# Access to Credit and its Relationship with Information and Communication Technology Tools' Adoption in Agricultural Extension among Peasants in Rangwe Sub-County, Kenya


## ABSTRACT

Access to agricultural credit is one of the key factors that boost the adoption of technologies to improve agricultural production. Information and Communication Technology (ICT) tools have been referred to as essential channels in the dissemination of agricultural extension information. However, it has been observed that the majority of peasants were not using them to access the information. The aim of this study was to delineate the level of agricultural credit access, sources of the credit, amount of the credit accessed, and the correlation between access to the credit and the use of ICT tools in the extension services among peasants. A correlation research design was utilized in this study at Rangwe Sub-County, Kenya. Data were collected with the help of pretested structured questionnaire from 106 peasants who grow cassava in the Sub-County. The data obtained were analyzed using Spearman's correlation and descriptive statistics with the aid of Statistical Package for Social Science (SPSS) Version 25. Descriptive results revealed that 68% of the peasants interviewed had no access to the credit, while 32% had access. The majority (70%) of those who had the access received it from Saving and Credit Co-Operative (SACCOs). The majority (68%) received the lowest amount of credit. Spearman's correlation revealed that there was a moderate, positive correlation between access to credit and the use of the ICT tools. The correlation was statistically significant at 1% level of significance ($R = +.646^{**}$, $P = .000$, $R^2 = 0.417$). Access to credit appears to provide a positive and moderate correlation with the use of the ICT tools as it predicts 42% of the use of the tools in cassava production. The positive correlation coefficient indicates that an increase in access to agricultural credits among the peasants translates to an increase in the adoption of ICT tools in agricultural extension.



***Keywords****: Agricultural Credit, ICT tools, agricultural technology, post-harvest handling, marketing information*


## 1. INTRODUCTION

Globally, agriculture is a sector that has been negatively affected by low productivity despite the fact that it is a basic instrument for the reduction of poverty, food security increment, and enhancement of sustainable development (Tanti *et al*., 2022). Efficacious dissemination of agricultural information among the farming stakeholders is one of the major contributions to increasing agrarian productivity (Kamal *et al.,* 2022). It has been observed that the use of ICT tools in sharing agricultural information is one of the major ways to connect farmers and sources of information easily and faster (Birke and Knierim, 2020). The information may entail tillage and sowing practices, soil and water conservation techniques, improved seeds, fertilizer application, appropriate methods of pesticides, and fungicide application to crops. It may also include harvesting and post-harvesting operations (Ahmadi *et al*., 2022).

In Kenya, according to the report by the Kenya National Bureau of Statistics [KNBS], (2020), the agricultural sector contributes about 11% of her labour force and about 34% of her Gross Domestic Product (GDP). This could mean that agriculture is a basic sector in the Kenyan economy. Most of the farmers practice farming on a piece of land of fewer than 3 acres (Odhiambo, 2020). The farmers can easily adopt the novel techniques when they receive the information timely through constructive extension dissemination techniques like ICT tools (Hoang *et al.,* 2022). The tools refer to a set of technological devices and resources used to receive, store and communicate information. The tools are becoming crucial methods for improving agricultural production across the world (Tiwari *et al*., 2022). The ICT tools mostly used in the extension service delivery include radios, televisions, computers, phones, and the internet. These tools are used to communicate agricultural extension services that include improved inputs, on-farm practices, harvesting activities, post-harvest handling, and marketing information (Mallory *et al.,* 2022).

In Rangwe Sub-County, adoption of agricultural technology has been encouraged by the government and private organizations as a crucial method to improve agrarian production. Nevertheless, the percentage of adoption of most of the technologies remains low (Ruzzante *et al.*, 2021). The Sub-County is marked by the low adoption of ICT tools in agricultural extension services delivery among peasants. Mallory *et al*., (2022) opined that low ICT tools' adoption could be one of the major causes of low crop productivity like cassava, mainly due to the inadequate access to agricultural extension services and improved inputs.

