

## Mobile Phone-Enabled Services Relevant for Accessing Agricultural Information by Smallholder Farmers in Bungoma County, Kenya

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### ABSTRACT

*Agricultural information is a key component in improving small-holder agricultural production and linking increased production. Improvements in agricultural productivity are realized when farmers are linked to agricultural information. The objective of this study was to establish the available mobile phone-enabled services relevant for accessing agricultural information by smallholder farmers in Bungoma County, Kenya. The study adopted a cross-sectional and correlational research design. The sample size comprised 400 respondents that were sampled using simple random sampling, and data was collected using questionnaires. Study findings revealed that 98.1% of the smallholder farmers owned phones, while only 1.9% did not own phones. Interestingly, 60% of the smallholder farmers did not use the internet on their phones to access agricultural information. 70.3% of the smallholder farmers got better connected to markets, and 66.5% indicated that by using mobile phone-enabled services, they accessed market information. 52.4% of the smallholder farmers stated the cost of using a mobile phone as the main factor considered in their choice of mobile phone network. Tests of hypotheses showed that a unit increase in mobile phone-enabled services causes an increase of 0.457 in accessing agricultural information; therefore, mobile phone-enabled services had a statistically significant influence on accessing agricultural information. The study underscores the necessity for enhanced training in advanced mobile phone operating skills among farmers through capacity building programs. Collaboration between the Kenyan government and county administrations is essential to bolster rural infrastructure supporting mobile phone services. To address financial constraints faced by smallholder farmers in accessing mobile data and subscriptions, county governments should allocate resources to establish information centers at sub-location agricultural extension offices. These centers would offer free Wi-Fi, enabling farmers to access agricultural information using their mobile phones. They are envisioned as pivotal hubs linking farmers, extension officers, agricultural information platforms, network providers, and other stakeholders within the county.*

**Key words:** Adoption, Agricultural Information, Farmer Participants, Mobile Phone-Enabled Services, Smallholder Farmers

### I. INTRODUCTION

A significant number of households, particularly in developing countries, are currently witnessing a transformative shift in agricultural progress as they embrace the use of information and communication technologies (ICT) on modern mobile devices (Khidir, 2019). The rapid expansion of mobile phones has proven to be an effective means of communication, leading to significant changes in the operational practices of numerous industries and the emergence of new professional opportunities in diverse areas, such as agriculture (Asongu, 2018). Effective communication is crucial in the agricultural industry to facilitate the successful implementation of innovative farming practices necessary for agricultural advancement. However, the limited resources and inadequate infrastructure in numerous developing countries have resulted in a significant disparity in communication between current agricultural knowledge and farmers. Baloch and Thapa (2014) conducted a study that demonstrates the significant potential of information and communication technology (ICT), particularly the mobile phone, in enhancing communication among diverse participants in the agricultural sector (Aker, 2011).

Mobile phone-enabled services have the potential to assist farmers and marketing agents in obtaining price information from various markets, thereby mitigating the need for costly transit between markets. This, in turn, facilitates timely sales of their products. The increasing adoption of mobile phones has enabled users to subscribe to mobile phone-enabled services, commonly known as m-services, which provide access to agricultural information (Wyche et al., 2016). M-services encompass the provision of electronic media material via mobile phones,

encompassing several sectors such as m-agriculture, m-commerce, m-banking, and m-payments. There are several formats through which they are available, such as short message service (SMS), unstructured supplementary services data (USSD), mobile phone applications, and support lines. Mobile phone-enabled services have the capability to establish connections between buyers and sellers, as well as facilitate the dissemination of general information pertaining to farming.

Particularly in Africa, there have been significant advancements in the use of mobile phone-enabled services for agricultural purposes, with a focus on market access and information retrieval (Gakuru et al., 2009). A number of African nations have developed programs aimed at facilitating the dissemination of market information via mobile phones. As an illustration, Ethiopia has implemented a system whereby it disseminates data feeds to farmers via text messaging, catering to mobile phone users who express interest (World Bank, 2011). The platform offers market data in many local languages. Every day, a toll-free number receives approximately 20,000 calls seeking price information. The provision of free text messaging and free phone services in Ethiopia aids smallholder farmers in acquiring information regarding the market conditions for various commodities, encompassing factors such as pricing, location, and consumer preferences (World Bank, 2011). According to Minten et al. (2012), the availability of mobile phones in Ethiopia has enhanced the ability of traders and businesses to engage in effective communication, thereby facilitating price negotiations and the execution of payments.

In recent years, smallholder farmers have traditionally relied on conventional extension methods to receive agricultural information. However, the increasing population of farmers has resulted in the inadequacy of these extension services, making them ineffective (Baloch & Thapa, 2014). In this particular scenario, communication tools such as mobile phones offer efficacious solutions to the challenges faced by farmers, facilitating effective communication among diverse players within the agricultural industry. Hence, it is imperative to promptly embrace novel methodologies for the distribution of agricultural information, ensuring that it serves as a supplementary resource rather than a replacement for agricultural extension services. Mobile phones have the potential to serve as a rapid and efficient means of disseminating agricultural information to farmers. In order to address the existing gap in knowledge and contribute to the existing literature, the present study was conducted with the objective of assessing the effects of mobile phone-enabled services on the accessibility of agricultural information among smallholder farmers in Bungoma County, Kenya.

## II. LITERATURE REVIEW

The agriculture sector serves as the primary pillar of the majority of African economies. A significant proportion of the African population, over 80%, is engaged in agricultural activities, primarily as small-scale farmers who rely on agriculture as their primary source of income and sustenance. Smallholder farmers perceive research and agricultural advice services as valuable sources of information (Thiam et al., 2018; Ameru et al., 2018). Nevertheless, the conventional methodology is currently facing challenges due to limited resources and excessive demands (Masuki et al., 2010; Thiam et al., 2018). The emerging strategy involves the implementation of digital agriculture, which leverages mobile phone-enabled services.

