ADOPTION OF CLIMATE-SMART HORTICULTURE PRACTICES AND USE OF MOBILE PHONES IN TAITA-TAVETA COUNTY, KENYA

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ABSTRACT

Mobile phones have become the most commonly used tools in communication across various sectors and farmers have not been left behind. Previous studies have shown that farmers with mobile phones record higher agricultural productivity. However, there has been little empirical evidence on the use of mobile phone on climate-smart horticulture (CSH) and differences in CSH adoption behaviour between mobile phone users and non-users. This study aimed to characterize the adoption of CSH practices and mobile phone use among farmers. The study used primary data drawn from a focus group discussion and random sample of 403 green gram and tomato farmers in Taita-Taveta County, Kenya. Results reveal that 71% of the farmers adopted crop rotation while only 2% adopted crop insurance practices. Also, 97% of farmers own mobile phones and use them for social calls while 44% use them for CSH. The study showed that use of smartphone is positively related to the number of CSH practices adopted. More mobile phone users adopted CSH practices than non-users. Paired *t*-test results show that the adoption of CSH practices was significantly higher for mobile phone users than the non-users. There is need for the government to partner with software developers and telecommunication service providers to develop an integrated mobile phone-supported CSH software application to enhance farmer productivity.

Key words: mobile phone, climate-smart horticulture, green grams, tomatoes.

INTRODUCTION

Horticulture is the leading income earner to Kenyan farmers, contributing 31% of the total value earned from agriculture (KNBS, 2020). On the other hand, vegetables (including tomatoes) contribute 22% to domestic value of marketed horticultural crops (HCD, 2018). Specifically, 90% of tomatoes and green grams produced by smallholder farmers in Taita-Taveta county are sold for household income (Mohamed and Chege, 2019).

However, negative effects of climate change such as prolonged droughts and unpredictable rainfall distribution affects crop productivity (Nhemachena *et al*., 2020). For example, Northern and Western parts of Kenya may not be suitable for green gram production during March to May season due to shifts in climatic conditions (Mugo *et al*., 2020). This requires specific interventions such as use of well-adapted seed varieties, sustainable farming systems and agroforestry to make the areas conducive for tomato and green gram production. These interventions are referred to as climate-smart horticulture (CSH), since they have been shown to improve resilience to climate change effects and crop productivity (Amadu *et al*., 2020; Sahu, 2016; Thornton *et al*., 2018).

Mobile phones are useful tools in assisting farmers to understand and adopt CSH practices (Baumuller, 2016; Mittal and Hariharan, 2018). They reduce information gaps by allowing farmers to access real time information that fit their specific contexts (Etwire *et al*., 2017). Consequently, farmers with smartphones have been shown to access wide range of information (including technology simulations) related to modern farming techniques (Krell *et al*., 2021). Therefore, the role of mobile phone on CSH cannot be under-estimated. For instance, it has been shown that farmers use mobile phones to access information concerning weather, input and output prices, money transfer services, connect to other farmers and contacting extension agents (Etwire *et al*., 2017; Kirui *et al*., 2012; Mittal and Mehar, 2014).

In Taita-Taveta County, about 80% of farmers own a mobile phone (County Government of Taita-Taveta, 2018). However, little is known about how they apply their mobile phones in horticulture. Besides, there are different agro-ecological zones in the county under which farmers produce different crops and require different CSH interventions (Anuga *et al*., 2013; Jaetzold *et al*., 2010). Focusing on green grams and tomato crops would help reduce information deficit and contribute to agricultural development in the area.

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MATERIALS AND METHODS

Data sources and sampling procedure

The study used primary data collected from field surveys in Wundanyi, Mwatate and Taveta sub-counties in Taita-Taveta County. The three sub-counties were purposively selected due to high concentration of tomato and green gram farmers. Also, green grams and tomatoes are the most important crops for generating income in the three locations.

The sample size was calculated using a formula adapted from Cochran (1977). The formula is presented in equation (1).

$$n_o = \frac{Z^2pq}{e^2} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

where; n_0 is the sample size, Z is the *Z-critical* value at a particular confidence level, p is the maximum level of variance, q is *(1-p)* and e is the desired margin of error.