The adoption of the tools in agricultural extension requires capital to buy them and access the extension services. The majority of peasants in the rural localities of the Sub-County have a low-income level, which may translate to inadequate capital and low technology adoption (Rengaraj and Shibu, 2022). This might restricts agricultural sustainable development in Rangwe Sub-County, Kenya (Kamal *et al.,* 2022).

The peasants may require agricultural credit to adopt the modern agricultural technologies used in agricultural extension. Agricultural credit refers to funds borrowed for use in agricultural production, processing, and marketing (Moahid *et al*., 2021). The provision of agricultural credit may be one of the major means to overcome financial problems for the farmers. Agricultural credit provides enabling environment and ability for the smallholder farmers to purchase and maintain the ICT tools and subscribes to the extension services (Birke and Knierim, 2020). The types of agricultural credit available to the farmers include seasonal credit, development credit, agri-business credit, and loan size (Ullah *et al.,* 2020). This study hence sought to explain the access level of agricultural credit, credit sources, amount of the credit accessed, and the correlation between access to credit and the use of ICT tools in the extension services among the peasants.

## 2 LITERATURE REVIEW

### 2.1 Access Level to Agricultural Credit

Access level to agricultural credit is the percent of smallholder farmers able to receive agricultural credit to be used in farm production (Sa'adu *et al.,* 2022). Tiwari, (2022) reported that smallholder farmers require funds to buy ICT tools and maintain them in good working conditions as well as subscribe to agricultural extension services. However, the majority of smallholder farmers in the rural localities have a low-income level. This condition disadvantaged them when it comes to technology adoption (Ullah *et al.*, 2020). Access to agricultural credit could be one of the major contributions to solving farmers' financial problems. Agricultural credit is used as a method to provide short and long-term financial aid for smallholder farmers. However, Meena, (2021) noted that the access level was low among the farmers while some of the farmers were also reported to get less amount of credit. Hoang *et al.* (2022) conducted a study and reported that access to credit has the potential to increase the financial ability of smallholder farmers to use ICT tools in agriculture. Although a few who accessed the credit got a small amount.

Dagunga *et al.* (2020) found that a high rate of access to credit among smallholder farmers is one of the great pillars that improve the adoption of agricultural technologies including the e-extension. The access to the credit was found to be average among the farmers. Ruzzante *et al.* (2021) reported that technology has developed a number of digital financial services that smallholder farmers can access through mobile phones. Examples of mobile financial services with low and high adoption rates included mobile loans, mobile payments, mobile money, mobile banking, and mobile savings (Martinez-Gomez *et al*., 2022). The access level was not consistent across the farmers interviewed. This provides the gap for a study to determine access levels in other areas, especially in Rangwe Sub-County.

**2.2 Sources of Agricultural Credit and Correlation**

The Source of agricultural credit was operationally defined in this study as the providers of the credits to farmers. Various agencies are committed to providing agricultural credit to farmers. The credit is categorized based on the source such as institutional and non-institutional agencies (Bernards, 2022). The major sources of credit for agricultural producers include Commercial Banks, Agricultural Credit Institutions, Farm Service Agencies, and Insurance Companies (Meena *et al.,* 2021). Ullah *et al*. (2020) reported that access to agricultural loans from banks enabled smallholder farmers to adopt and use novel agricultural technologies in farming. Odhiambo (2020) also found that farmers who got flexible loans from government agencies were able to buy and use improved inputs such as seeds, fertilizers, and pesticides.

In Kenya, especially in Rangwe Sub-County, access to credit from money lending institutions is accredited as a significant accelerator in agricultural technology adoption like the use of ICT tools. The smallholder farmers may access credit from public and private institutions such as banks, farmer groups, friends, and relatives (Sa'adu *et al.,* 2022). Çetin *et al.,* (2021) found that some of the smallholder farmers who had used mobile phones to share agricultural information had not received agricultural credit from any source. The effects of credits on smallholder farmers were not uniform across the farmers in various localities. Some literature recorded a positive correlation while others recorded a negative. The contradictions in the correlation between access to credit and technology adoption indicate a gap that this

study sought to fill by determining whether access to credit correlates with the use of ICT tools among peasants in Rangwe Sub-County, Kenya.

