Original Research Article

Assessment of Information and Communication Technology Tools' Usage in Agricultural Extension among Peasant Cassava Farmers in Rangwe Sub-County, Kenya

Abstract

Problem: Despite the potential of Information and Communication Technology (ICT) tools like radios, mobile phones, televisions and computers to enhance agrarian development through sufficient dissemination of agricultural information, its adoption is low. This could be due to inadequate assessment of the determinants of ICT tools' usage. Aims: This study sought to determine selected demographic characteristics, extent of ICT tools' usage and correlation between the selected demographic factors and ICT tools' usage among peasant farmers (PFs) who produce cassava in Rangwe Sub-County, Kenya. Methodology: This study adopted a correlation research design and used a pretested semi-structured questionnaire to gather data among 106 PFs. Results: The majority of the PFs were female, middle age (36-50 years), attained primary education and earned the lowest average annual income ($X \leq$ KES160, 000). ICT tools were used more among males, education elite, higher-income earners and youths. Spearman's correlation analysis showed that a correlation between the selected demographic factors and ICT tools' usage was statistically significant (P=.000) at a 99% confidence level. Conclusion: It revealed that ICT tools' adoption is directly proportional to income, gender equality and education, while it is inversely proportional to age. Recommendation: The study recommended the provision of supporting policies for the selected demographic factors, availability of training centers and subsidized credit interest rate.

Keywords

Information and Communication Technology tools, Peasant farmers, Demographic factors, Agricultural information, Agricultural extension

1. Introduction

Globally, agricultural extension service delivery, especially the traditional method experience notable constraints in satisfying the needs of farmers who have larger number and widely distributed locations. On the same note, the novel agrarian technologies require a triumphant marketing through timely provision of the essential information to the targeted farmers (Zulqarnain et al., 2020). According to Sa'adu et al. (2022) efficacious conveyance of agrarian information and productive interlinkage among agricultural stakeholders are greatly required to achieve the extension goals. Wan-Mohd et al. (2020) noted that agricultural extension should embrace modern technology and Information and Communication Technology (ICT), which can facilitate knowledge management process to achieve sustainable development.

In Africa, smallholder farmers need pieces of agricultural information that include adequate cassava inputs, management practice and marketing, among other extension services (Okoroji et al., 2021). In addition, there are infestations of crop pests and diseases like cassava bacterial blight and spider (Okuku, 2018). Diseases affect the plants' growth and production of tubers depending on the infection level of the plant. Cassava that is severely affected by the illnesses shows poor growth with no tubers, while cassava moderately affected produces few tubers with intermediate development compared to a healthy plant. The pests cause chlorosis, shrivelled leaves and yellow speckles (Wagaba et al., 2021). Kabir et al. (2022) noted that the use of ICT tools in sharing agricultural extension services has a greater potential to solve the farm problems.

In Kenya, the Government and other organizations introduced some clean cassava seeds. The seeds were believed to be early maturing and disease resistant. The varieties include mijera, shibe, karembo, karibuni, nzalauka, tajirika, Siri, TMS30572, MH95/0183, TM/14 and MH93/OVA (Cheboi et al., 2021). Agricultural extension officers from Green Shamba, One Acre Fund and the public extension offices have been disseminating teaching PFs about cultivation of the new varieties and the benefits. However, the extension staffs were limited by large and widely distributed regions to cover. In addition, the use of ICT tools in agricultural extension services delivery has become more necessary following the lockdown directives communicated by the government of Kenya due to the emergence of coronavirus, which causes COVID-19 illness (Kansiime et al., 2021).

In Rangwe Sub-County, the condition necessitated the need to use the ICT tools in agricultural extension to ensure the smallholder farmers timely receive cassava information instead of the traditional method, where agricultural extension officers had to travel and physically serve many smallholder farmers demanding the information (Samwel et al., 2021). A few SHFs who used the ICT tools and platforms in agricultural extension received agrarian information faster and easier, which translates to a significant cassava yield (Ogenga et al., 2018). However, the ICT tools' adoption by the PFs is low.