The advent of mobile phone technology in the agricultural sector has generated optimism over its potential to alleviate challenges faced by smallholder farmers in terms of productivity and sales. This optimism stems from the belief that mobile phones can enhance accessibility to crucial information and markets. According to the study, agricultural products possess a limited duration of viability, necessitating prompt and punctual transportation to marketplaces. The inadequate road network in Kenya significantly impedes the accessibility of marketing opportunities (Tadesse et al., 2015).

In recent years, the African continent has witnessed a rapid expansion of internet usage, accompanied by a significant increase in the prevalence of mobile phones. These technical advancements have quickly established mobile phones as the most widely adopted gadget in the history of Africa, with their popularity continuing to expand. Furthermore, the advent of mobile phones and the internet has facilitated several advancements in various domains (Evans, 2018). Digital payments, such as mobile money, have been found to provide various advantages to farmers, actors in the agricultural value chain, and rural communities. These benefits include enhanced security in transactions, increased access to investment opportunities, the ability to save, and ultimately, the growth of agribusiness (Potnis et al., 2017; Schuster, 2017; Evans, 2018a; Kabbiri et al., 2018; Shepherd et al., 2018).

There has been a growing interest and positive outlook regarding the potential of mobile phone-enabled services to enhance the efficiency and effectiveness of information dissemination among farmers in rural areas of Africa. These services aim to facilitate the timely exchange and utilization of agricultural information, encompassing crucial decisions related to land preparation, planting, irrigation, weeding, harvesting, storage, and marketing (Muriithi

et al., 2009; Kabbiri et al., 2018). Consequently, a range of innovations that use mobile phones in the broadcast of agricultural information to farmers have been devised at local, national, and regional levels throughout Africa in response to these conjectures. An illustration of this may be seen in the operations of the Ethiopian Commodity Exchange (ECX), which effectively disseminates real-time information regarding commodity prices to farmers. This is achieved through the direct provision of market data to farmers via electronic display boards located at 31 centers around Ethiopia, as well as through the ECX website. Market data is additionally disseminated by SMS and telephone communications. Additionally, the utilization of mobile phones for transmitting price data to its database is facilitated using the wireless application protocol.

According to Nyamba et al. (2012), the utilization of information and communication technologies (ICTs) holds significant potential for fostering agricultural growth in poor countries. Among the various kinds of ICTs, mobile phones have emerged as a particularly promising tool in this regard. Mobile phones serve as a means of connecting individuals to other individuals, information, markets, and services (Aker et al., 2010). They are gaining significance among agro-based entrepreneurs as a form of infrastructure that enhances the efficiency of agricultural markets, facilitates investment, and contributes to empowerment.

Mutungu et al. (2016) established that the utilization of mobile phones in the context of market-oriented farming, along with the presence of supportive ICT rules and policies as well as sufficient infrastructure, has a beneficial impact on rural livelihood outcomes. According to Haruna et al. (2013), novel methods are offered to extension agents for effectively engaging farmers residing in remote rural regions, which have historically posed significant challenges for communication, particularly in developing nations.

Rural farmers in developing nations have documented several advantages arising from the utilization of mobile phones inside their agricultural enterprises. Notably, the reduction of trip expenses, time-saving measures, and improved market accessibility emerge as prominent outcomes. Mobile phones have been found to have a discernible impact on various aspects, such as the expansion of social connections and opportunities, enhanced market accessibility, and improved efficiency leading to higher productivity (Martin et al., 2011).

According to Chhachhar et al. (2014), the utilization of mobile phones by farmers has been found to result in energy and time savings, ultimately leading to improvements in their revenue. This platform facilitates direct communication between farmers, market brokers, and consumers, enabling farmers to sell their products at favorable pricing. Despite the fact that there is a paucity of information on the agricultural uses of mobile phones by these farmers, there is a dearth of information on the agricultural uses of mobile phones by these farmers (Asa, 2015). This study aimed to address the existing knowledge gap by examining the effects of mobile phone-enabled services on smallholder farmers' access to agricultural information in Bungoma County, Kenya.

## II. METHODOLOGY

The research was conducted within three sub-counties located in Bungoma County, Kenya. The aforementioned sub-counties encompassed Tongaren, Mt. Elgon, and Bumula. The selection of the three sub-counties for this study was deliberate and based on specific criteria. Bumula was chosen due to its high population density and limited agricultural potential. Tongaren was selected as it represents a cosmopolitan area with moderate to high agricultural potential. Lastly, Mt. Elgon was included in the study as it is known for being a vegetable growing zone (BCIDP, 2013). The study adopted cross-sectional and correlational research designs. The target population was 395,108, while the study population was 118,533. Using Yamane's formula, the sample size was computed to give a sample size of 400 respondents that were sampled using stratified random sampling. The collected data were analyzed using descriptive and inferential statistics. The descriptive statistics include frequency, percentage, and mean scores, while the hypothesis test was done using regression and chi-square tests, and findings were presented in the form of figures and tables.

## III. FINDINGS & DISCUSSIONS

### 4.1 Demographic Characteristics

The study sought to investigate selected demographic characteristics. The findings were presented in Table 1.