## 3 MATERIAL AND METHODS

### 3.1 Study Location

This research study was approved by National Commission for Science Technology and Innovation (NACOSTI) in license No. NACOSTI/P/21/14779. The study was conducted in Rangwe Sub-County, Kenya (Figure 1). According to Rangwe Sub-County Ministry of Agriculture Annual Report (2021), the Sub-County has an approximate area of 273.2 $km^2$. It is located at a latitude of 0° 34' 30" S and a longitude of 34° 9' 20" E. The Sub-County consists of four administrative wards that include Gem East, Kochia, Kagan, and Gem West. It has a population of 3808 smallholder cassava farmers. The Sub-County receives an average annual bimodal rainfall of about 1150 mm (County Integrated Development Program [CIDP], 2021). The major economic activity is Agriculture; where the majority (60%) of the residents cultivate approximately 86% of the land and grow cassava, maize beans, sweet potato, kales, millet, pineapple, sugar cane, and rice (Cheboi et al*.,* 2021). Rangwe Sub-County was selected in the study because the use of ICT tools in agricultural extension was observed to be low despite the effort of the government to promote cassava production and the use of ICT tools in agricultural extension service delivery.

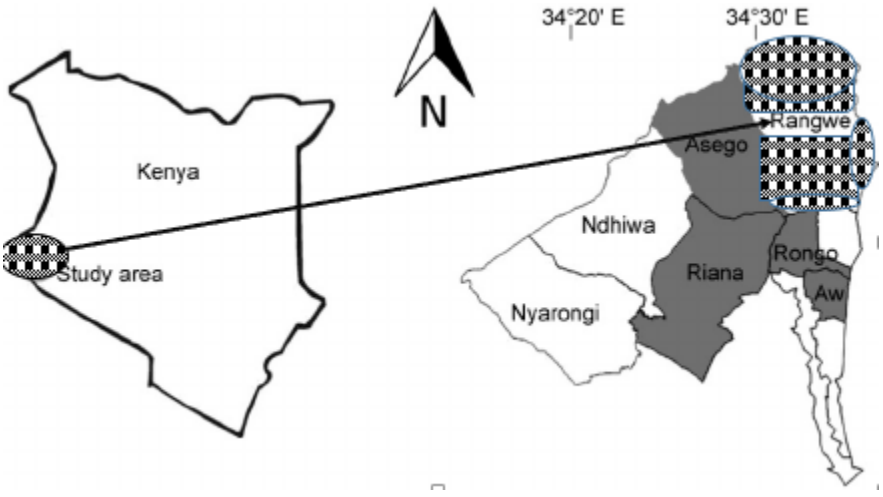


**Figure 1:** Rangwe Sub-County, Kenya (CIDP, 2021).

### 3.2 Sampling Procedure and Sample Size

The Sub-County was purposively selected for the study based on the low use of ICT tools among the smallholder cassava farmers. The appropriate number of respondents was arrived at with the aid of the Naissuma (2000) formula as illustrated.

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

……..(i)

Where: e = Standard error, *n* = appropriate sample size, N **=** accessed population in the area, C**=** Coefficient of Variation.

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

……..(ii)

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

The study employed a proportionate sampling technique to get respondents' sampling proportion from the four wards in Rangwe Sub-County (Table 1). The sampling technique was appropriate due to its ability to provide sampling equity. The study also used a simple random sampling method to choose 106 peasants from the sampling frame.

**Table 1**

Accessible population and sample size distribution

| Population unit | Accessible population | Proportion (%) | Sample size |
|---|---|---|---|
| Kochia ward | 760 | 25 | 27 |
| Kagan ward | 867 | 29 | 31 |
| Gem Westward | 740 | 24 | 25 |
| Gem Eastward | 658 | 22 | 23 |
| **Total** | **3025** | **100** | **106** |

Source: MoALFI, (2021).

## 3.3 Instrumentation

The study was guided by its objectives to develop a structured questionnaire. The questionnaire was appropriate for this study because it facilitated easy collection of data that were easy to analyze. Section A of the questionnaire covered level of access, section B covered the credit sources and section C covered amount of credit.