This study used 95.1% confidence level and 0.049 desired margin of error. The p was presumed to take a value of 0.5, since the disparity among CSH farmers was not known and the fact that green gram farmers' characteristics are slightly different from tomato farmers. Therefore, the sample size was calculated as shown in equation (2);

$$n_o = \frac{1.96^2 \times 0.5 \times 0.5}{0.049^2} = 400 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

This sample size was proportionately distributed among the three sub-counties in accordance with the 2019 Kenya population and housing census. Additional 20 (equivalent to 5%) farmers were added to cater for incomplete questionnaires and potential non-response.

Data was collected through focus group discussion (FGD) checklist questionnaire and a structured questionnaire. The FGD had eleven (11) members comprising tomato and green gram farmers, agricultural officers, agricultural input dealers, local administrator and credit provider. The discussion involved understanding the locally accepted meaning of climate change and climate-smart horticulture (CSH), CSH practices adopted in the area, evolution of mobile phone and its use in agriculture. This helped to gain broader insights on the study area.

Subsequently, a household survey was conducted whereby individual farmers were randomly selected and interviewed using semi-structured questionnaires. The questionnaire was used to collect information on socio-economic characteristics of the farmers, mobile phone use and climate-smart horticulture. Four hundred and fifteen (415) farmers participated in the household survey. However, during data cleaning, 12 questionnaires were found to be incomplete and hence not included in the analysis. Therefore, this study used a total of 403 filled questionnaires (59 from Wundanyi, 122 from Mwatate and 222 from Taveta sub-counties); 115 respondents were tomato farmers, 259 green gram farmers and 29 farmers produced both crops.

Data analysis

Bar graphs and tables were used to show the percentage of farmers who adopted CSH practices and used mobile phones for different purposes including CSH. On the other hand, Pearson's correlation analysis (Hung *et al*., 2018) was used to check for the relationship between the type of mobile phone used (basic feature phone, low-end smartphone and high-end smartphone) and the number of CSH practices adopted. To show this, the study applied Pearson's correlation coefficient (r_{xy}) shown in equation (3):

Given paired data $(x_1, y_1), \ldots, (x_n y_n)$ consisting of n pairs, r_{xy} was defined as;

$$r_{xy} = \frac{\sum_{i=1}^{n}(x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum_{i=1}^{n}(x_i - \bar{x})^2}\sqrt{\sum_{i=1}^{n}(y_i - \bar{y})^2}} \ldots\ldots\ldots (3)$$

where;

n is the sample size

x_i is the type of mobile phone and y_i is the number of CSH practices adopted.

$\bar{x}, \bar{y}$ are the means of x and y variables, respectively.

Equation (3) can be re-written as;

$$r_{xy} = \frac{\sum x_i y_i - n\bar{x}\bar{y}}{\sqrt{(\sum x_i^2 - n\bar{x}^2)}\sqrt{(\sum y_i^2 - n\bar{y}^2)}} \ldots\ldots\ldots (4)$$

In addition, one-way analogous analysis of variance (ANOVA) (Mai and Zhang, 2017) was used to compare the proportions of three groups of farmers including tomato, green gram and both crops. The procedure uses maximum likelihood method to estimate variation between and within groups. According to Mai and Zhang (2017), comparing group proportions for binary data has the same hypothesis as one-way ANOVA for continuous data but applies different models because the outcome variable (for binary data) does not have a normal distribution. Following this background, one-way analogous ANOVA table was used (Table I).

TABLE 1- ONE-WAY ANALOGOUS ANOVA FOR THE THREE GROUPS OF FARMERS

Source	Sum of variance	Degree of freedom	Test statistic	*p*-value
Between group	$SS_B = -2(\ell_{Mo} - \ell_{M1})$	$k-1$	$\tilde{D} = -2(\ell_{Mo} - \ell_{M1})$	$\Pr[\chi^2(k-1) \geq \tilde{D}]$
Within group	$SS_W = -2\ell_{M1}$	$n-k$		
Total	$SS_T = -2\ell_{Mo}$	$n-1$		

Source: Mai and Zhang (2017).

Paired *t*-test was used to measure the differences in CSH adoption between mobile phone users and non-users. The difference between mobile phone users and non-users was treated as a random sample drawn from a normal population with mean of $\mu_D = \mu max - \mu min$ and unknown standard deviation. The hypothesis tested using *t*-test was given as; H_0: There are no differences in climate-smart practice(s) adoption between mobile phone users and non-users (μmax=μmin) and H_1: More mobile phone users adopt climate-smart practice(s) than non-users (μmax > μmin).