Some research findings have revealed that a few demographic factors limit the use of ICT tools in agricultural extension among smallholder farmers (Maria et al., 2021; Steinke *et al.* 2020; Birke & Knierim, 2020). Promoting the adoption of ICT tools in agricultural extension require identification and solving the limiting factors (Dhehibi et al., 2020). This study selected a few demographic factors because there was limited information where there is a correlation between them and ICT tools' adoption among the PFs. The factors include age, gender, income and education.

2. Methodology

2.1 Study Area and Target Population

The permission for the study was granted by the National Commission for Science Technology and Innovation (NACOSTI) under the license No. NACOSTI/P/21/14779. It was conducted in Rangwe Sub-County, Kenya (Figure 1), located at a latitude 0° 34' 30" S and longitude 34° 9' 20" E. Its area is approximately 273.2 km^2 and has four administrative wards that include Kochia, Kagan, Gem west and Gem east (CIDP, 2021). The Sub-County has an average bimodal rainfall of about 1150 mm. It has a population of 3808 peasant cassava farmers. Out of the total peasant population, accessible population was 3025 cassava growers in a farming group (Rangwe Sub-County Ministry of Agriculture Annual Report, 2021). The residents in Rangwe Sub-County derive their livelihoods from agriculture, formal or informal wage labor, and commerce. Agriculture is the main source of employment to about 60% of the residents. The farmers cultivate about 86% of their lands for subsistence farming practices. The smallholder farmers grow cassava, maize, beans, sorghum, sweet potatoes, kales, millet, and rice for consumption. They also grow pineapple and sugar cane as a cash crop (Cheboi et al., 2021).

The Sub-County government promotes cassava production among the PFs because the crop can tolerate drought and provide food security in times of insufficient rainfall (Samwel et al., 2021). Agricultural extension officers encourage the use of radios, computers and mobile phones as a tool for effective extension service delivery. However, the use of ICT tools among cassava PFs was low.

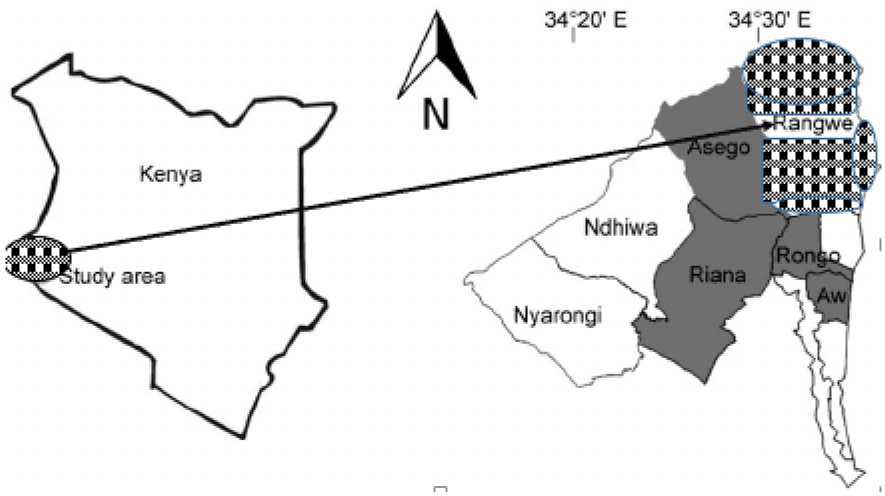

Figure 1: Rangwe Sub-County's map (CIDP, 2021)

2.2 Sampling Procedure and Sample Size

The study purposively chose the Sub-County due to its low adoption of ICT tools among the PFs and the low yield of cassava. Naissuma, (2000) formula was used to calculate the appropriate sample size out of the accessible population as shown:

$$n = \frac{\boldsymbol{NC^2}}{\boldsymbol{C^2} + (\boldsymbol{N} - \boldsymbol{1})\boldsymbol{e^2}}$$

Where: **N =** the population within the study area, **C=** Coefficient of Variation, n = the required sample size, **e** = Standard error.

$$n = \frac{3025x(0.21)^2}{(0.21)^2 + (3025 - 1)x(0.02)^2} = 106$$

The study expected 95% confidence (5% sampling error) to obtain an appropriate sample size of SHFs from Rangwe Sub-County.

