



## **Smallholder Rice Farmers' Perceptions on Usefulness of Mobile-Phone Technology in Bahi District, Tanzania**

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### **Authors' contributions**

*This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.*

### **Article Information**

DOI: 10.9734/SAJSSE/2022/v14i230374

### **Open Peer Review History:**

This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: <https://www.sdiarticle5.com/review-history/87062>

**Original Research Article**

**Received 08 March 2022**

**Accepted 16 May 2022**

**Published 20 May 2022**

### **ABSTRACT**

Mobile Phone Technology is increasingly becoming a powerful method of interpersonal communication. This paper documents smallholder rice farmers' perception of the usefulness of this technology in communicating agricultural production and market information. Data were collected from 282 smallholder farmers selected randomly from rice farmers in Bahi District, Tanzania. The findings revealed that 97.2% of the sampled smallholder farmers owned the phone for more than three years. All phones were able to perform the basic function of sending and receiving short messages and making and receiving calls, with very few (18.8%) capable of accessing the internet. 48% and 78% of the respondents perceived the network coverage and costs of buying and running the technology respectively as moderate, whilst 54.3% perceived the technology as useful in communicating agricultural production and market information. However, only less than 36% of the respondents confirmed to have used the technology to communicate agricultural production and market information, with very few (3.2%) communicating with extension officers. It is recommended that intervention intended to improve farming through mobile phone technology should be configured around the basic functions of mobile phones. More so, extension officers should increase the use of mobile phone technology in advising farmers through automated short message services or a stationed officer on calls.

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*Keywords: Mobile phone technology; smallholder farmers; rice farmers; Bahi District; and smallholder farmers' perception.*

## 1. INTRODUCTION

Information has always been an important component in agricultural development processes [1]. Irrespective of their location and type of agricultural enterprises, farmers' most commonly searched information has been the know-how aspects, which give them fundamental agricultural facts. For instance, farmers may want to know the best cultivation practices, sources of improved seeds and or animal feeds, amount and type of inputs to use, also contextual information such as weather, as well as market information, including prices, demand indicators, and other logistical information [2,3].

Essentially, poor access to agricultural information has been a potential explanation for the limitation of agricultural performance in developing countries and has made farmers vulnerable to several risks, both during farming, transportation and marketing of their crops [4-6].

One major explanation associated with farmers' poor access to agricultural information has been the under-utilization of Information Communication Technologies (ICT) [7-9]. Limited access to agricultural information affects the usefulness of various agricultural technologies that directly relate to agricultural performance.

Like other developing countries, Tanzania farmers suffer from poor agricultural information accessibility [7,10]. Radio, newspaper, internet, email, mobile phones or notice boards for a while have been recognized as the most useful methods for dissemination of agricultural information in Tanzania [11]. However, many of these options have their limitations; for instance, newspapers tend to be concentrated in urban areas and require literacy, internet access is low, and TV and radio have limited information range and provide one-way communication [12,13].

Recent mobile-phone has been a reliable source of information among rural and urban dwellers in developing economies, but some limitations from other methods have made this option more famous and accepted [14]. In Tanzania, the uptake of mobile phones has been growing enormously and continues to grow, for instance, from 110 518 subscribers in the year 2000 to 25 827518 in 2011 [15].

Despite the usefulness of mobile phone technology (MPT) and its potential to foster agricultural development in Tanzania, there is an apparent inconsistency between the mobile phone subscriptions that are increasingly being adopted on the one hand and their adoption in agricultural practices on the other hand. This may be due to unknown limitations that people in both rural and urban areas face when using technology, which may emanate from individuals' behaviour and perception towards technology or may arise from challenging technologies. This paper, therefore, focuses on farmers' perceptions of mobile phone technology.

As postulated by Rogers [16], diffusion of innovation theory outlines the importance of adopters' perceptions of innovation and, hence, adopting that particular innovation. Specifically, the adopter's perceptions of innovation are categorized into five classes [16]: Being (1) relative advantage (the degree to which an innovation is perceived as being better than the idea it supersedes); (2) compatibility (the degree to which an innovation is perceived as consistent with the existing values, past experiences and needs of potential adopters); (3) complexity (the degree to which an innovation is perceived as relatively difficult to understand and use); (4) trialability (the degree to which an innovation may have experimented on a limited basis); and (5) observability (the degree to which the results of an innovation are visible to others). Based on the design and nature of the study (i.e. it is non-experimental and not trucking perception of others [non-users]), this paper focused on the three classes, namely; relative advantages, compatibility and complexity, to measure the farmers' perception of Mobile Phone Technology (MPT).