**Table 1**  
Shows the Demographic Characteristics of the Smallholder Farmers in Bungoma County

|                     | Sub-county |       |          |       |           |       | Total | F     | %             | X <sup>2</sup> | P |
|---------------------|------------|-------|----------|-------|-----------|-------|-------|-------|---------------|----------------|---|
|                     | Bumula     |       | Tongaren |       | Mt. Elgon |       |       |       |               |                |   |
|                     | F          | %     | F        | %     | F         | %     | F     | %     |               |                |   |
| <b>Gender</b>       |            |       |          |       |           |       |       |       |               |                |   |
| Female              | 66         | 38.9% | 66       | 45.5% | 30        | 35.6% | 162   | 40.6% | <b>2.478</b>  | <b>0.290</b>   |   |
| Male                | 104        | 61.1% | 79       | 54.5% | 55        | 64.4% | 238   | 59.4% |               |                |   |
| <b>Age</b>          |            |       |          |       |           |       |       |       |               |                |   |
| Below 20            | 4          | 2.2%  | 0        | 0.0%  | 0         | 0.0%  | 4     | 0.9%  |               |                |   |
| 21-40               | 104        | 61.1% | 79       | 54.5% | 41        | 48.9% | 224   | 56.1% | <b>8.774</b>  | <b>0.187</b>   |   |
| 41-60               | 51         | 30.0% | 53       | 36.4% | 40        | 46.7% | 144   | 35.8% |               |                |   |
| Above 60            | 11         | 6.7%  | 13       | 9.1%  | 4         | 4.4%  | 28    | 7.1%  |               |                |   |
| <b>Status</b>       |            |       |          |       |           |       |       |       |               |                |   |
| Single              | 47         | 27.8% | 21       | 14.3% | 6         | 6.7%  | 74    | 18.4% |               |                |   |
| Married             | 113        | 66.7% | 109      | 75.3% | 69        | 82.2% | 291   | 73.1% |               |                |   |
| Separated           | 4          | 2.2%  | 2        | 1.3%  | 0         | 0.0%  | 6     | 1.4%  | <b>15.127</b> | <b>0.57</b>    |   |
| Widow               | 6          | 3.3%  | 9        | 6.5%  | 6         | 6.7%  | 21    | 5.2%  |               |                |   |
| Divorced            | 0          | 0.0%  | 4        | 2.6%  | 4         | 4.4%  | 8     | 1.9%  |               |                |   |
| <b>Education</b>    |            |       |          |       |           |       |       |       |               |                |   |
| No formal education | 4          | 2.2%  | 0        | 0.0%  | 8         | 8.9%  | 12    | 2.8%  |               |                |   |
| Primary education   | 11         | 6.7%  | 13       | 9.1%  | 26        | 31.1% | 50    | 12.7% | <b>51.935</b> | <b>0.001</b>   |   |
| Secondary education | 83         | 48.9% | 34       | 23.4% | 42        | 48.9% | 159   | 39.6% |               |                |   |
| College             | 72         | 42.2% | 98       | 67.5% | 9         | 11.1% | 179   | 44.8% |               |                |   |
| <b>Income</b>       |            |       |          |       |           |       |       |       |               |                |   |
| <10000              | 98         | 57.8% | 55       | 37.7% | 60        | 71.1% | 213   | 53.3% |               |                |   |
| 10000-20000         | 44         | 25.6% | 59       | 40.3% | 21        | 24.4% | 124   | 30.7% |               |                |   |
| 21000-30000         | 15         | 8.9%  | 9        | 6.5%  | 4         | 4.4%  | 28    | 7.1%  | <b>19.875</b> | <b>0.011</b>   |   |
| 31000-40000         | 11         | 6.7%  | 13       | 9.1%  | 0         | 0.0%  | 24    | 6.1%  |               |                |   |
| >40000              | 2          | 1.1%  | 9        | 6.5%  | 0         | 0.0%  | 11    | 2.8%  |               |                |   |

From this table, there were more males 59.4% as compared to females 40.6%. Chi-square test of variation was conducted to determine whether there were statistically significant differences (when  $p > 0.05$ , there are no statistically significant differences and when  $p < 0.05$ , there are statistically significant differences). Chi-square test of variation in the distribution of gender ( $X^2_{2,0.05} = 2.478$ ) showed that there was no significant ( $p > 0.05$ ) variation between gender distribution and the sub counties were similar in terms of age as shown in Table 1, the largest proportion of smallholder farmers were middle-aged 56.1%, with remaining divided between the elderly adults 35.8% and older adults 7.1% categories. Small holder farmers that were below 20 years only accounted for 0.9%. Chi-square test of variation in the distribution of age ( $X^2_{6,0.05} = 8.774$ ) showed that there was no significant ( $p > 0.05$ ) variation between age distribution and the sub counties. The results in this table also indicates that nearly three quarters 73.1% of the smallholder farmers were married, 18.4% were single, 5.2% were widows, 1.9% were divorced while 1.4% of the smallholder farmers were separated. Chi-square test of variation in the distribution of marital status ( $X^2_{8,0.05} = 15.127$ ) showed that there was no significant ( $p > 0.05$ ) variation between marital status distribution and the sub counties. Respondents' education levels included both who attended and completed a particular educational level.

According to the table, nearly half of the smallholder farmers attended college 44.8% with over a quarter 39.6% had secondary school education. 12.7% of the smallholder farmers had primary education while only 2.8% of the



farmers had no formal education. Tongaren had the largest percentage of smallholder farmers who attended and completed college education 67.5%. In comparison of the three Sub counties, Bumula and Tongaren had largest percent of smallholder farmers with a secondary education 48.9% respectively. Chi-square test of variation in the level of education ( $X^2_{6,0.05} = 2.478$ ) showed that there was a significant ( $p < 0.05$ ) variation between the level of education and the sub counties. From table 1, more than half 53.3% of the smaller holder farmers had an income of less than Kshs. 10,000. Nearly one-third 30.7% of the smallholder farmers had an income of between Kshs. 10,000-20,000. It was observed that 7.1% of the small holder farmers had an income of between Kshs. 21,000-30,000, 6.1% of them had an income of between Kshs. 31,000-40,000 while only 2.8% of the smallholder farmers indicated that they had an income of Kshs. 40,000 and above. Chi-square test of variation in the distribution of smallholder farmers income levels ( $X^2_{8,0.05}=19.875$ ) showed that there was a significant ( $p<0.05$ ) variation between smallholder farmers income levels and the sub counties.

## 4.2 Descriptive Statistics

### 4.2.1 Phone Ownership and Duration of Ownership

Results in Table 2 shows phone ownership and duration of ownership by smallholder farmers in Bungoma County.