### 3.3.1 Validity

Validity is the extent to which an instrument measures what it is supposed to measure (Mugenda and Mugenda, 2008). The validity of the instrument was ensured by the experts in the Department of Agricultural Education and Extension of Egerton University and the Department of Agribusiness Management and Extension of Masinde Muliro University of Science and Technology.

### 3.3.2 Reliability

Reliability is the consistency with which an instrument measures what it is supposed to measure (Mugenda and Mugenda, 2008). The reliability of the instrument was tested using a pilot study with 30 peasants randomly selected from cassava farmers in Homa-bay Town Sub-County. The Sub-County was selected because it possesses similar characteristics to Rangwe Sub-County. The questionnaire confirmed its reliability by attaining an alpha coefficient (0.756α) which is above the threshold (0.70α) for acceptable reliability (Cronbach, 1975).

## 3.4 Data Collection Procedure

An introduction letter was obtained from the Egerton Board of Post-Graduate Studies and the letter was used to get a research permit (license No. NACOSTI/P/21/14779) from the National Commission for Science, Technology, and Innovation (NACOSTI). The permit was presented to Agricultural officers in Rangwe Sub-County to be allowed to collect data. One ward agricultural officer from the four wards guided the data collection process. The peasants were invited at one point at a time and the questionnaires were given to them randomly in the order of their arrival at the venue. Those who had difficulties in filling the questionnaires were assisted appropriately. All the ethical issues were considered.

## 3.5 Data Analysis

The data collected were coded and cleaned using Statistical Package for Social Sciences (SPSS) Version 25 to enhance analysis. Percentage, frequency, and spearman's correlation coefficient were employed to analyze the data meaningfully. Spearman's correlation is a nonparametric measure of strength and direction of correlation between two variables measured on an ordinal scale.

## 4 RESULTS AND DISCUSSION

The study intended to describe the level of access to agricultural credit, sources of the credit, the approximate amount of the credit received, and the correlation between access to the credit and the use of ICT tools in agricultural extension. The results obtained from this study were analyzed and discussed as follows.

### 4.1 Level of Access to Agricultural Credit

The results revealed that 68% of the interviewed peasants had no access to credit, while 32% had access (Figure 2). These results revealed that the majority of the peasants did not receive agricultural credits. This could mean that they had some constraints that prevented them from getting the credits. Some of the problems mentioned by the majority of the respondents included the requirement of expensive collateral as a security to get loans, unawareness of the credit existence, penalties when one fails to pay back the loan high-interest rates for the loans, negative myths about the loans, and wrong information concerning the credit. The percentage of the farmers who received agricultural credits indicated that the credits are available and accessible. The results supported the findings of Zulfiqar (2020) that the rate of the farmers' access to agricultural credit is low. However, it opposed Odhiambo (2020) that a larger percentage of smallholder farmers are increasingly accessing agricultural loans.

