African Journal of Rural Development, Vol. 8 (1): January - March, 2023: pp. 27-39 ISSN 2415-2838

Smallholder Farmer Access to ICTs and Digital Content: Experiences from Uganda

D.P. MIREMBE[1], J.T. LUBEGA[2], B. SSEKKITO[3], F. NAMBOGO[4] and B. NAMAGEMBE[5].

[1]College of Computing and Information Sciences, Makerere University, P.O. Box 7062, Kampala, Uganda
[2]Nkumba University, P.O Box 237, Entebbe, Uganda
[3]Eight Tech Consults, P.O. Box 36859, Kampala, Uganda

Corresponding Author: drake.mirembe@mak.ac.ug

ABSTRACT

The agricultural sector is the largest employer in Uganda, and it remains essential to secure the livelihood of the Ugandan population. According to a report by Price Water House Coopers, 37% of Uganda's GDP is dependent on the agricultural sector. Likewise, according to the Uganda National Household Survey (UNHS) 2019/20, the highest percentage of the working population (68.1 percent) work in the agriculture sector and taking the largest share in employment (47 percent). Despite the advancement in Information Communication Technology, the majority of small-holder farmers have limited access and usage of Information Communication Technologies (ICTs). The limited access and usage of ICTs such as smart phones constrain farmers in access to information, extension services, quality markets, among others, resulting into sub-optimal productivity and income. Studies continue to show that the use of ICTs in agriculture has been linked to farmers' enhancement in decision making, access to quality markets, improved price determination, enhanced farm level decision making and access to quality inputs, among others. The use of ICTs enables farmers to make informed decisions, supports adoption of new innovations and improvement of farmers entrepreneurs' abilities. This study focused on establishing the extent of farmers usage of digital platforms to acquire knowledge in the five regions of Uganda (Eastern, Western, Central, Northern, Rwenzori). The study adopted a mixed methods research approach which involved both qualitative (desk review, key informant interviews and focus group discussions) and quantitative (surveys) data collection methods. The qualitative data were analyzed using thematic content analysis while quantitative data were analyzed using descriptive statistics. The study found that through trainings and sensitization, farmers were able to access information using ICTs such as radio, television and social media to access and share vital information about their produce. The desired content delivery modes or platforms range from social media platforms, farming television programs, radio programmes, SMS platforms and digital media platforms in public places. The results revealed that only 30% of the farmers had not attended any agricultural training in the last 24 months, majority of the farmers (69.4 - 79.60%) indicated to listen to radio daily, a total of 568 (62.69%) who were using other platforms also indicated that they have never surfed the internet, and 486 (53.64%) of the farmers who were accessing other platforms indicated never to have used any social media

Cite as: Mirembe, D.P., Lubega, J.T., Ssekkito, B., Nambogo, F. and Namagembe, B. 2023. Smallholder Farmer Access to ICTs and Digital Content: Experiences from Uganda. *African Journal of Rural Development* 8 (1): 27-39.

Received: 10 March 2023
Accepted: 20 March 2023
Published: 31 March 2023

platform. A total of 535 farmers preferred to receive information via radio and 452 preferred television broadcasts mainly in the evening time of the day. The study results show that majority 827 (91.38%) preferred agriculture content be delivered in local languages followed by English language with 442 (48.79%). The key challenges constraining access and usage of ICTs among smallholder farmers include; lack of appropriate digital skills, limited awareness of ICTs, high costs of devices and internet bundles, lack of appropriate digital content, among others. Generally, the use ICTs varies across different elements such as time of the day, language used, technology used, content delivered, agriculture value chain, among others.

Keywords: ICTs, smallholder farmers, Uganda

RÉSUMÉ

Le secteur agricole est le plus grand employeur en Ouganda, et il reste essentiel de sécuriser les moyens de subsistance de la population ougandaise. Selon un rapport de Price Water House Coopers, 37 % du PIB de l'Ouganda dépend du secteur agricole. Selon l'Enquête nationale sur les ménages de l'Ouganda (UNHS) 2019/20, le pourcentage le plus élevé de la population active (68,1 %) travaille dans le secteur agricole, représentant la plus grande part de l'emploi (47 %). Malgré les avancées en matière de technologie de l'information et de la communication, la majorité des petits exploitants agricoles ont un accès limité et une utilisation limitée des technologies de l'information et de la communication (TIC). Leur accès restreint aux TIC, telles que les smartphones, limite leur accès à l'information, aux services de vulgarisation, aux marchés de qualité, entre autres, ce qui entraîne une productivité et un revenu sous-optimaux. Des études continuent de montrer que l'utilisation des TIC dans l'agriculture est liée à l'amélioration de la prise de décision des agriculteurs, à l'accès à des marchés de qualité, à la détermination améliorée des prix, à la prise de décision au niveau de l'exploitation agricole et à l'accès à des intrants de qualité, entre autres. L'utilisation des TIC permet aux agriculteurs de prendre des décisions éclairées, de favoriser l'adoption de nouvelles innovations et d'améliorer les compétences des entrepreneurs agricoles. Cette étude visait à établir l'étendue de l'utilisation des plateformes numériques par les agriculteurs pour acquérir des connaissances dans les cinq régions de l'Ouganda (Est, Ouest, Centre, Nord, Rwenzori). L'étude a adopté une approche de recherche mixte, impliquant à la fois des méthodes de collecte de données qualitatives (revue documentaire, entretiens avec des informateurs clés et discussions de groupe) et quantitatives (enquêtes). Les données qualitatives ont été analysées à l'aide d'une analyse de contenu thématique, tandis que les données quantitatives ont été analysées à l'aide de statistiques descriptives. L'étude a révélé que grâce à des formations et à une sensibilisation, les agriculteurs ont pu accéder à l'information en utilisant des TIC telles que la radio, la télévision et les médias sociaux pour accéder et partager des informations vitales sur leurs produits. Les modes ou plateformes de diffusion de contenu souhaités vont des plateformes de médias sociaux aux programmes de télévision agricole, en passant par les programmes radio, les plateformes SMS et les plateformes de médias numériques dans les lieux publics. Les résultats ont révélé que seuls 30 % des agriculteurs n'avaient pas suivi de formation agricole au cours des 24 derniers mois. La majorité des agriculteurs (694 - 79,60 %) ont indiqué écouter la radio quotidiennement. Parmi ceux qui utilisaient d'autres plateformes, 568 (62,69 %) n'avaient jamais surfé sur Internet, et 486 (53,64 %) des agriculteurs qui utilisaient d'autres plateformes n'avaient jamais utilisé de médias sociaux. 535 agriculteurs préféraient recevoir des informations via la radio, tandis que 452 préféraient les émissions de télévision, principalement en soirée. Les résultats de l'étude montrent que la majorité (827 - 91,38 %) préférait