**Table 2**

*Phone Ownership and Duration of Ownership by Smallholder Farmers in Bungoma County*

|                           |                     | Sub-county |       |          |       |           |        |       |       | X <sup>2</sup> P |              |
|---------------------------|---------------------|------------|-------|----------|-------|-----------|--------|-------|-------|------------------|--------------|
|                           |                     | Bumula     |       | Tongaren |       | Mt. Elgon |        | Total |       |                  |              |
|                           |                     | F          | %     | F        | %     | F         | %      | F     | %     |                  |              |
| Have a mobile phone       | Yes                 | 168        | 98.9% | 139      | 96.1% | 85        | 100.0% | 392   | 98.1% |                  |              |
|                           | No                  | 2          | 1.1%  | 6        | 3.9%  | 0         | 0.0%   | 8     | 1.9%  | <b>3.263</b>     | <b>0.515</b> |
| Period of phone ownership | <less than 12months | 17         | 10.0% | 15       | 10.4% | 8         | 8.9%   | 40    | 9.9%  |                  |              |
|                           | 12-24 months        | 36         | 21.1% | 28       | 19.5% | 8         | 8.9%   | 72    | 17.9% | <b>7.488</b>     | <b>0.278</b> |
|                           | 25-36 months        | 30         | 17.8% | 13       | 9.1%  | 26        | 31.1%  | 69    | 17.5% |                  |              |
|                           | >36months           | 87         | 51.2% | 88       | 61.0% | 43        | 51.1%  | 218   | 52.4% |                  |              |

Nearly all 98.1% of the smallholder farmers indicated that they owned phones while only 1.9% of the smallholder farmers did not own phones. It was also established that more than half 52.4% of the smallholder farmers indicated that they owned the phones for more than 36 months. Almost an equal number of smallholder farmers 17.9% and 17.5% indicated that they owned the phones for a period between 12-24 months and 25-36 months respectively while only 9.9% of the smallholder farmers had a phone for a period less than 12 months. Chi-square test of variation in the distribution of smallholder farmers having a phone ( $X^2_{4,0.05} = 3.263$ ) showed that there was no significant ( $p > 0.05$ ) variation between smallholder farmers' phone ownership and the sub counties. Chi-square test of variation in the distribution of how long smallholder had a phone ( $X^2_{6,0.05} = 7.488$ ) showed that there was no significant ( $p < 0.05$ ) variation between smallholder farmer's period of phone ownership and the sub counties. This finding indicates that a significant proportion of smallholder farmers had considerable familiarity with mobile phones, implying that mobile phones could potentially serve as a means to disseminate agricultural knowledge. The utilization of mobile phone-enabled services for accessing agricultural information holds promising potential for widespread adoption among smallholder farmers. According to a study conducted in Nigeria on the utilization of cell phones in the agricultural sector, it was revealed that 98.7% of the participants had access to mobile phones (Asa et al., 2017).

### 4.2.2 Network Service and Network Quality For Smallholder Farmers

Table 3 shows the network service and network quality for smallholder farmers in Bungoma County.

**Table 3**

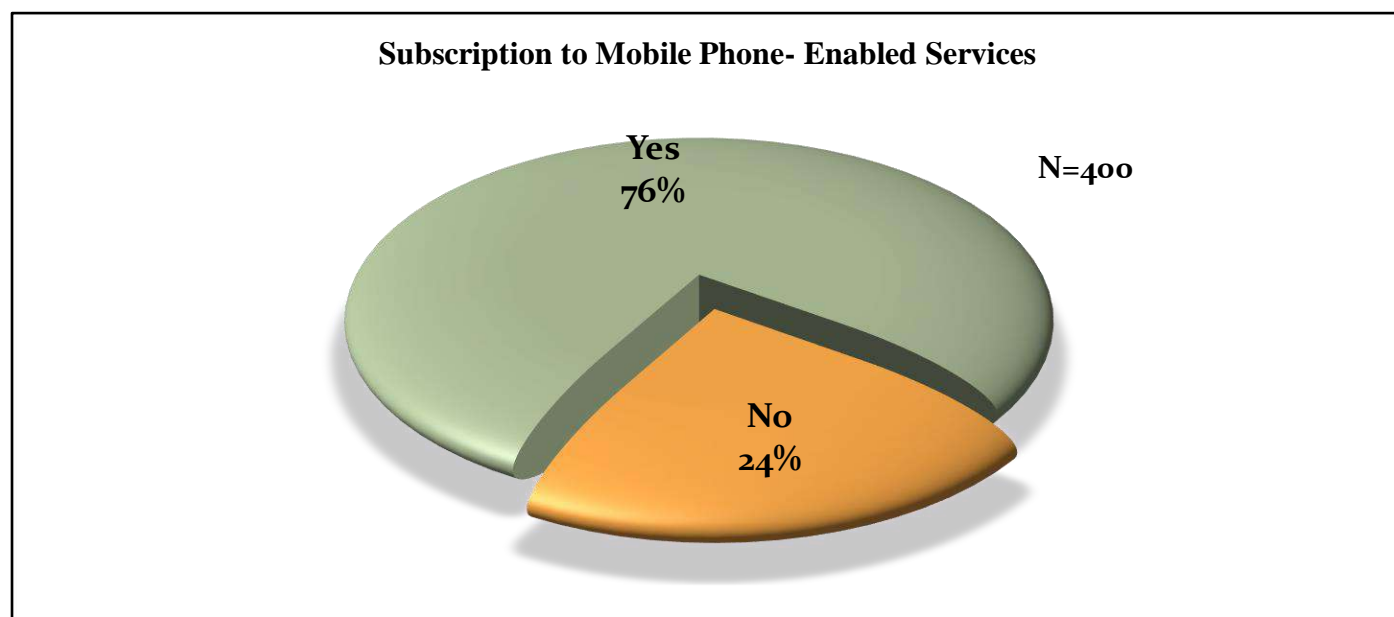
*Network Service and Quality for Smallholder Farmers in Bungoma County*