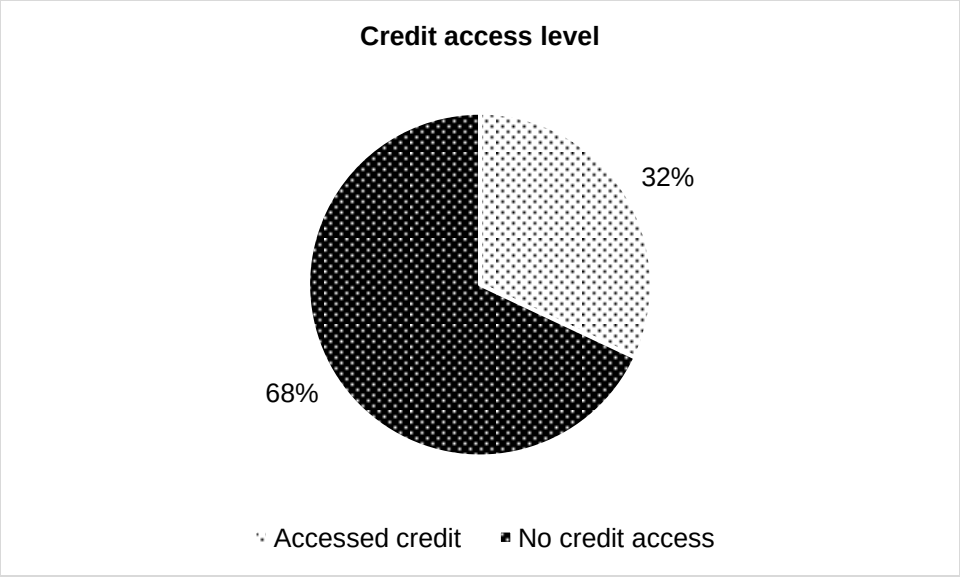


**Figure 2**: Credit access level

**4.2 Sources of Agricultural Credit**

The majority (70%) of those who had access to agricultural credit, received the credit from SACCOs followed by 21% who received it from banks then 9% received it from friends (Figure 3). The SACCOs were formed by the farmers to save and borrow money. These results revealed that the SACCOs dominated the agricultural credit sector in the Sub-County. The reasons suggested by the respondents to explain why the majority preferred SACCOs included more accessibility, easy to get loans, and low-interest rates compared to banks. In addition, they mentioned that there was no collateral required of them to access the credits from SACCOs. This encourages the farmers to join and access the credit when needed. The lowest percentage of farmers getting loans from friends was explained by the fact that the source is not reliable. These results concurred with Ullah *et al*. (2020) that smallholder farmers prefer getting loans from SACCOs compared to other sources. However, it opposed Moahid *et al*. (2021) that banks are receiving many loan borrowers due to their reliability and availability.

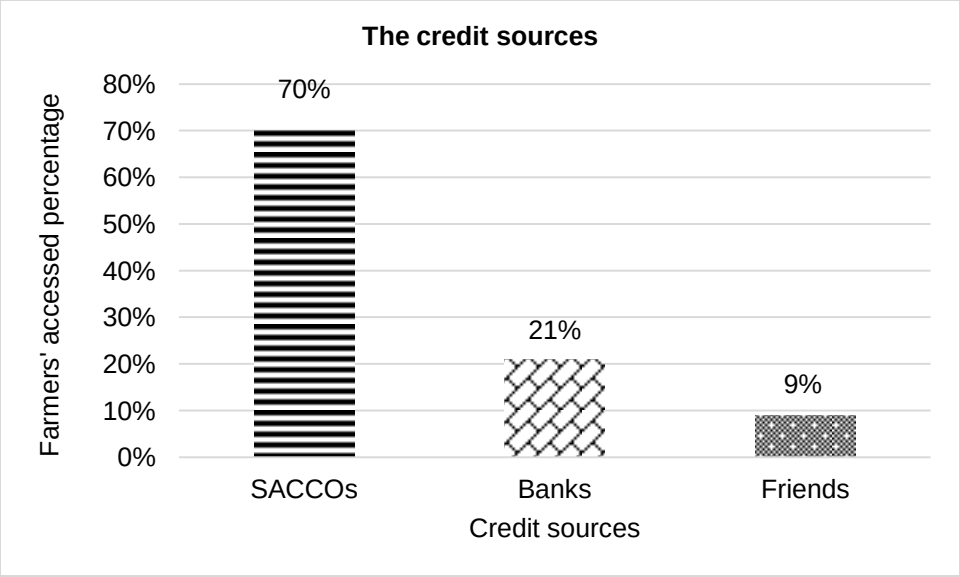


**Figure 3**: Credit sources

### 4.3 Amount of Agricultural Credit Accessed Per Year

The majority (68%) of the peasants that accessed credit, received less than KES 20,000 per year, followed by 19% who received less than KES 10,000, and lastly, 13% had received above KES 40,000 (Figure 4). The results revealed that many of the farmers who accessed the credit got the lowest amount. The respondents said that the sources of the credit they preferred did not have enough credit to give the farmers. The lowest percentage of the farmers who received the largest credit indicated that the farmers had inadequate capacity to borrow huge amounts of loans. This could be attributed to the small nature of the farming enterprise. The results supported (Tiwari, 2022) that the majority of peasants borrowed a small amount of agricultural credit. However, it opposed Moahid *et al*. (2021) who noted that smallholder farmers received a large sum of credit to improve their farming scale.