RESULTS AND DISCUSSION

Climate-smart horticulture adoption characteristics

The results indicate that there is high relationship between adoption of CSH practices and different farmer types Table II. For instance, there were significant differences in the use of well-adapted seed variety, matching planting dates with weather information received, crop rotation, soil testing, terracing, agroforestry, use of live barriers, organic manure, mulching, farm ponds for water harvesting and storage and contour cultivation between the three types of farmers (producers of green grams, tomatoes and both crops). This is because farmers adopt CSH practices based on their environment and the context in which they operate (Lipper *et al*., 2014; Thornton *et al*., 2018).

In addition, the results imply that the type of crop produced largely determines the CSH practice(s) adopted. Farmers who produced tomatoes only and those who produced both green grams and tomatoes adopted more CSH practices than those who produced green grams only. But, there was no significant difference in adoption of crop insurance, crop diversification and mixed farming practices between the three types of farmers.

Pooled results in Figure 1 show that Taita-Taveta County farmers adopted CSH practices to different extents. This is because each type of crop and agro-ecological zone requires different interventions in terms of CSH practices (Aryal *et al*., 2018).

The results demonstrate that crop rotation was the most adopted practice with 71% of farmers practicing it. The high adoption of crop rotation practice is attributed to low income of farmers and the farmers' perception that crop rotation is the most effective method of controlling weeds, diseases and pests (Acheampong *et al*., 2021; He *et al*., 2008). On the other hand, only 2% of the farmers adopted crop insurance. Similar results were obtained by Nyabochwa (2015) who revealed that low crop insurance uptake was due to lack of awareness of such facility by farmers. Other practices such as terracing and use of well adapted seed variety were adopted by 54% and 50% of the farmers, respectively.

Crop diversification, mixed farming, agroforestry, use of compost manure, mulching, among others, were practiced by less than 50% of the farmers under study. This is because most farmers in the area rely on rain-fed agriculture, have low access to extension services and low income, which limits their farm practices (Fliegel and Kivlin, 1966; Kassie, 2014; Kemboi *et al*., 2020).

Farmers' climate-smart horticulture adoption behaviour

Figure 2 shows CSH adoption pattern exhibited by tomatoes and green gram farmers in Taita-Taveta County. The results revealed that about 55% of the farmers took up to 3 months, while 33% of them took more than 12 months

TABLE II- CLIMATE-SMART HORTICULTURE PRACTICES ADOPTED BY DIFFERENT TYPES OF FARMERS

CSH practices	Type of farmer		
	Green grams (%) (n =259)	*Tomatoes (%) (n=115)*	*Both green grams and tomatoes (%) (n =29)*
Well adapted seed variety	40.93[c]	66.09[b]	72.41[a]
Matching planting dates	16.22[c]	36.52[b]	41.38[a]
Crop rotation	62.93[c]	85.22[b]	93.10[a]
Use of cover crops	27.80[c]	42.61[a]	41.38[b]
Soil testing before fertilizer application	8.49[c]	30.43[b]	34.48[a]
Terracing	44.02[c]	73.04[a]	65.52[b]
Agro-forestry	41.70[c]	53.91[b]	65.52[a]
Live barriers such as Napier grass	16.60[c]	53.91[a]	27.59[b]
Mixed farming	44.02	52.17	55.17
Crop insurance	2.70	1.74	3.45
Crop diversification	46.72	51.30	58.62
Use of compost manure and organic fertilizers	33.98[c]	71.30[a]	55.17[b]
Mulching	27.80[c]	60.87[b]	65.52[a]
Minimum tillage	24.32[c]	24.35[b]	44.83[a]
Farm ponds for water storage	12.36[c]	42.61[b]	44.83[a]
Integrated Pest Management (IPM)	13.90[c]	48.70[a]	17.24[b]
Contour cultivation	23.55[c]	48.70[a]	44.83[b]

Note: [a, b, c] denotes significant differences (at 10% level or better) in climate-smart practice(s) between different types of crop farmers in descending order of magnitude.

to adopt the practice(s). This diverges from earlier claim by Rogers (1983) that majority of adopters lie between early majority and late majority. The results show a different pattern from that which was proposed by Rogers (1983), since less farmers lied between innovators and laggards.

Some factors that may have led to high number of early adopters include; awareness of climate change and CSH, social factors such as indigenous knowledge and farming experience (Pagliacci *et al*., 2020). In addition, Fliegel and Kivlin (1966) noted that innovations that are perceived to be less risky but rewarding are accepted swiftly and practiced by farmers. However, farmers who hesitate to put their money in agricultural innovations end up being laggards (Diederen *et al*., 2003).