|                 |           | Sub-county |       |          |       |           |       |       |       | X <sup>2</sup> | P     |
|-----------------|-----------|------------|-------|----------|-------|-----------|-------|-------|-------|----------------|-------|
|                 |           | Bumula     |       | Tongaren |       | Mt. Elgon |       | Total |       |                |       |
|                 |           | F          | %     | F        | %     | F         | %     | F     | %     |                |       |
| Safaricom       |           | 144        | 45.9% | 112      | 35.6% | 58        | 18.5% | 314   | 78.5% |                |       |
| Airtel          |           | 24         | 30.6% | 42       | 53.1% | 13        | 16.3% | 79    | 19.8% | 2.456          | 0.673 |
| Telkom          |           | 3          | 50.0% | 2        | 25.0% | 2         | 25.0% | 7     | 1.7%  |                |       |
| Network quality | Poor      | 1          | 1.1%  | 1        | 1.3%  | 3         | 6.7%  | 5     | 2.4%  |                |       |
|                 | Average   | 38         | 42.2% | 30       | 40.0% | 18        | 40.0% | 86    | 41.0% | 3.344          | 0.765 |
|                 | Good      | 49         | 54.4% | 42       | 56.0% | 24        | 53.3% | 115   | 54.8% |                |       |
|                 | Very good | 2          | 2.2%  | 2        | 2.7%  | 0         | 0.0%  | 4     | 1.9%  |                |       |

From the table, majority 78.5% of the smallholder farmers indicated that they were using Safaricom, 19.8% of them were using Airtel while only 1.6% of the farmers were using Telkom. More than half 54.8% of the smallholder farmers indicated that the quality of network was good another 41.0% of the farmers stated that the network was average while 2.4% of the smallholder farmers stated that their network was poor and another 1.9% of the farmers indicated that their network was very good. Chi-square test of variation in the distribution of smallholder farmers in the network service ( $X^2_{4,0.05} = 2.456$ ) showed that there was no significant ( $p > 0.05$ ) variation between smallholder network service providers and the sub counties. Chi-square test of variation in the distribution of smallholder farmers’ responses on network quality ( $X^2_{6,0.05} = 3.344$ ) showed that there was no significant ( $p > 0.05$ ) variation between smallholder farmers’ responses on network quality and the sub counties. The results agree with POTRAZ, (2018) which reported that 87.7% of the total population was active mobile subscribers. The rate of mobile network subscribers had increased by 3.1 when compared to the first quarter of 2018 (POTRAZ, 2018). Majority of the farmers in the study area use Safaricom hence providing reliable communication attributing to the fact to the network quality.

**4.2.3 Subscription to Mobile Phone Enabled Services**

Figure 1 shows the findings on subscription to mobile phone enabled services by smallholder farmers in Bungoma County



**Figure 1**

*Subscription to Mobile Phone Enabled Services by Smallholder Farmers in Bungoma County*

It is shown that more than three quarters 76% of the smallholder farmers stated that they were subscribed to a mobile phone enabled service while nearly a quarter 24% of the stallholder farmers indicated that they had not

subscribed to any mobile enabled services. This shows that farmers have access to a range of mobile phone enabled services, although most services remain at small scale adoption. About three quarter of the respondents agreed to have registered with One Acre Fund which has penetrated all parts of Bungoma County. The NGO works with the small holder farmers to equip them with supplies and training the need to thrive. One Acre Funds customer engagement team uses SMS to ensure everyone in the field who is registered with the organization stay connected. Farmers use mobile phones to make loan repayment, sign up for inputs and services, and view trainings.

#### 4.2.4 Smallholder Farmers Mobile Phone Use

Table 4 shows smallholder farmers' mobile phone use for various purposes in Bungoma County.

**Table 4**

*Smallholder Farmers Mobile Phone Use in Bungoma County, Kenya.*

|   |     | Sub-county |       |          |       |           |        |       |       | X <sup>2</sup> | P     |
|---|-----|------------|-------|----------|-------|-----------|--------|-------|-------|----------------|-------|
|   |     | Bumula     |       | Tongaren |       | Mt. Elgon |        | Total |       |                |       |
|   |     | F          | %     | F        | %     | F         | %      | F     | %     |                |       |
| Communicate agricultural information to and from various stakeholders | Yes | 20         | 74.1% | 21       | 56.8% | 7         | 77.8%  | 48    | 65.8% | 2.738          | 0.254 |
|   | No  | 7          | 25.9% | 16       | 43.2% | 2         | 22.2%  | 25    | 34.2% |                |       |
| To seek research information  | Yes | 14         | 60.9% | 17       | 56.7% | 5         | 83.3%  | 36    | 61.0% | 1.495          | 0.474 |
|   | No  | 9          | 39.1% | 13       | 43.3% | 1         | 16.7%  | 23    | 39.0% |                |       |
| To communicate with fellow farmers                                    | Yes | 43         | 93.5% | 15       | 46.9% | 4         | 100.0% | 62    | 75.6% | 23.582         | 0.000 |
|   | No  | 3          | 6.5%  | 17       | 53.1% | 0         | 0.0%   | 20    | 24.4% |                |       |
| To promote interpersonal relationships                                | Yes | 52         | 88.1% | 61       | 89.7% | 28        | 100.0% | 141   | 91.0% | 3.488          | 0.175 |
|   | No  | 7          | 11.9% | 7        | 10.3% | 0         | 0.0%   | 14    | 9.0%  |                |       |