## 2. METHODOLOGY AND ANALYTICAL FRAMEWORK

To measure farmers' perception, four groups of variables were developed. Group 1 examines and discusses three major variables; (i) Ownership of the mobile phone –whether the farmer-owned a device or not, and (ii) Period of mobile phone use –whether a farmer has been using the technology for a short or long period, and (iii) Technological aspect of the mobile phone technology among rice farmers –whether the device is able to receive and make calls,

receive and send messages, connect to the internet, and able to take photos. The variables in this group were guided by classes 2 and 3 of Rogers' [16] Diffusion of Innovation Theory. Group 2 evaluates and discusses three main variables; (i) Perception of MPT network coverage –whether the mobile phone network is strong, moderate or weak, (ii) Perception of the cost of using MPT –whether it is high, moderate or low, as well as (iii) Perception on the importance of using MPT in communicating agricultural production and marketing information –whether it is very important, fairly or not important. The variables in this group are guided by class 1 of Rogers' [16] Diffusion of Innovation Theory. Group 3 examines two major variables that track the skills required when using MPT. These are: basic skills and specific skills—such as writing, reading, language and searching skills. The variables in this group are guided by class 2 and 3 of Rogers' [16] Diffusion of Innovation Theory. While group 4 evaluated the information being communicated on these devices, specifically that related to agricultural production and marketing activities. The variables in this group were guided by classes 1 and 2 of Rogers' [16] Diffusion of Innovation Theory.

A cross-sectional survey design was used to collect the data for the study. Since the study is non-experimental and purely relies on observational data, this design enabled the accurate collection of the data required to answer the research questions (Bryman, 2008). The sample was drawn from small scale paddy farmers; since the number of these farmers in the study area (both for MPT adopters and non-adopters) was not known, the formula  $n = p(1 - p) \left(\frac{Z}{E}\right)^2$  which determines the sample size from the unknown population for binary outcome was used to identify 382 individual farmers for sampling, whereby  $n$  is the sample size,  $p$  is proportional to success (for this case is the proportion of adopters of MPT in the population);  $Z$  is confidence interval (1.96); and  $E$  is the margin of error (0.05). The 384 paddy farmers were randomly selected, of which 282 used mobile phone technology (MPT) to communicate agricultural production and marketing information, and were regarded as adopters of MPT, while 102 were non-adopters MPT. Since the study intended to focus on the perception of adopters of MPT, then the 282 were used to give the information to address the study's objectives. According to Eichenberger et al. (2011) and

Louangrath (2014), any sample above 100 is statistically acceptable to give relevant information for a particular study.

The nature of the study required the respondents to give their opinion on how they perceive MPT. In that perspective, techniques that describe the variation of the opinions, such as frequencies and percentages as well as mean comparison, were employed to address the desired objective. The distribution was focused on knowing to what extent (High or low ) categorical variables of interest have deviated from the average and a threshold for dichotomous variables. In addition, information gathered using focus group discussions was used to clarify and substantiate the findings.

### 3. FINDINGS

#### 3.1 Ownership, Period of use and Technological Aspect of Mobile Phone Technology

It was observed that the majority (97.2%) of the respondents own mobile phones, most (67.7%) of whom have been using the technology for a period of over three years (Table 1).

Results in Table 1 further indicate that all mobile phones were able to receive and make calls as well as receive and send short message services. At the same time, very few (18.8% and 12.1%) had access to the internet and abilities to take photos, respectively. Reflecting on these results, one may say that these farmers have achieved the minimum requirements to tap the technological advantage of the MPT innovation, that is, having phones which are able to receive and make calls and send and receive messages. However, having phones with access to the internet and the ability to take photos is likely to increase the farmers' possibility to tap the technological advantage of the MPT innovation; it gives an impression that most farmers are missing a lot by not possessing phones with such characteristics.

Notwithstanding the above-missed opportunity, information obtained from the Focus Groups Discussion revealed that Mobile Phone Technology is perceived as a useful innovation that allows communication among rice farmers. One of the FGD participants commented that *"we are better now with these mobile phones than in*

previous years, where you have to physically visit a place to get information”.

technology is important in communicating production and marketing information (Table 2).