The proportionate sampling method established appropriate sampling percentages of peasant cassava farmers in Kochia, Kagan, Gem West, and Gem East administrative wards. The sampling method was preferred because it enhances equity in the selection percentage. Out of the obtained proportion from the four wards, the study used a simple random sampling method to choose 106 respondents. The simple random sampling method ensured that every population unit had an equal chance of selection.

3.0 Results

The study was set to determine demographic characteristics, extent of ICT tools' usage and correlation between selected demographic factors and ICT tools usage among peasant cassava growers in Rangwe Sub-County, Kenya. The results were analyzed and discussed.

3.1 Demographic Characteristics

The selected demographic factors included education level, age, average annual income level, and gender. Studying the selected characteristics were important because they could help one understand the nature of cassava farming among peasant farmers. The characteristics were discussed as shown.

3.1.1 Education Level of the Farmers

Figure 2 illustrates the farmers' education attainment. It revealed that peasant farmers who attained primary education level were the largest percentage (52%) in the study area. This was followed by 30.19% who attained secondary, 15.09% attained post-secondary and 5.66% did not attain formal education. This may suggest the low use of ICT tools in cassava production due to inadequate formal skills and knowledge applied in the use of the tools. The results concurred with Naqvi et al. (2021) that largest percentage of the smallholder farmers in their study were illiterate. However, it contrasted Kacharo (2020) who found that a higher percentage of farmers had attained secondary level.

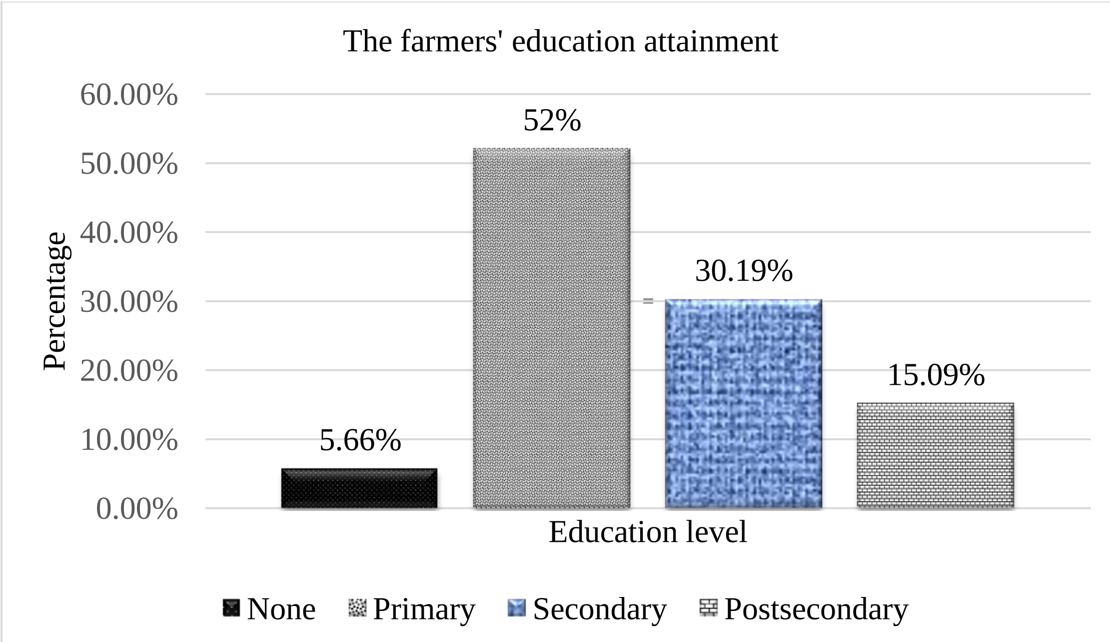

Figure 2: The farmers' education attainment

3.1.2 Farmers' Age

Figure 3 illustrates the farmers' age distribution. It revealed that the majority (42.45%) of the peasant farmers were in the age range of 36-50 years. This was followed by 26.42% within 51-65 years and 23.58% within 18-35 years. Lastly, 7.55% of them were above 65 years. A significant percentage of middle age showed that the farmers are still in their active stage of agricultural production. The least percentage of the young people in the production revealed that this category does not participate in cassava production. Perhaps the youths spend most of their time in school and other economic activities other than in the cassava production. The results supported Uzochukwu et al. (2021) that majority of farmers are in their middle age. On the other hand, it opposes Khan et al. (2020) that most farm producers are youths.