It was observed that more than half 65.8% of the farmers used the phones to communicate agricultural information to and from various stakeholders while 34.2% of the farmers did not use their phones for this purpose. Chi-square test revealed that there were no statistically significant differences ( $p < 0.05$ ) in use of mobile phones in communicating agricultural information to and from various stakeholders. It was observed that 61.0% of the farmers used their phones to seek research information while 39.0% did not use it for the same purpose. Chi-square test revealed that there were no statistically significant differences ( $p > 0.05$ ) in use of mobile phones to seek research information. It was also observed that three quarters 75.6% of the farmers used phones to communicate with fellow farmers while another 24.4% of the farmers did not use it for this purpose. Chi-square test revealed that there were statistically significant differences ( $p < 0.05$ ) in use of mobile phones to communicate with fellow farmers. Finally, 91.0% of the smallholder farmers indicated that they used their phones to promote interpersonal relationships while 9.0% did not use it for this purpose, however, Chi-square test revealed that there were no statistically significance differences ( $p > 0.05$ ) in the use of mobile phones to promote interpersonal relationships. According to Jensen (2010), mobile phones facilitate the connection between smallholder farmers and other stakeholders throughout the agricultural value chain, including dealers, transporters, input suppliers, mobile service providers, and researchers. This connectivity effectively eliminates the necessity for farmers to physically travel in search of information. Aker et al. (2011) conducted a study that revealed the positive impact of utilizing mobile phone-enabled services on various aspects, including improved market accessibility, access to information on diseases and climate, enhanced access to extension services, establishment of market links and distribution networks, and increased access to financial resources.

#### 4.2.5 Mobile Phone Use frequency

Table 5 shows the frequency of mobile phone use for various purposes in Bungoma County.

**Table 5***Frequency of Mobile Phone Use for Various Purposes by smallholder farmers in Bungoma County*

|  | <b>Very often<br/>(every<br/>day)</b> | <b>Often (4-<br/>6days)</b> | <b>Occasionally<br/>(2-3 days)</b> | <b>Rarely<br/>(1day)</b> | <b>Never<br/>used</b> | <b>Mean</b> | <b>Std.<br/>Dev.</b> |
|--|---------------------------------------|-----------------------------|------------------------------------|--------------------------|-----------------------|-------------|----------------------|
| Send information to various agricultural stakeholders  | 13.30%                                | 11.00%                      | 19.50%                             | 28.10%                   | 28.10%                | 3.47        | 1.356                |
| Seek research information  | 19.80%                                | 15.60%                      | 19.30%                             | 26.90%                   | 18.40%                | 3.08        | 1.398                |
| Talk with fellow farmers about farming issues  | 39.20%                                | 15.60%                      | 25.90%                             | 16.00%                   | 3.30%                 | 2.29        | 1.23                 |
| Talk to fellow farmers about social issues   | 41.50%                                | 23.10%                      | 19.80%                             | 11.80%                   | 3.80%                 | 2.13        | 1.189                |
| Talk with parents about farming issues   | 44.80%                                | 9.50%                       | 15.70%                             | 19.50%                   | 10.50%                | 2.41        | 1.472                |
| Talk with parents to enhance interpersonal relationships                                     | 42.90%                                | 12.40%                      | 22.40%                             | 17.10%                   | 5.20%                 | 2.3         | 1.316                |
| Call extension officer for help on farming issues  | 13.70%                                | 10.80%                      | 17.00%                             | 40.10%                   | 18.40%                | 3.39        | 1.285                |
| Talk to buyers of particular agricultural products   | 16.00%                                | 14.60%                      | 27.40%                             | 31.60%                   | 10.40%                | 3.06        | 1.234                |
| Talk to researchers about new agricultural technology  | 8.10%                                 | 14.20%                      | 19.00%                             | 20.90%                   | 37.90%                | 3.66        | 1.326                |
| Talk to extension officers about how to carry out agricultural management practices          | 10.80%                                | 18.40%                      | 22.60%                             | 31.60%                   | 16.50%                | 3.25        | 1.242                |
| Talk to input suppliers about availability of certain agricultural inputs                    | 5.70%                                 | 22.60%                      | 22.20%                             | 41.00%                   | 8.50%                 | 3.24        | 1.073                |
| Talk to marketing agents about prices of a particular agricultural product at a certain time | 6.60%                                 | 24.10%                      | 27.80%                             | 32.10%                   | 9.40%                 | 3.14        | 1.091                |
| Talk to a friend to enhance interpersonal relationships                                      | 47.60%                                | 19.30%                      | 16.00%                             | 15.10%                   | 1.90%                 | 2.04        | 1.19                 |