Evolution and key drivers of mobile phone use among farming community in Taita-Taveta County

In the FGD that involved tomato and green gram farmers, agro-input dealers, local administrators and credit service providers, the participants described the evolution of mobile phone use and key drivers as shown in Table III. The focus group comprised 53% and 47% male and female participants, respectively, distributed between 24 and 57 years of age.

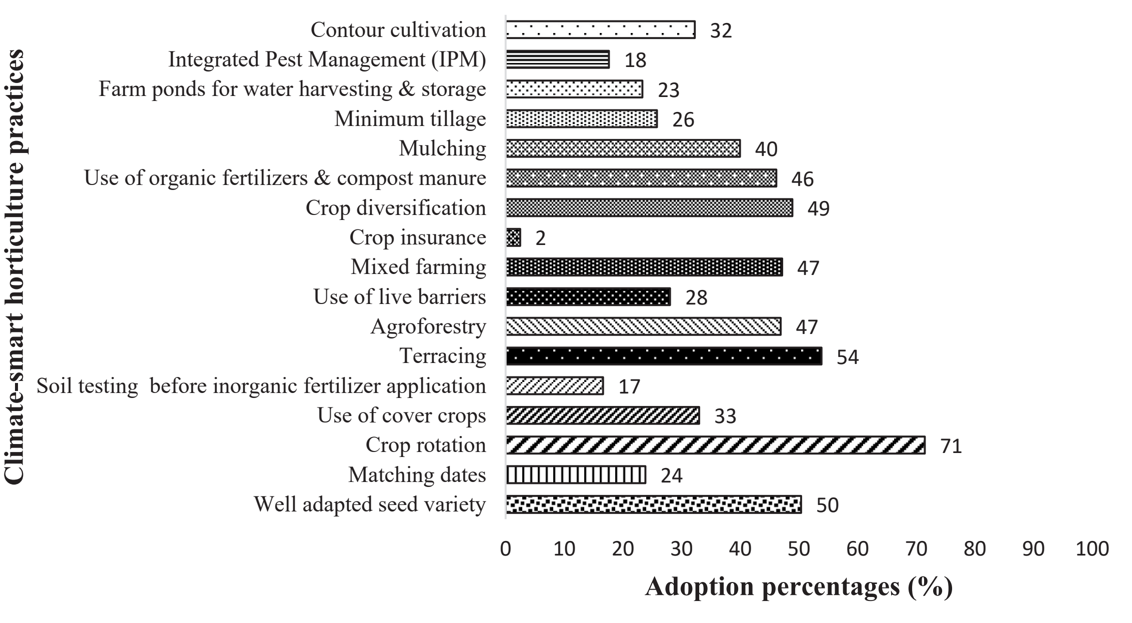

Figure 1: Percentage of farmers who adopted climate smart horticulture practices in Taita-Taveta County