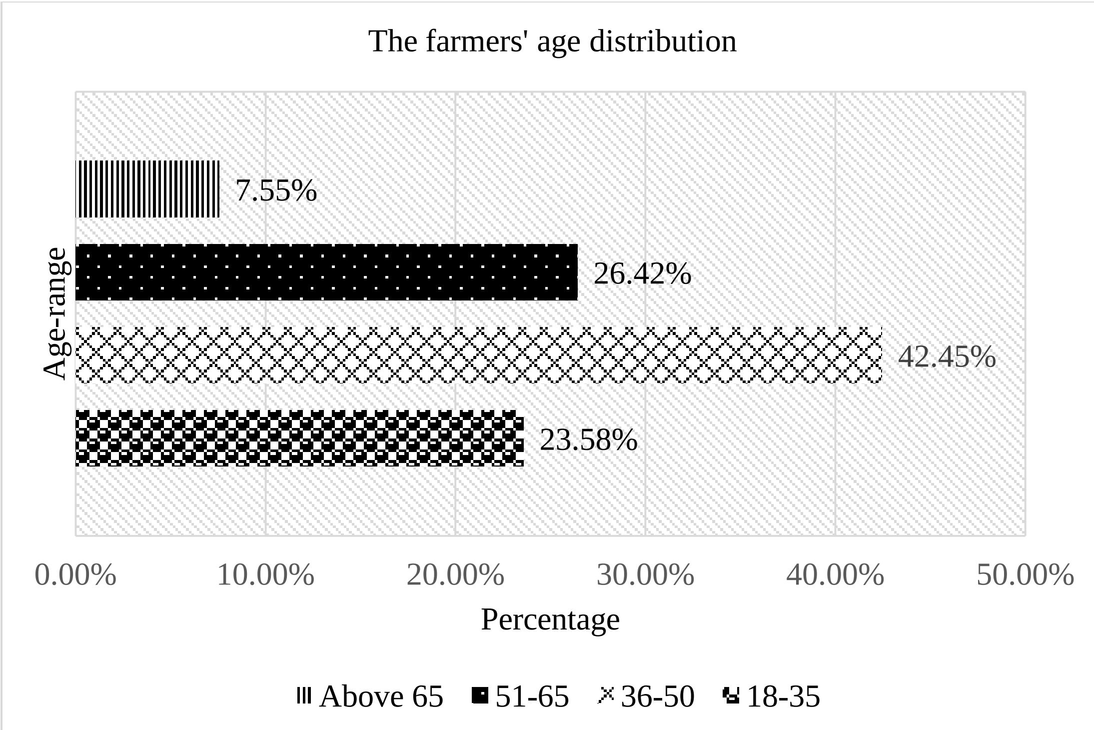

Figure 3: The farmers' age distribution

3.1.3 Farmers Income level

Figure 4 illustrates the farmers' income levels in KES 1000. It revealed that the majority (58.49%) of the smallholder farmers recorded a lower average annual income level of KES 160,000 and below. This was followed by 23.58%, who recorded an average annual income level of between KES 161,000 to 270,000, and lastly, 17.92% recorded KES 271,000 to 38,00. This may suggest the low use of ICT tools in cassava production due to inadequate capital required to purchase and maintain the ICT tool. The results supported the findings of Wichean and Sungsanit (2022) that larger number of farmers in their study had lower income levels. However, the results opposed the findings of Hartmann et al. (2021), who found that most farmers had a middle-income level.