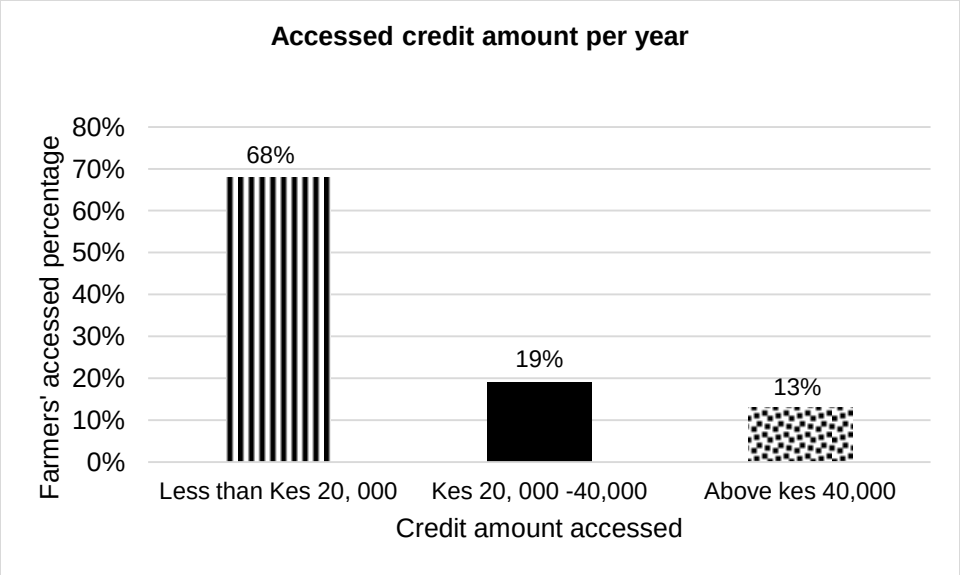


**Figure 4**: Amount of credit accessed per year

### 4.4 Access to Agricultural Credit and Use of ICT Tools

Table 2 revealed that out of those who got access to the credit (35 peasants), the majority (28 peasants) adopted the use of ICT tools in agricultural extension. On the other hand, out of those who did not access the credit (71 peasants), the majority (61 peasants) did not use ICT tools in agricultural extension. This suggested that access to agricultural credit could be among other factors that facilitated the use of ICT tools in communicating agricultural extension information. Perhaps the credit might complement the financial muscles to adopt the tools in agriculture. The results supported Ullah *et al.* (2020) who reported that microloans increase the rate of technology adoption and amount of profits from farming among farmers. Nevertheless, it opposed Akintelu *et al.* (2021) who asserted that loans are risky and have no association with technology adoption.

**Table 2**: Access to the credit and use of ICT tools

| | | **Use of ICT tools** | | |
|---|---|---|---|---|
| | | No use | Use | Total |
| **Access to credit** | No access | 61 | 10 | 71 |
| | Access | 7 | 28 | 35 |
| Total | | 68 | 38 | 106 |

### 4.5 Relationship between Access to Agricultural Credit and Use of ICT Tools

A Spearman's rank-order correlation was run to determine the relationship between peasants' access to credit and the use of ICT tools in agricultural extension. Table 3 illustrates Spearman's correlation between access to credit and ICT tools' usage. There was a moderate, positive correlation between access to credit and the use of the ICT tools, which was statistically significant at 1% level of significance ($R = +.646^{**}$, $P = .000$, $R^2 = 0.417$). Access to credit appears to provide a moderate guide to the use of the ICT tools as it predicts 42% of the use of the ICT tools in the extension services. The remaining (58%) unexplained variance may involve other variables. The use of ICT tools increases with an increase in access to credit. The results concurred with the findings of Ullah *et al*. (2020) who also confirmed a relationship between access to credit and the use of technologies. However, it contrasted with the findings of Akintelu *et al.* (2021), who stated that access to credit did not show any relationship with technology adoption.