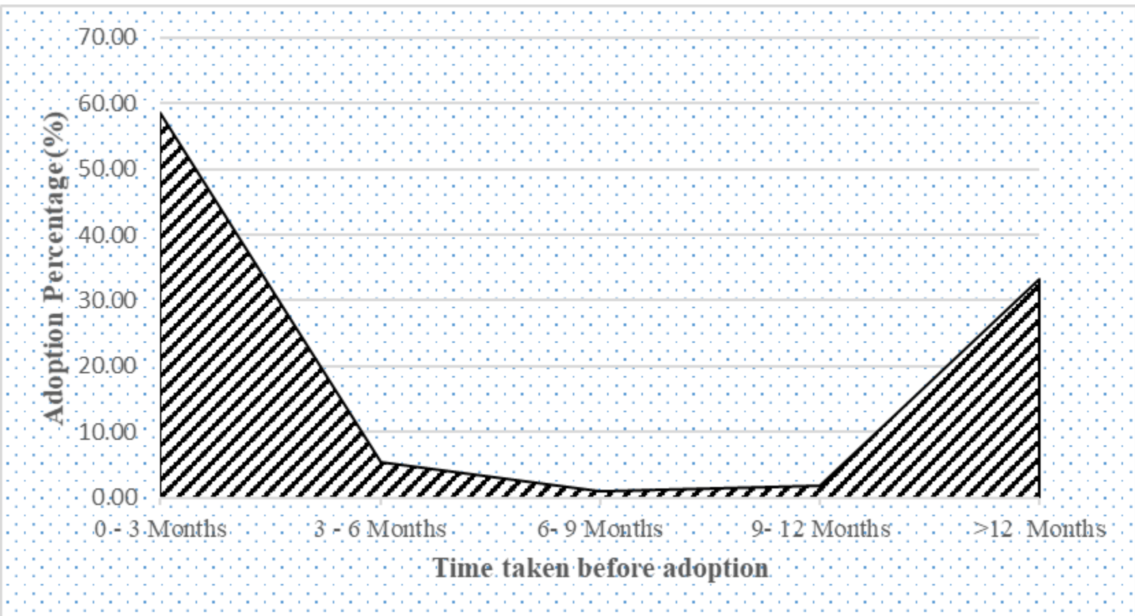

Figure 2: Climate-smart horticulture practice(s) adoption pattern among farmers in Taita-Taveta County

TABLE III- EVOLUTION OF MOBILE PHONE USE AND KEY DRIVERS FROM 1980 – 2021

Period	Changes in mobile phone use	Key drivers of change
1980 -1990	• There were no mobile phones in the area during this period. • People used to queue at telephone booths (which were also limited in number) to communicate using landline phones. • The landline phones could not support messaging services. Therefore, users were limited to calls only.	• Underdeveloped mobile phone technology. • Very few people were educated • Mobile phones were not in the country during this period.
1991 -2000	• Mobile phones were introduced in the country during this period. • It was very difficult to get a mobile phone because it was not easily accessible and had a high cost of operation. • It was possible to make calls and send limited (characters) short text messages using mobile phone during this period.	• High level of poverty. • No network connectivity in the area. • Improved mobile phone technology relative to the previous period. • Few mobile phone producing companies (such as Nokia and Motorola) were available.
2001 -2010	• Mobile phone penetration improved and poor households could afford but low-end smartphones were accessible to wealthier households only. • It was mainly used for social communication through calls and text messaging. • It was difficult to find network connectivity. • Commercial farmers would sometimes use their phones for agricultural purposes. • Text messages were mainly used to communicate to farmers. • It was rarely used to pass climate change information from government and non-governmental organizations. • Introduction of mobile money transfer services such as M-pesa.	• Introduction of more network service providers such as Safaricom Ltd and Celtel, who improved network access to rural areas. • Reduced cost of acquiring and operating a mobile phone (in terms of airtime and electric power access) relative to previous period. • Improved education levels among households compared to previous periods.

2011 -2021	• It was cheap to acquire a mobile phone (one can get it with only KES. 1,000) compared to earlier periods. • Network connectivity was readily available due to introduction of different network service providers. • Introduction of high-end smartphones which can handle multiple tasks and applications. • Easy to access farming-related information through mobile phones and most farmers were using them. • Many social media platforms such as WhatsApp, Facebook and twitter where farmers can interact. • Mobile phones were used for multiple tasks such as marketing, obtaining weather forecast information, teleconferencing, making and receiving payments and entertainment.	• High number of mobile phone shop outlets and brands (such as Nokia, Samsung, Huawei, Oppo, Apple, Itel and Tecno). • Accessibility of high quality network (4th generation (4G)) in most areas. • Increased demand for high-end smartphones with ability to perform multiple tasks such as money account management, teleconferencing, document processing and filing and e-commerce. • Low cost of operation (in terms of airtime, technical knowledge and power access). • High literacy level compared to earlier periods. • Increased youthful population demanding new types of phone with better features.

The results show that the application of mobile phones in farming became more evident from the period 2001. These findings are consistent with the observations of Bayes *et al*. (1999), Masuki *et al*. (2007) and Mittal and Tripathi (2009) on the role and use of mobile phone in agriculture. The findings also show that the application of mobile phones in CSH has continued to grow to currently include; real time weather information, agricultural market information and information on crop husbandry practices. Similarly, previous studies such as Baumuller (2016), Krell *et al*. (2020) and Mittal and Hariharan (2018) showed that mobile phones were being applied by farmers to get information on markets, weather and crop husbandry practices.

Mobile phone use characteristics among climate-smart horticulture farmers

Mobile phones are the most widely used tools for communication in Kenya (CAK, 2019). Similarly, farmers own different types of mobile phones, which they use to communicate as shown in Table 4.