### 3.2 Perception of Network Coverage, Costs, & Importance of Using MPT

About 74% of the surveyed sample perceived that the mobile phone network coverage in the District is good, while about 25% believed the network is strong. The majority (90%) considered the cost of purchasing a mobile phone to be affordable. The findings also show that the majority (95.4%) believed that mobile phone

Combining the three elements in Table 2, i.e. network coverage, cost of purchasing a mobile phone, and their importance in communication production and marketing information, the technology is perceived as useful and important to the smallholder rice farmers. This being the case, it appears that there is a great opportunity to improve smallholder farmers’ production and marketing performance through improved utilization of the Mobile Phone Technology.

**Table 1. Ownership, period of use & technological aspect of MPT (n=282)**

| Variable  | No. of respondents | $\chi^2$ values of mean difference |
|---|--------------------|------------------------------------|
| <b>Mobile phone ownership</b>                                 |                    |                                    |
| Own   | 274(97.2%)         | 98.103***                          |
| Borrow  | 8(8.5%)            |                                    |
| <b>Period been using Mobile phone</b>                         |                    |                                    |
| 3 or above years  | 191(67.7%)         | 24.286***                          |
| Less than three years   | 91(32.3%)          |                                    |
| <b>Mobile phone ability to receive and make calls</b>         |                    |                                    |
| Able to receive and make calls                                | 282 (100%)         | N/A (as sd=0)                      |
| Not able  | 0(0.0%)            |                                    |
| <b>Mobile phone ability to receive and send short message</b> |                    |                                    |
| Able to receive and send a short message                      | 282(100%)          | N/A (as sd=0)                      |
| Not able  | 0(0.0%)            |                                    |
| <b>Mobile phone access to the internet</b>                    |                    |                                    |
| Have access to the internet                                   | 53(18.8%)          | 8.064***                           |
| Have no access to the internet                                | 229(81.2%)         |                                    |
| <b>Mobile phone’s ability to take photos</b>                  |                    |                                    |
| Able to take a photo  | 34(12.1%)          | 6.207***                           |
| Not able to take a photo                                      | 248(87.9%)         |                                    |

\*\*\* Significant at 1% level; MPT is Mobile Phone Technology

**Table 2. Perception of network coverage, costs, & importance of MPT (n=282)**

| Variable                                     | No. of Respondents |
|--|--------------------|
| <b>Perception of network coverage</b>        |                    |
| Strong                                       | 71(25.2%)          |
| Moderate                                     | 138(48.9%)         |
| Weak   | 73(25.9%)          |
| <b>Perception of the cost of using MPT</b>   |                    |
| High   | 32(11.3%)          |
| Moderate                                     | 220(78.0%)         |
| Low  | 30(10.6%)          |
| <b>Perception of importance of using MPT</b> |                    |
| Very important                               | 153(54.3%)         |
| Fairly important                             | 116(41.1%)         |
| Not important                                | 13(4.6%)           |

Note: MPT is Mobile-phone Technology

### 3.3 Perceptions of the Skills Required to Operate MPT

It was found that 59% of the sampled smallholder rice farmers believed that Mobile Phone Technology does not require specialized skills to operate the mobile phone, while 41% thought otherwise. The difference is statistically significant at the 1% level (Table 3).

Furthermore, evaluation of the required specific skills showed that all specific skills such as writing, reading, language, and searching were perceived not necessary to use the MPT (Table 3). These results are somewhat surprising because one would expect that, with the ever-increasing advancement in Mobile Phone Technology, the smallholder rice farmers would perceive themselves as requiring specific skills to operate the technology.

The reasons associated with these farmers' surprising perception include the fact that most respondents (80.79%) had formal education, which assures that these individuals possess basic skills that guarantee the minimum competence required to operate MPT. In addition, as indicated in Table 1, more than half of the respondents (67.7%) had an experience using mobile phones for more than three years. This experience might cause the respondent's perception of the skills required.

### 3.4 Information Communicated

To substantiate the usefulness of Mobile Phone Technology in communicating production and marketing information by rice producers, rice farmers were asked to indicate the kinds of information they communicate through the technology. The results revealed that for production, the information included; weather forecast, diseases and pests, technologies and innovations, agro-inputs price, and good agricultural practice (Table 4).

Results in Table 4 further indicate that very few (less than 36%) respondents communicated production information identified during the study. Even worse is the per cent of the respondents who communicate technology and innovation; and agro-inputs price information, whereas less than 17% of the respondents communicate this type of information. This implies that, though the respondents acknowledge the usefulness of the Mobile Phone Technology, its use among them is very low, translating to the need to launch special intervention to reverse the trend.

Results related to marketing information comprised; price of produce, market of produce, transportation, processing, access to credit, and aggregation of rice produce (Table 5).