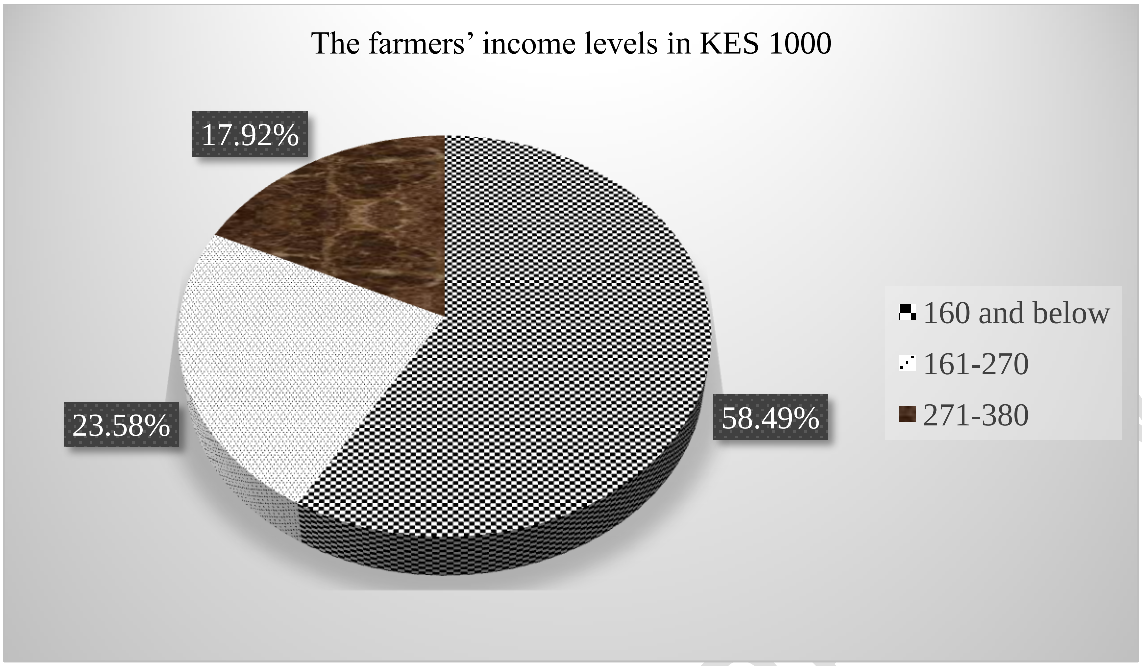

Figure 4: The farmers' income levels in KES 1000

3.1.4 Farmers' Gender

Figure 5 shows the farmers' gender distribution. It established that, out of the total respondents, the majority (62%) were female, while 38% were male. This revealed a relatively wide range in the number of male and female smallholder farmers producing cassava in the study area. It supported the findings of Nyarko and Kozari (2020), who reported that most smallholder farmers are female. Nevertheless, it opposes the results from the study by Rowntree (2018) which found just a few percentage of females engaged in farming activities.