In this study, a *basic feature phone* was defined as a mobile phone that supports voice call, messaging and money transfer services only. On the other hand, *low-end smartphones* included mobile phones that support voice calls, operate on second and/or 3rd generation network, limited applications and memory size of

TABLE IV - FARMER CLASSIFICATION BASED ON TYPE OF PHONE USED IN CLIMATE-SMART HORTICULTURE

Type of mobile phone	Mobile phone ownership among farmers (%)
None	3.47
Basic feature phone	57.32
Low-end smartphone	23.82
High-end smartphone	15.38

less than one gigabyte (GB) random access memory (RAM). *High-end smartphones* comprised of personal digital assistants, more than one GB RAM, mobile phones that support graphics, 3rd generation network and above and can support teleconferencing applications.

Results show that 96% of farmers in Taita-Taveta County own a mobile phone; over half of them having basic feature phone compared to low-end and high-end smartphones. This implies that a high number of farmers have low access to mobile phone-based agricultural information services. This finding is similar to that of Quandt *et al*. (2020) who noted that majority of farmers in Tanzania had basic feature phones which limited their use of agricultural information services. Table V shows one-way analogous ANOVA results on the difference in the use of mobile phone between the three types of farmers (green grams, tomatoes and both crops). The results reveal that most farmers used their mobile phones for social calls, entertainment and social chats (Facebook, WhatsApp and twitter). However, there are differences in the use of mobile phones between the various groups of farmers.

For instance, farmers who produced tomatoes and both crops mainly used their mobile phones for social chats, searching information on output markets, making and receiving payments compared to green gram producers.

The results also revealed that there was less application of mobile phones in searching for information on weather, agricultural inputs and contacting agricultural extension agent(s) among all the three types of farmers. This is attributed to lack of awareness of such services and skills to use them (Khan *et al*., 2019). In addition, majority of farmers had basic feature phones, which limited their access to agricultural information services (Quandt *et al*., 2020).

Pooled results in Figure 3 indicate that over 96% of Taita-Taveta county farmers (tomato and green grams) use their mobile phones for social calls while 63% and 59% use it for social chats (through WhatsApp, Facebook and twitter) and entertainment, respectively. However, less than 44% use their phones for agricultural purpose such as searching for; price, agronomic, weather and farm transport information and making and receiving payments. These findings are consistent with those of Chhachhar *et al*. (2014) who found that farmers' ownership of mobile phones did not necessarily reflect their application for agricultural purposes.

TABLE V -MOBILE PHONE USE CHARACTERISTICS AMONG DIFFERENT CROP FARMERS

Use of mobile phone	Type of farmer *Green grams (%) (n = 259)*	*Tomatoes (%) (n = 115)*	*Both green grams and tomatoes (%) (n = 29)*
Social calls	95.37	96.52	100.00
Play games	8.88^{c}	18.26^{a}	10.34^{b}
Entertainment	55.60	65.22	68.97
Social chats (Facebook, WhatsApp and twitter)	57.14^{c}	70.43^{b}	79.31^{a}
Search for information on farm labourers	3.47^{c}	8.70^{b}	13.79^{a}
Search for weather information	10.04	9.57	10.34
Search for agricultural input information	18.53^{c}	36.52^{b}	44.83^{a}
Search for agricultural output information	33.98^{c}	59.13^{b}	62.07^{a}
Making and receiving payments	32.82^{c}	62.61^{b}	65.52^{a}
Contact agricultural extension agent	20.08^{c}	33.91^{b}	34.48^{a}
Search for agronomic information	22.01^{c}	46.09^{b}	51.72^{a}
Search for farm transport information	25.10^{c}	39.13^{b}	41.38^{a}
Search for non-agricultural information	16.22^{c}	29.57^{b}	34.48^{a}

Note: $^{a, b, c}$ denote significant differences (at 10% level or better) in the use of mobile phone between different types of crop farmers in descending order of magnitude