**Table 3. Perception of the Skills Required to Perform MPT (n=282)**

| Variable  | No. of Respondents | $\chi^2$ Values of Mean Difference |
|---|--------------------|------------------------------------|
| <b>Perception of Skills Requirement to Operate Mobile Phone</b> |                    |                                    |
| <i>Required</i>   | 115(40.8%)         | 13.911***                          |
| <i>Not required</i>   | 167(59.2%)         |                                    |
| <b>Specific Skills Requirement</b>                              |                    |                                    |
| <b>Writing Skills</b>   |                    |                                    |
| <i>Required</i>   | 26(9.2%)           | 5.342***                           |
| <i>Not required</i>   | 256(90.8%)         |                                    |
| <b>Reading Skills</b>   |                    |                                    |
| <i>Required</i>   | 43(15.2%)          | 7.110***                           |
| <i>Not required</i>   | 239(84.8%)         |                                    |
| <b>Language Skills</b>  |                    |                                    |
| <i>Required</i>   | 17(6.0%)           | 4.246***                           |
| <i>Not required</i>   | 265(94.0%)         |                                    |
| <b>Searching Skills</b>   |                    |                                    |
| <i>Required</i>   | 80(28.4%)          | 10.549***                          |
| <i>Not required</i>   | 208(71.6%)         |                                    |

\*\*\* is significant at 1%; MPT is Mobile Phone Technology

**Table 4. Production information communicated through MPT (n=282)**

| Message communicated              | No. of Respondents | t-test    |
|-----------------------------------|--------------------|-----------|
| <b>Weather forecast</b>           |                    |           |
| <i>Communicated</i>               | 100(35.5%)         | 12.426*** |
| <i>Not communicated</i>           | 182(64.5%)         |           |
| <b>Disease and pets</b>           |                    |           |
| <i>Communicated</i>               | 92(32.6%)          | 11.665*** |
| <i>Not communicated</i>           | 190(67.4%)         |           |
| <b>Technology and Innovation</b>  |                    |           |
| <i>Communicated</i>               | 47(16.7%)          | 7.497***  |
| <i>Not communicated</i>           | 235(83.3%)         |           |
| <b>Agro-inputs price</b>          |                    |           |
| <i>Communicated</i>               | 29(10.3%)          | 5.675***  |
| <i>Not communicated</i>           | 253(89.7%)         |           |
| <b>Good Agricultural Practice</b> |                    |           |
| <i>Communicated</i>               | 95(33.7%)          | 11.948*** |
| <i>Not communicated</i>           | 187(66.3%)         |           |

\*\*\* is significant at 1%; MPT is Mobile-phone Technology

**Table 5. Market information communicated through MPT (n=282)**

| Message communicated               | No. of Respondents | t-test    |
|------------------------------------|--------------------|-----------|
| <b>Price of produce</b>            |                    |           |
| <i>Communicated</i>                | 158(56.0%)         | 18.922*** |
| <i>Not communicated</i>            | 124(44.0%)         |           |
| <b>Market of produce</b>           |                    |           |
| <i>Communicated</i>                | 166(58.9%)         | 20.053*** |
| <i>Not communicated</i>            | 116(41.1%)         |           |
| <b>Transportation</b>              |                    |           |
| <i>Communicated</i>                | 31(11.0%)          | 5.891***  |
| <i>Not communicated</i>            | 251(89.0%)         |           |
| <b>Processing</b>                  |                    |           |
| <i>Communicated</i>                | 32(11.3%)          | 5.997***  |
| <i>Not communicated</i>            | 250(88.7%)         |           |
| <b>Access to credit</b>            |                    |           |
| <i>Communicated</i>                | 4(1.4%)            | 2.011**   |
| <i>Not communicated</i>            | 278(98.6%)         |           |
| <b>Aggregation of rice produce</b> |                    |           |
| <i>Communicated</i>                | 37(13.1%)          | 6.514***  |
| <i>Not communicated</i>            | 245(86.9%)         |           |

\*\*\* and \*\* are significant at 1% and 5%, respectively; MPT is Mobile-phone Technology

Results in Table 5 further show that most of the respondents communicate information related to the price of produce (56%) and the market of produce (58.9%). In comparison, very few (less than 14%) respondents communicate information about rice production's transport, processing, and aggregation. They further indicate that even fewer (1.4%) respondents communicate information about accessing credit.

These results consistently support the earlier conclusion that, though the respondents

acknowledge the usefulness of the Mobile Phone Technology, its use among them is very low, translating to the need to launch special intervention to reverse the trend.