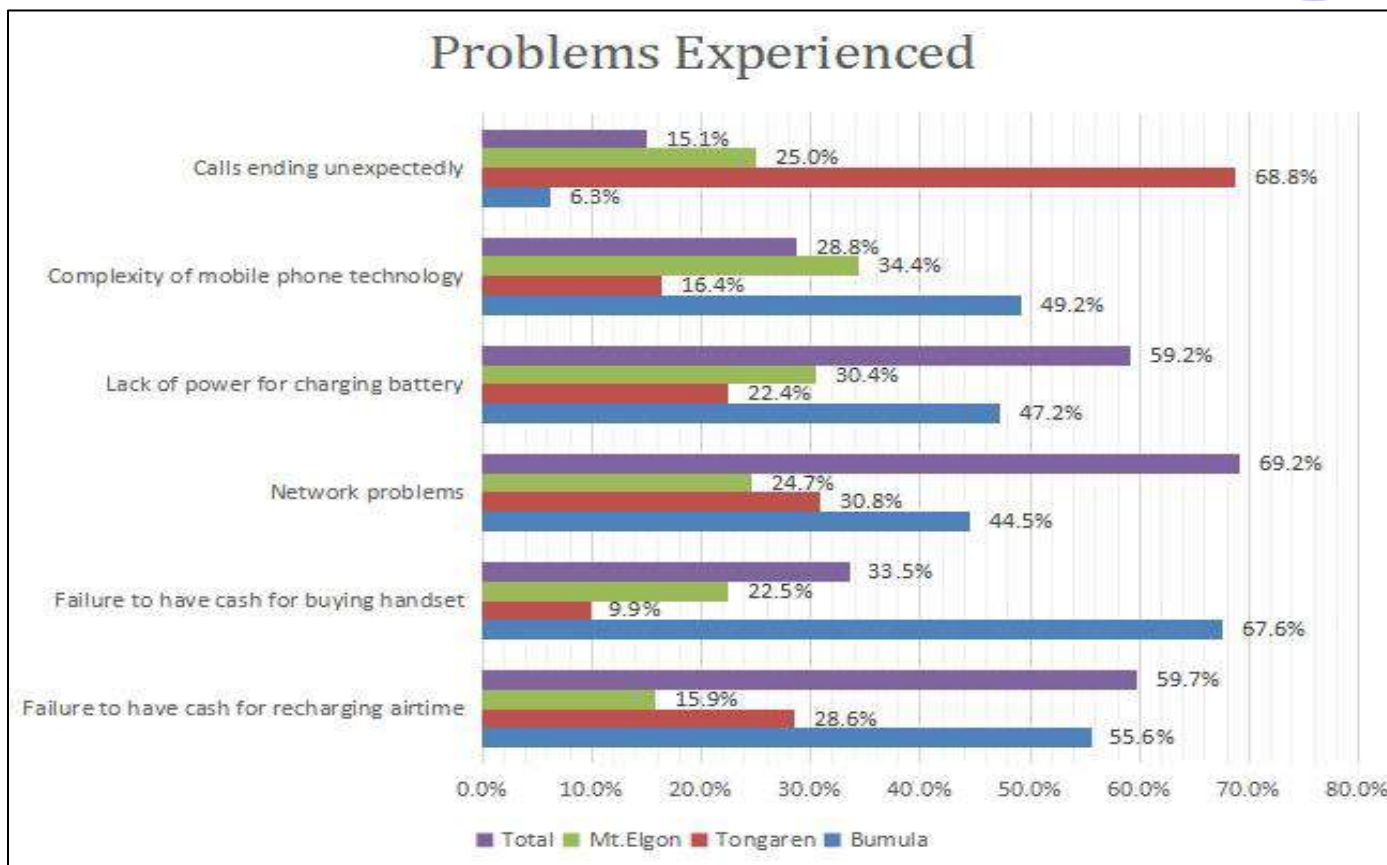
Source: *field survey*, 2022

From the table, more than a quarter (28.1%) of the smallholder farmers indicated that they rarely and never used their mobile phones to send information to various agricultural stakeholders, another 26.9% of the smallholder farmers indicated that they rarely used their phones to seek research information. It was observed that 39.2% of the smallholder farmers frequently used their mobile phones to talk with fellow farmers about farming issues. Another 41.5% of the smallholder farmers very often used their mobile phones to talk to fellow farmers about social issues. The results of the study indicate that the participants engaged in regular communication using mobile phones. A considerable proportion of farmers reported frequent engagement in social and interpersonal communication with friends, parents, and fellow farmers. This finding is consistent with the study conducted by Khan et al. (2019) in Punjab, Pakistan, which examined the mobile phone usage habits among farmers. The findings of the study indicated that a significant proportion of farmers (73.3%) employ mobile phones use as a means of communication with their family, relatives, and friends. This observation suggests that majority of the farmers are not fully utilizing mobile phone technology for agricultural purposes as indicated by 26.7% of the respondents. The increasing prevalence of personal contact utilization also suggests that farmers are actively engaging in the sharing of farm knowledge and experience within their familial, peer, and social networks. The robust communication observed within tight-knit social networks provides individuals with a feeling of reassurance in relation to the exchange of agricultural expertise and the acquisition of necessary information.

#### 4.2.6 Problems experienced by Smallholder Farmers

Figure 2 shows the problems experienced by smallholder farmers in Bungoma County.





**Figure 2**  
*Problems Experienced by Farmers in Accessing Agricultural Information*

It was observed that 69.2% of the farmers experienced network problems, 59.7% of the farmers indicated failure to have cash for recharging airtime, 59.2% of the farmers stated that there was lack of power for charging battery. 33.5% of the farmers stated that they did not have cash for buying handset, 28.8% faced problems of complexity of phone technology and only 15.1% of the farmers stated that calls ended unexpectedly. There are certain factors that constrain the full utilization of the potential of uses of mobile based services mainly by small holder farmers. The findings revealed that the greatest problems that hindered farmers in the study area in accessing agricultural information were network problems and power. The findings of this study agree with the findings of Fox et al. (2001) who established that infrastructural aspects such as network problems and lack of power are limiting factors to the use of mobile phones to communicate agricultural information. Infrastructure is one of the big challenges to develop ICT solutions in developing countries. It was observed that electricity power supply in Bungoma County is available only at the main urban centres and few residential homes of progressive farmers in close proximity to urban centers or highways. Generally, there is lack of evenly distributed main electricity to the village level. Because of lack of access to electricity, the majority of farmers have devised ways to use mobile phone in this context by switching off when not expecting urgent SMS and calls. While others had spare battery so that when one battery is being used the spare is being charged at the shopping center.

The same was observed by Ahmed et al. (2016) that farmers in rural areas in developing countries have very low income so affordability to purchase the hand set and availability of the required services with internet is a key issue. Cash for buying handsets and charging airtime was seen as a challenge agreeing with Mascarenhas (2010) who said smallholder farmers are still unaware of mobile phone technology because of economic reasons. Mostly the income of the farmers of rural areas is low and most of them are very poor and cannot afford mobile phones. Additionally, these types of the mobile phone application require advanced smartphones along with internet. Smartphones are expensive and out of the purchasing power of the farmers and high-speed internet charges are very high. Therefore, smartphone with high internet is difficult to afford as the poor farmers are ever fighting for their basic needs. Previous research conducted yielded comparable findings, attributing the primary cause of unaffordability to high costs. Furthermore, the study posited that both governments and mobile firms bear responsibility for the cost-related issues and service



deficiencies. Wolf (2001) documented that the expense associated with accessing information and communication technologies (ICTs) in economically disadvantaged nations was frequently prohibitive.