**Table** 3**:** Spearman's correlation of access to agricultural credit and ICT tools' usage

| Number of the respondents | Correlation coefficient (R) | Sig. (2-tailed)/ P-value | $R^2$ | Coefficient of determination |
|---|---|---|---|---|
| 106 | $+0.646^{**}$ | 0.000 | 0.417 | 42% |

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

### 5. CONCLUSION

The level of access to agricultural credit was found to be relatively low and the few who got access received little amount. The most preferred source of credit among the respondents was SACCOs. The study also confirmed that there was a statistically significant relationship between access to credit and the use of ICT tools in agricultural extension among cassava peasants in Rangwe Sub-County, Kenya. Access to credit could predict 42% of the use of ICT tools in the extension.

### Ethical Approval And Consent

This research study ensures numerous ethical considerations which included presenting a research permit to the Rangwe Sub-County Agricultural Ministry, conducting proper self-introduction to the farmers, and explaining the real purpose of the study. The study also respected the confidentiality, anonymity,

dignity, norms, and culture of the farmers. Full consent was obtained FROM respondents before the data collection process.

## RECOMMENDATIONS

The study arrived at the following recommendations:

i) The County Government should provide an enabling environment for the credit providers to thrive in the Sub-County.

ii) Farmers should strive to get agricultural credits that might boost their adoption of ICT tools.

iii) Policymakers should prioritize agricultural policies that facilitate encourage the adoption of ICT tools in agricultural extension


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## DECLARATIONS

### Competing Interests

The authors of this article declared no competing interests.

### Authors' Contribution

J.C. Dimo conducted the literature review, designed the study, collected data, analyzed the data, and prepared the first draft of the manuscript. S. W. Maina and A.C. Ndiema helped with data analysis, edited the manuscript, and supervised the study process. All authors consented and approved the manuscript for publication.


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## REFERENCES


Ahmadi, S., and Irfan, M. (2022). Impact of social media on agricultural extension in Afghanistan–A Case of Ahmad Aba District. *International Journal for Research in Applied Sciences and Biotechnology*, *9*(2), 67-72.

Bernards, N. (2022). The World Bank, Agricultural Credit, and the Rise of Neoliberalism in Global Development. *New Political Economy*, *27*(1), 116-131.

Birke, F. M., and Knierim, A. (2020). ICT for agriculture extension: actor-network theory for understanding the establishment of agricultural knowledge centers in South Wollo, Ethiopia. *Information Technology for Development*, *26*(3), 591-606.

Çetin, F., Urich, T., Paliszkiewicz, J., Mądra-Sawicka, M., and Nord, J. H. (2021). ICTs, Empowerment, and Success: Women's Perceptions across Eight Countries. Journal of Computer Information Systems, 61(1), 1-10. https://doi.org/10.1080/08874417.2020.1799452

Cheboi, P. K., Siddiqui, S. A., Onyando, J., Kiptum, C. K., and Heinz, V. (2021). Effect of Ploughing Techniques on Water Use and Yield of Rice in Maugo Small-Holder Irrigation Scheme, Kenya*. Agri-Engineering, 3(1), 110-117.* https://doi.org/10.3390/agriengineering3010007

County Integrated Development Plan. (2021). Homa-Bay, *Nairobi. Kenya.*

Cronbach, L. J. (1975). Beyond the two disciplines of scientific psychology. *American psychologist*, *30*(2), 116.

Dagunga, G., Amoakowaa, A., Ehiakpor, D. S., Mabe, F. N., and Danso-Abbeam, G. (2020). Interceding role of village saving groups on the welfare impact of agricultural technology adoption in the Upper East Region, Ghana. *Scientific African*, *8*, e00433.

Hoang, H. G., Van Nguyen, D., and Drysdale, D. (2022). Factors influencing the use of agricultural information by Vietnamese farmers. *IFLA Journal*, 03400352211066941.