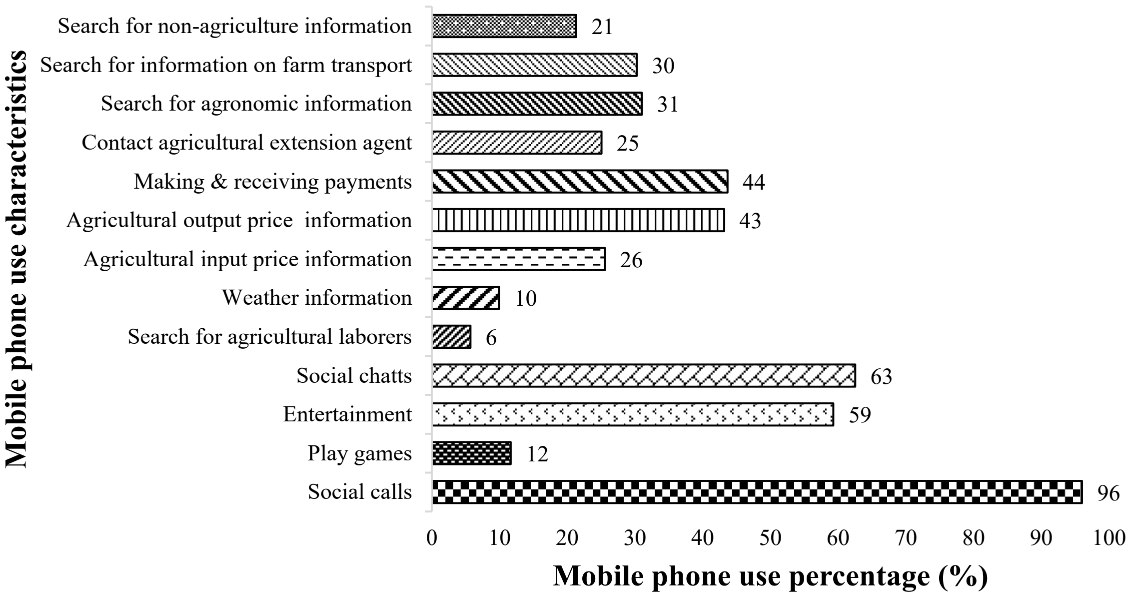

Figure 3: Extent to which climate-smart horticulture farmers use their mobile phones

Correlation between the type of mobile phone used and the number of climate-smart horticulture practices adopted

Figure 4 shows a positive correlation (co-efficient of 0.17) between the types of mobile phone the farmers use and the number of CSH practices adopted. Farmers who used high-end smart phone adopt more CSH practices. There was weak correlation because few farmers owned smartphones compared to basic feature phone (see Table IV). Also, majority of farmers (64%) in this study were green gram producers. These results confirm the observation in Table II, where it was noted that a significantly low number of green gram farmers adopted the CSH practices.

Differences in climate-smart horticulture adoption characteristics between mobile phone users and non-users

Table VI presents the adoption of CSH practices between mobile phone users and non-users on CSH. Using *t*-test statistic, results show that a significantly higher number of mobile phone users in horticulture adopted most CSH practices compared to non-users. For example, the difference in adoption of agroforestry, use of terraces, cover crops and crop rotation was 38%, 32%, 29% and 25%, respectively between mobile phone users on CSH and non-users. These results are consistent with the observations by Mittal (2016) that mobile phone users adopted new farming practices and technologies due to improved awareness.

Previous research has also shown that majority of digital device users on climate-smart agriculture adopt at least one climate-smart agriculture practice (Shrader *et al*., 2020). Similarly, the results reveal that only crop diversification was highly adopted practice by mobile phone non-users on CSH relative to users, with a difference of 4%. This is because most mobile phone non-users were older in terms of age implying that they were more concerned with household food security (Dembele *et al*., 2018; Kemboi *et al*., 2020). As noted in Table 3, most farmers (64%) in this study were green gram farmers who mainly depend on rainfall for their farming activities. This has been shown to enhance crop diversification to reduce the risk of loss (Kassie, 2014).

CONCLUSION AND RECOMMENDATIONS

The study characterized the adoption of CSH practices and use of mobile phones. Results show that there is a relationship between the type of crop produced and CSH practices adopted. Crop rotation was the most adopted practice in the area. Conversely, very few farmers insured their crops over climate-related losses. Other practices were also adopted by less than fifty percent of farmers. Further, it was shown most farmers adopted the CSH practices very quickly. The use of mobile phones for