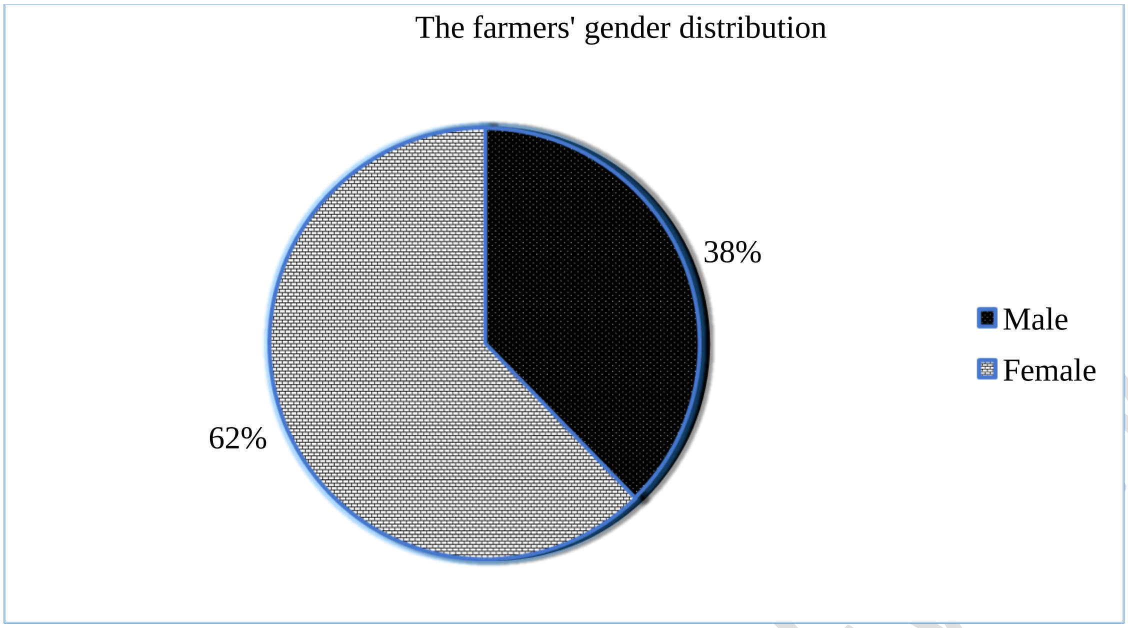

Figure 5: The farmers' gender distribution

3.2 Extent of Information and Communication Technology Tools Usage

The study determined extent of ICT tools' usage and discussed the results as shown (Figure 6). Majority (55%) of the ICT tools' users in agricultural extension adopted mobile phones. This was followed by 29% who used radios, 11% used televisions and lastly 5% used computers. The results supported Nyarko and Kozári (2021) that mobile phones were greatly employed in agricultural extension services among smallholder farmers. However, Sennuga (2019) noted that many farmers adopted radios to access extension services.

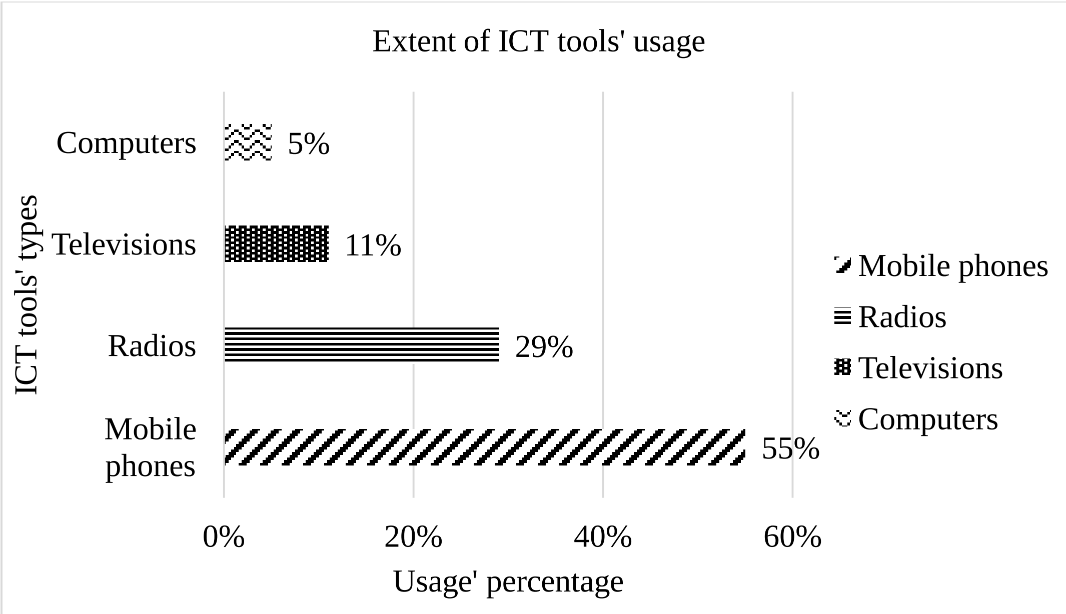

Figure 6: Extent of ICT tools’ usage

3.2.1 Extent of Use against Education Level

The data on education levels of the smallholder farmers were crossed-tabulated with the use of ICT tools (Table 1). The frequency revealed that greater number (24) of peasant farmers using the ICT tools in cassava production attained secondary education level, followed by 16 of them who attained post-secondary education level. The rest did not use the ICT tools in the production. The results could mean that the increase in education level leads to an increase in the use of ICT tools in cassava production. It supported Wan-Mohd et al. (2020), who also reported that higher education level increased the likelihood of the smallholder farmers to use the ICT tools in agriculture.

