the study identified the following factors; network availability, language competence, digital knowledge, education level, gender, and farmer's experience in farming. Table 6 below, shows the results of binary regression analysis to test the independent variables. The table shows the independent variables have no problem in the prediction and showing relationships.

Network availability has a significant negative relationship with the outcome. As network availability increases, the likelihood of the outcome decreases. This suggests that poor network availability may hinder market accessibility or price transparency, with an odds ratio of 0.204, meaning a 1-unit increase in network availability decreases the odds of the outcome by about 80%. The confidence interval indicates that this result is statistically significant.

Language has a significant positive relationship with the outcome. Farmers who are more comfortable with the language used in mobile phone platforms are more likely to benefit from market information and price transparency. The odds ratio of 11.958 indicates a very strong positive effect, where the odds of success increase by about 12 times for each unit increase in language compatibility.

Digital knowledge negatively affects the outcome, with an odds ratio of 0.250, suggesting that better digital knowledge reduces the likelihood of the outcome. This may indicate that farmers with advanced digital knowledge may already have access to more traditional or efficient means of market access, making mobile phone use for market information less impactful.

The education level has a positive but statistically insignificant effect on the outcome. Although the odds ratio of 1.946 suggests that higher education levels might slightly increase the odds of the outcome, the lack of statistical significance (p-value = 0.282) means that education alone does not significantly contribute to market accessibility or price transparency.

Gender has a significant positive impact on the outcome, with a very strong odds ratio of 11.262, indicating that males are significantly more likely to benefit from mobile phone-based market information. This suggests gender disparities in the adoption or utilization of mobile technologies for market transparency in Mbarali District.

The farmer's experience has a strong positive effect on the likelihood of benefiting from mobile-based market access and price transparency. The odds ratio of 10.797 indicates that more experienced farmers are significantly more likely to utilize mobile phones for market-related benefits.

Table 6: Factors influencing smallholder farmers in the use of mobile phones in search for market and price transparency for agriculture produces

Independent Variable	Coefficient (B)	Std. Error	Wald	Sig	df	Exp(B)	95% C.I. for Exp(B)	
							LL	UL
Network Availability	-1.587	0.691	5.276	0.022*	1	0.204	0.062	0.710
Language	2.481	0.599	17.188	0.001***	1	11.958	4.913	28.912
Digital Knowledge	-1.384	0.681	4.129	0.042*	1	0.250	0.079	0.798
Education Level	0.666	0.618	1.159	0.282	1	1.946	0.622	6.134
Gender	2.421	0.771	9.860	0.002**	1	11.262	3.201	40.096
Farmer's Experience	2.379	0.692	11.818	0.001***	1	10.797	3.492	33.721
Constant	-1.44	1.050	1.885	0.170	1	0.237	-0.239	2.906

Significance codes: *** = Significant at the 0.001 level; ** = Significant at the 0.01 level; * = Significant at the 0.05 level.

The analysis reveals several key factors influencing the use of mobile phones for market accessibility and price transparency among smallholder farmers in Tanzania. Significant positive

relationships were found between language compatibility, gender, and farmer experience with the likelihood of benefiting from mobile-based market information, with the odds of success notably higher for farmers who are more familiar with the language, male, and more experienced. Conversely, network availability and digital knowledge had negative associations with the outcome, suggesting that poor network infrastructure and higher digital literacy may reduce the impact of mobile technologies. Education level showed a positive but statistically insignificant effect. These findings highlight the importance of considering socio-demographic factors and infrastructure when promoting mobile phone usage to improve market transparency and accessibility in rural farming communities.

Similarly, the results through FGDs revealed that the majority of farmers in the Mbarali District had inadequate information.

EO response was that:

> "…mobile phones have played a great role in assisting farmers in getting information on market trends and being able to properly set prices for their farm produce. Mobile phones have closed the distance gap; rice business is conducted regardless of the distance the customer is in Tanzania. Orders are made through mobile phones, payments and/or money transactions are made through mobile money, and goods are shipped to the customer through vehicle transports and their agents there is no need for a face-to-face meeting with a customer..." (EO,2024)

On interviewing the District Agricultural Officer, the study discovered that:

> "…use of mobile phones for market search and price transparency; has made farmers aware of market price fluctuations and also know the quality of goods the market needs, through mobile phones, especially farmers with smartphones, it is easy to get access to news in different corners of the country and the continent at large, so farmers know the standard to with their products are supposed to reach. Therefore the study found that mobile phones have a great contribution to the rise of the quality of farm produce since farmers get user views directly and work on improving…"(DAO,2024)

In interviewing the WEOs, all of them from the three selected wards pointed out that:

> "…the difficulties farmers in their respective areas face on using mobile phones in general. One is the case of networking availability, especially in some remote areas of the wards, network coverage is not smooth hence farmers have to walk a distance to access mobile phone networks…"(WEOs, 2024)

Conclusion

The use of mobile phones for market accessibility and price transparency has proven to be a transformative tool for smallholder farmers in Mbarali District, Tanzania. Mobile technology has facilitated better access to real-time market information, allowing farmers to make informed decisions regarding the sale of their produce. By providing price transparency, mobile phones have

reduced the reliance on middlemen, enabling farmers to secure fairer prices for their goods and enhancing their bargaining power. Furthermore, mobile banking and mobile money services have improved financial inclusion, allowing farmers to conduct transactions efficiently and securely. The adoption of mobile phones has contributed to greater market efficiency, improved income stability, and enhanced the overall financial well-being of smallholder farmers in the region. As mobile technology continues to evolve, its role in supporting smallholder farmers is likely to expand, offering further opportunities for agricultural growth and development in Tanzania.

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