Kamal, A. B., Sheikh, M. K., Azhar, B., Munir, M., Baig, M. B., and Reed, M. R. (2022). Role of Agriculture Extension in Ensuring Food Security in the Context of Climate Change: State of the Art and Prospects for Reforms in Pakistan. *Food Security and Climate-Smart Food Systems*, 189-218

KNBS (Kenya National Bureau of Statistics) (2020), Economic Survey 2020, Kenya National Bureau of Statistics, Nairobi.

Mallory, A., Parker, A., Hutchings, P., and Sakrabani, R. (2022). Why Agricultural Tools Work in Theory But Aren't Adopted in Practice: A Grounded Theory Approach to ICT in Ghana and Kenya. *Air, Soil and Water Research*, *15*, 11786221221092782.

Martinez-Gomez, V., Domenech, J., and Mas-Verdú, F. (2022). Adoption of ICT innovations in the agri-food sector: An analysis of French and Spanish industries. In Innovation Strategies in the Food Industry (pp. 229-238). Academic Press. http://dx.doi.org/10.1016/B978-0-12-803751-5.00012-X

Meena, S. S., Vikash, M., and Anubhav, M. (2021). Source of Agricultural Credit. https://www.researchgate.net/publication/352179290

Moahid, M.; Khan, G.D.; Yoshida, Y.; Joshi, N.P.; Maharjan, K.L. Agricultural Credit and Extension Services: Does Their Synergy Augment Farmers' Economic Outcomes? Sustainability 2021, 13, 3758. https://doi.org/10.3390/su13073758

Mugenda, A. G. (2008). Social science research: Theory and principles. Nairobi. *Kijabe Printers*

Naissuma, D.K. (2000). Survey sampling: Theory and methods. Nairobi: *University of Nairobi*.

Odhiambo, F. O., and Upadhyaya, R. (2020). Flexible loans and access to agricultural credit for smallholder farmers in Kenya. *Agricultural Finance Review*.

Rangwe Sub-County Ministry of Agriculture Annual Report. (2021). *Nairobi*.

Rengaraj, D., and Shibu, N. S. (2022). Use of Information and Communication Technology in Agriculture among Farmers in the South Region of India. International Journal of Advanced Research in Engineering and Technology, 11(11), 240.

Ruzzante, S., Labarta, R., and Bilton, A. (2021). Adoption of agricultural technology in the developing world: a meta-analysis of the empirical literature. *World Development*, *146*, 105599.

Sa'adu, M., Man, N., Kamarulzaman, N. H., Shah, J. A., and Tafida, A. A. (2022). Factors Affecting use of Information Communication Technologies among Extension Agents in North-East, Nigeria. *Journal of Agricultural Extension*, *26*(1), 36-43.

Tanti, P. C., Jena, P. R., and Aryal, J. P. (2022). Role of institutional factors in climate-smart technology adoption in agriculture: Evidence from an Eastern Indian state. *Environmental Challenges*, *7*, 100498.

Tiwari, S. P. (2022). Information and communication technology initiatives for knowledge sharing in agriculture. *arXiv preprint arXiv:2202.08649*.

Tiwari, S. P. (2022). Information and communication technology initiatives for knowledge sharing in agriculture. *arXiv preprint arXiv:2202.08649*. https://doi.org/10.48550/arXiv.2202.08649

Ullah, A., Arshad, M., Kächele, H., Khan, A., Mahmood, N., and Müller, K. (2020). Information asymmetry, input markets, adoption of innovations, and agricultural land use in Khyber Pakhtunkhwa, Pakistan. *Land use policy*, *90*, 104261.

Ullah, A., Mahmood, N., Zeb, A., and Kächele, H. (2020). Factors determining farmers' access to and sources of credit: Evidence from the rain-fed zone of Pakistan. *Agriculture*, *10*(12), 586.

Zulfiqar, F., Shang, J., Zada, M., Alam, Q. and Rauf, T. (2020), "Identifying the determinants of access to agricultural credit in Southern Punjab of Pakistan", GeoJournal, In Press, doi: 10.1007/ s10708-020-10227-y.