Table 1

Frequency for the ICT tools' usage against education level

		Education level				
		None	Primary	Secondary	Post-secondary	Total
Use of ICT tools	No use	6	52	8	0	66
	Use	0	0	24	16	40
Total		6	52	32	16	106

3.2.2 Extent of use against Age Range

The study computed a cross-tabulation between use of ICT tools in cassava production and age range (Table 2). The frequency revealed that greater number (24) of the peasant farmers using the ICT tools in cassava production are in the age range between 18-53 years. This was followed by 16 who were 36-50 years of age. The rest of them had not used the tools in cassava production. This revealed that youths are the majority of information technology earlier adopters. The results agreed with Hoang et al. (2022), who found that young people quickly adopt new technologies. On the other hand, it opposes the findings of Korongo et al. (2021), who noted that middle age farmers are the majority in agricultural technology adoption.

Table 2

Frequency for age range against the use of the ICT tools

		The age range in years				
		18-35	36-50	51-65	Above 65	Total
Use of ICT tools	Use	24	16	0	0	40
	No use	1	18	39	8	66
Total		25	34	39	8	106

3.2.3 Extent of use against Annual Average Income Level

The study computed a cross-tabulation of annual income level with the use of the ICT tools in cassava production (Table 3). It revealed that the majority (20) of the smallholder farmers using the ICT tools in cassava production had earned an average annual income of between KES 161-270, followed by 18 who had earned between KES 271-380. The rest of them had not used the tools in cassava production. It revealed that the smallholder farmers with higher annual income adopted the use of the ICT tools in cassava production. The reason could that higher-income farmers had more financial capability to buy and maintain the tools in the services. The results supported the findings of the United Nations (2018), who noted that farmers with more income are earlier adopters of technologies. On the contrary, it opposes Zulqarnain et al. (2020), who stated that farmers with low-income farmers had potential to adopt agricultural technology.

Table 3

Frequency for annual income levels against the use of ICT tools

		Annual income level in 1000 Kenyan shillings			
		160 & below	161-270	271-380	Total
Use of ICT tools	Use	0	20	18	38
	No use	62	5	1	68
Total		62	25	19	106

3.2.4 Extent of use against Gender

The study collected data on the peasant farmers' gender and crossed-tabulated with the use of the ICT tools in cassava production (Table 4). It revealed that the majority (28) of the farmers using ICT tools in cassava production was male, followed by female (10). The rest did not use ICT tools in the production. The lower frequency of the female farmers using the ICT tools in cassava production could mean female growers had more domestic responsibilities. Therefore, they had less time to attend the ICT programs. It supported Khan et al. (2020), that more male growers adopted new technologies than their female counterparts. However, it contrasted Kabir et al. (2022), who noted that more female than male farmers adopts technology in agriculture.

Table 4

Frequency for the ICT tools' usage against gender

		Gender		
		Male	Female	Total
Use of ICT tools	Use	28	10	38
	No use	12	56	68
Total		40	66	106

3.3 Correlation between Selected Demographic factors and ICT tools' Usage

The study employed Spearman's rank-order to determine correlation between the selected demographic factors and ICT tools' usage.

3.3.1 Correlation between Education Level and ICT tools Usage

The study used Spearman's correlation to find out correlation between peasant farmers' education level and their use of ICT tools in cassava production (Table 5). It revealed a high, positive correlation, which is statistically significant at 1% level of significance (R = +.815**, *P* = .000, R^2 =0.664). Education level appears to provide a substantial guide no ICT tools' adoption as it predicts at 66% of its usage in cassava production. The remainder (34%) of the unexplained variance may involve other factors. This shows that the use of ICT tools is directly proportional to the farmers' education. The results concurred with Naqvi et al. (2021), that education and technology adoption correlate. However it opposes (Ulhaq et al. (2022) who stated that farmers' education level does not determine technology adoption.