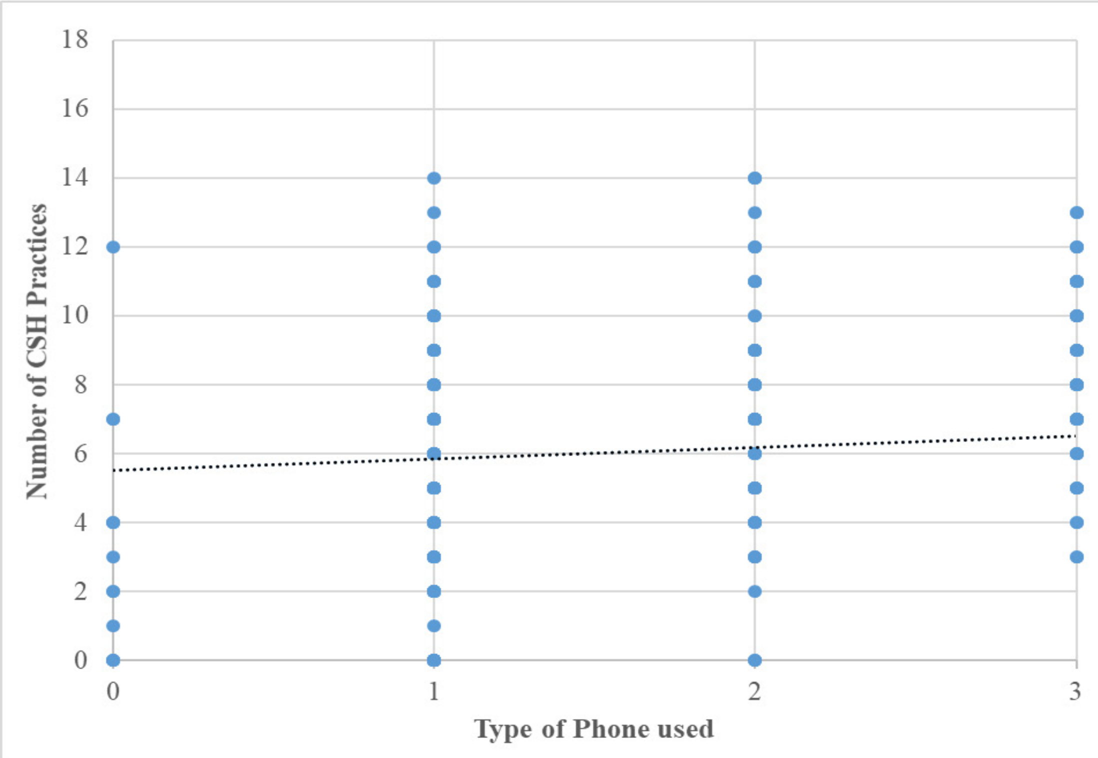

Figure 4: Correlation analysis of type of phone used against the number of climate-smart horticulture practices adopted. Note: X-axis; 0 =non-use of mobile phone, 1 = basic-feature phone, 2 = low-end smartphone, 3 = high-end smartphone.

TABLE VI- DIFFERENCES IN CLIMATE-SMART HORTICULTURE PRACTICES BETWEEN MOBILE PHONE USERS AND NON-USERS

CSH practice	*Mobile phone users (n = 224)*	*Mobile phone non-users (n = 179)*	*Mean difference*
Use of improved and well adapted seed variety	0.59	0.39	0.20^{***}
Matching planting dates to weather information received	0.31	0.15	0.16^{***}
Crop rotation	0.83	0.58	0.25^{***}
Use of cover crops	0.46	0.17	0.29^{***}
Efficient use of inorganic fertilizers through soil testing	0.19	0.14	0.05
Use of terraces	0.68	0.36	0.32^{***}
Agroforestry	0.64	0.26	0.38^{***}
Use of live barriers such as napier grass	0.38	0.16	0.22^{***}
Mixed farming	0.48	0.46	0.02
Crop insurance	0.03	0.02	0.01
Crop diversification	0.47	0.51	-0.04
Use of organic fertilizers & compost manure	0.54	0.37	0.17^{***}
Mulching	0.50	0.27	0.23^{***}
Minimum tillage	0.33	0.17	0.16^{***}
Farm ponds (water harvesting & storage)	0.30	0.15	0.15^{***}
Integrated Pest Management	0.18	0.17	0.01
Contour cultivation	0.42	0.21	0.21^{***}

Note: *** means 1% statistical significance level.

agricultural information services has grown but the uptake by farmers is still low. In addition, the results showed that ownership of a high-end smartphone improves adoption of CSH practices where more mobile phone users adopted CSH practices than non-users. Therefore, it is important for the government to partner with telecommunication service providers and software developers to provide climate-smart mobile phone-supported application and offer basic training on its use for agricultural development.

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