Apart from the above low usage of Mobile Phone Technology observed among the smallholder farmers, another shocking finding was related to whom the farmers communicate with about production and market information; whereby, very few indicated that they communicate with Extension Offers (Table 6).

**Table 6. Whom do the farmers communicate with, through MPT (n=282)**

| Communicate with            | No. of Respondents | t-test    |
|-----------------------------|--------------------|-----------|
| <b>Fellow Farmer</b>        |                    |           |
| Communicated                | 241(85.5%)         | 40.642*** |
| Not communicated            | 41(14.5%)          |           |
| <b>Extension Officer</b>    |                    |           |
| Communicated                | 9(3.2%)            | 3.044***  |
| Not communicated            | 273(96.8%)         |           |
| <b>Farmers Organization</b> |                    |           |
| Communicated                | 19(6.7%)           | 4.506***  |
| Not communicated            | 263(93.3%)         |           |

\*\*\* is significant at 5%, respectively; MPT is Mobile-phone Technology

Results in Table 6 indicate that most (85.5%) of the respondents communicate rice production and market information to fellow farmers than they do to extension officers (3.2%) and farmers' organizations. In a Focus Group Discussion (FGD) with these smallholder farmers, it was crystal clear that extension officers rarely use Mobile Phone Technology to advise phones. One of the FGD participants said, "Very few of us get advice from extension officers through the telephone; after all, how do you get the officers' number. As a result, we wait until they pay a visit" This implies that most smallholder farmers located in remote areas are missing out on necessary expertise likely to be obtained from extension officers and farmers' organizations.

#### 4. CONCLUSION

This paper focuses on assessing the perception of smallholder farmers on the usefulness of Mobile Phone Technology. The findings have revealed that most of the sampled smallholder farmers have owned a mobile for more than three years. This implies that mobile phone technology is widely used in the study area, and, likely, smallholder farmers will widely use it in many places.

All phones owned by the sampled smallholder farmers can send and receive Short Messages Service (SMS) and receive and make calls; with very few having access to the internet and being able to take photos. This implies that smallholder farmers who are normally located in remote areas can mainly benefit from the basic functions of the Mobile Phone Technology, giving an impression that effort to communicate with them through such technology should be configured around these basic functions. Otherwise,

advanced functions requiring internet access and photo-taking are to be widely promoted.

Regarding respondents' perception of network coverage, costs, and importance of Mobile Phone Technology in communicating agricultural information, the sampled smallholder farmers indicated that the network coverage and costs of the technology are moderate, whilst they perceived the technology to be very important in communicating both agricultural production and market information. Hence, it can be concluded that Mobile Phone Technology is increasingly becoming a powerful method of interpersonal communication and that smallholder farmers located in remote areas are widely realizing its importance in their livelihood.

Further findings show that, even though the sampled smallholder farmers have realized the importance of Mobile Phone Technology in communicating agricultural production and market information, the percentage of the sampled smallholder farmers who use the technology to communicate agricultural production and market information is very low by all standards. This led to the conclusion that the perception of smallholders that Mobile Phone Technology is very useful in communicating agricultural production and market information; has not been translated to an equal level of usage of the technology. This may be associated with the common modus operand of agricultural extension officers in performing their duties, where in most cases, these extension officers offer their expertise by physical visiting farmers while not effectively harnessing the potential that mobile phone technology has in promoting agriculture. This is why it is not surprising to find out that majority of the sampled smallholder farmers who indicated that they communicated agricultural production and market information

did it to their fellow farmers, neither to extension nor to farmers' organizations.

## 5. RECOMMENDATIONS

A positive perception of farmers on mobile phone technology should be considered an avenue to improve the farmers' capacity to utilise the mobile phone functionalities. This can be through encouraging the use of advanced mobile phone technology with internet and photos, which could be more intuitive for farmers.

It is high time for extension officers and related actors to emphasize the usefulness of mobile phone technology as an alternative to physical visits – a common modus operand of providing extension services. Using MPT can fast track the flow of information and reach majority of farmers in a short period and enhance extension service in the times of emergencies, for instance, in cases of a pandemic where social distancing is highly encouraged.

In collaboration with farmers' organizations in the area, mobile phone operating companies can also develop special numbers with frequently asked questions that could help farmers access quick production and marketing information, but on the other hand, help the companies increase their revenues.

More collaborations between Local Government Authorities and mobile phone service providers to improve farmers' related information could be part of CSR. Such intervention could include a free toll number, where farmers in need can directly call an extension Officer to get instant advice.

## CONSENT

As per international standard or university standard, respondents' written consent has been collected and preserved by the author(s).

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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