Table 5

Spearman's correlation for education level and ICT tools' usage

Number of the respondents	**Coefficient of Correlation (R)**	***P*-value**	$\mathbf{R^2}$
106	+0.815**	0.000	0.664

Note: ** indicates correlation is significant at the 0.01 level (2-tailed)

3.3.2 Correlation between Age Range and ICT tools Usage

The study used Spearman' correlation to establish whether the farmers' age range and the use of ICT tools correlate (Table 6). It revealed a high, negative correlation, that is statistically significant at 1% significance level (R = -.777**, *P* = .000, R^2 = 0.604). The age range appears to explain 60% of ICT tools' adoption in cassava production. Remaining (40%) unexplained variance may involve other unknown factors among the smallholder farmers. The use of ICT tools decreases with an increase in the age range. The results supported Nyarko and Kozari (2020) that age impact technology adoption. However, it opposes the report by Korongo et al. (2021), who noted that age does not influence the use of ICT services.

Table 6

Spearman's correlation for age rang and ICT tools' usage

Number of the respondents	**Coefficient of correlation (R)**	***P*-value**	$\mathbf{R^2}$
106	-0.777**	0.000	0.604

Note: ** indicates correlation is significant at the 0.01 level (2-tailed)

3.3.3 Correlation between Average Annual Income and ICT tools Usage

The study applied Spearman's correlation to ascertain whether the peasant farmers' average annual income level and ICT tools adoption correlate (Table 7). There was a high, positive correlation, which is statistically significant at 1% significance level (R = .882**, *P* = .000, R^2 =0.778). The average annual income level appears to provide a substantial guide on ICT tools adoption as it predicts at 78% of the adoption in cassava production. Remaining (22%) unexplained variance may involve other undetermined factors. This was in line with Sennuga (2019), who also reported a relationship between income level and the use of information technologies. On the other hand, it contradicted Akintelu et al. (2021), who noted that farmers' income levels did not correlate with the adoption of modern technology.

Table 7

Spearman's correlation of annual income level and the use of ICT tools

Number of the respondents	**Coefficient of correlation (R)**	***P*-value**	**R^2**
106	+0.882**	0.000	0.778

Note: ** indicates correlation is significant at the 0.01 level (2-tailed)

3.3.3 Correlation between Gender and ICT tools Usage

The study employed Spearman's correlation to discover if gender and ICT tools usage correlate (Table 8). The results revealed a moderate, negative correlation, which is statistically significant at 1% significance level (R = -.554**, *P* = .000, R^2 =0.307). Gender explained 31% of ICT tools' adoption in agricultural extension. Remaining 69% constitute other factors. The results agreed with Çetin et al. (2021), that a correlation between gender and information technology exist. Nevertheless, it opposes Benard et al. (2021) that gender does not influence technology adoption.

Table 8

Spearman's correlation between gender and ICT tools' usage

Number of the respondents	Coefficient of Correlation (R)	***P*-value**	R^2
106	-0.554**	0.000	0.307

Note: ** indicates correlation is significant at the 0.01 level (2-tailed)

Results of Spearman's correlation among gender, income, age, education and ICT tools' adoption revealed that there is a statistically significant correlation.

3.3 Conclusions

The results indicated a statistically significant correlation between the selected demographic factors and ICT tools' usage. The analysis confirmed that ICT tools were used more among youths, males, higher-income earners, and highly educated peasant farmers. This could means that males tend to own most of production resources, such as land. Youths are more proactive in trying a new technology. Higher education level provides necessary skills required to operate the ICT tools, and lastly, higher income levels increase financial muscles to buy and subscribe the ICT services. Policymakers should prioritize policies that would support demographic factors, especially education, income, gender, and age.

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