### 4.3 Correlation between Mobile Phone Enabled Services and Accessing Agricultural Information

Table 6 shows the correlation between mobile phone enabled services and accessing agricultural information in Bungoma County.

**Table 6**

*Correlation between Mobile Phone-enabled Services and Accessing Agricultural Information*

|                               |                     | Accessing agricultural information |
|-------------------------------|---------------------|------------------------------------|
| Mobile phone-enabled services | Pearson Correlation | .739**                             |
|                               | Sig. (2-tailed)     | .000                               |
|                               | N                   | 400                                |

\*\*Correlation is significant at 0.01 level (2 tailed)

The results showed that there was a strong positive association ( $r=.739$   $n=400$   $p<.01$ ) between influence of mobile phone-enabled services and accessing agricultural information.

### 4.4 Regression analysis

In order to establish the extent of influence of mobile phone-enabled services and accessing agricultural information in Bungoma county the study used a coefficient of determination (R<sup>2</sup>) using regression analysis as shown in Table 7.

**Table 7**

*Mobile Phone-enabled Services and Accessing Agricultural Information*

| Model Summary |                   |          |                   |                            |
|---------------|-------------------|----------|-------------------|----------------------------|
| Model         | R                 | R Square | Adjusted R Square | Std. Error of the Estimate |
| 1             | .739 <sup>a</sup> | .546     | .543              | .61169                     |

Predictors: (*Constant*), Mobile phone-enabled services, Dependent variable: Accessing agricultural information

From Table 7, it is evident that the R value which shows the correlation between mobile phone-enabled services and accessing agricultural information is at .739 which is 73.9%. This shows that there is an influence between mobile phone-based services as a predictor and accessing agricultural information in Bungoma County. The coefficient of determination (R<sup>2</sup>) is .546 which represents 54.6% variation of accessing agricultural information as a result of mobile phone-enabled services. This means that if mobile phone-enabled services are used there will be a 54.6% increase in accessing agricultural information. Therefore, stakeholders in the agricultural sector should explore ways of enhancing mobile-phone enabled services in accessing agricultural information so that smallholder farmers in Bungoma County can benefit maximumly from such services and improve on their productivity.

**Table 8**

*Shows the Analysis of Variance*

**Table 8: ANOVA for Mobile phone-based services and accessing agricultural information**

| Model |            | Sum of Squares | df  | Mean Square | F       | Sig.              |
|-------|------------|----------------|-----|-------------|---------|-------------------|
| 1     | Regression | 159.941        | 1   | 159.941     | 427.649 | .000 <sup>b</sup> |
|       | Residual   | 149.226        | 399 | .374        |         |                   |
|       | Total      | 309.136        | 400 |             |         |                   |

a. Dependent Variable: Mobile phone-based services

b. Predictors: (*Constant*), Accessing agricultural information

As shown in Table 8, the high F-statistic (427.649) and the small p-value (0.000) indicates that the model is statistically significant. This means that mobile phone-enabled services are a strong predictor of accessing agricultural information in Bungoma County.

**Table 9***Regression Coefficients*

| Model |                               | Unstandardized Coefficients |            | Standardized Coefficients | t      | Sig. |
|-------|-------------------------------|-----------------------------|------------|---------------------------|--------|------|
|       |                               | B                           | Std. Error | Beta                      |        |      |
| 1     | (Constant)                    | 1.177                       | .072       |                           | 16.335 | .000 |
|       | Mobile phone enabled services | .133                        | .018       | .457                      | 7.253  | .000 |

a. Dependent Variable: Accessing agricultural information

From Table 9, a unit increase in mobile phone-enabled services causes an increase of 0.457 in accessing agricultural information. This demonstrates that mobile phones enhance efficiency by reducing the need for unnecessary visits, hence saving time. Positive engagement with stakeholders has been found to result in a heightened utilization of mobile phones as a means of disseminating agricultural information, as indicated by other researchers. According to Wyche et al (2016), acquisition of agricultural information by a single actor, such as a farmer, through mobile phones necessitates collaboration with other stakeholders. The results are consistent with the findings of Verma et al. (2018), which indicate a positive correlation between the acquisition of agricultural knowledge and the subsequent improvement in farmers' efficiency.

## V. CONCLUSIONS & RECOMMENDATIONS

### 5.1 Conclusions

It is clear from the findings that majority of the small holder farmers in the study area had mobile phone possession. Access to agricultural information through mobile phone enabled services is easier and faster than traditional agricultural advisory services. Market information indicated the farmers' reliance on mobile phone-enabled communication in rural areas. This further indicated that easy access to market information and financial transaction through mobile phone has made farmers more connected to the mainstream. The findings reported that majority of small holder farmers had mobile phone possession but indicated very basic operating skills limited to calls and SMS only. Due to this limited aptitude of Mobile phone enabled services, farmers were unable to access information from various internet-based information sources like portals and websites. This may pose a huge challenge as most of the authentic information lies over these web-based sources and social media forums which need advanced operating skills.

### 5.2 Recommendations

Based on the findings of this study, there is need for training in advanced operating skills in the training of the farmers regarding use of mobile phone technologies through capacity building programmes. The government of Kenya in collaboration with county governments should increase efforts to improve on the rural infrastructure both for mobile phone service providers and the user farmer. To cater for those smallholder farmers who cannot afford credit and mobile data or subscribe to available platforms, the county government should provide financial support for the establishment of information centers at sub location agricultural extension offices. These centers will provide free Wi-Fi for farmers and farmers can visit these centers with their mobile phones to access agricultural information. The information centers should be the linking platform for farmers, extension officers, agricultural information dissemination platforms, network providers and all agricultural stakeholders in the county.

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