que le contenu agricole soit diffusé dans les langues locales, suivie de l'anglais avec 442 (48,79 %). Les principaux défis limitant l'accès et l'utilisation des TIC chez les petits exploitants agricoles comprennent le manque de compétences numériques appropriées, la connaissance limitée des TIC, les coûts élevés des appareils et des forfaits Internet, ainsi que le manque de contenu numérique approprié, entre autres. En général, l'utilisation des TIC varie en fonction de différents éléments tels que l'heure de la journée, la langue utilisée, la technologie utilisée, le contenu diffusé et la chaîne de valeur agricole, entre autres.

Mots clés: TIC, petits exploitants agricoles, Ouganda

Introduction

World over, the use of Information Communication Technology (ICT) to enable service provisioning in a variety of areas is on the increase (Mirembe, 2015; Mpirirwe *et al*., 2021; Nakitto *et al*., 2022). Information Communication Technologies have been adopted in various sectors of the economy including agriculture and communities which have successfully exploited the potential of ICTs have been able to leapfrog some stages of development hence creating better opportunities for economic growth. In Africa and more specifically Uganda, ICTs are opening up new frontiers in the economy and defining new careers and vocations, and providing employment opportunities mainly to the youth (Mirembe, 2021). Agricultural sector still remains the backbone of the Uganda's economy, employing 68.1 % of the working population and contributing 37% to the country's GDP as of FY2019/2020 according to the National Budget Framework Paper FY 2020/21 – FY 2024/25 (MoFPED, 2019). In recognition of the potential of ICT, Government of Uganda earmarked ICTs in agriculture as one of the effective interventions to improve the agricultural sector as described in Uganda Vision 2040 (National Planning Authority, 2013) and the National Development Plan III (National Planning Authority, 2020). It is evident in many developing countries such as Uganda that ICTs have the ability to create new opportunities that enhance agriculture productivity and greatly contribute to economic development (Mirembe *et al*., 2015). Therefore, in this context Information Communication Technologies (ICT) are defined as; any device, tool, or application that permits the collection, visualization and exchange of data through interaction or transmission (Mirembe *et al*., 2019; MoICT, 2022). Further still, ICTs have enabled small-scale farmers to connect directly to consumers of their produce hence eliminating the middle men and the associated income losses incurred while accessing market (Mirembe *et al*., 2015; Ayim *et al*., 2022). Without application of appropriate ICTs, the small-holder farmers largely depend on the market agents to determine what prices to give for the agriculture produce which is disadvantageous to the farmers. These agents hike the prices and leave the producers with little or no profit. However, through ICTs small-holder farmers have access to market intelligence and can easily establish a competitive price for their produce, engage directly with potential consumers and negotiate a fair price for their produce. The use of ICTs is one way of linking small-holder producers to markets by enabling producers to perform informed decision-making during selling (Nakelet *et al*., 2017). This can be done through online marketing and open sharing of information about agriculture production.

This study therefore focused on determining the levels of awareness and use of digital platforms

to acquire information by small-scale farmers in Uganda, establishing the state of agriculture content delivery models and identify challenges faced when accessing and using ICTs. The paper is organized into the following sections. Section Two discusses related works in the field of ICT for Agriculture, the Third Section details the methodology used in the study and the Fourth section present the results and discussion of study findings. Section Five presents the emerging issues, conclusions and recommendations concerning ICT usage in the agriculture sector.

Related works

Information technology revolution is more noticeable now because of a number of factors one of which being the Covid-19 pandemic, which accelerated the demand and usage of ICTs in all sectors of the economy (Mpirirwe *et al*., 2021; Nakitto *et al*., 2022). Studies continue to show an increase in adoption and use of ICTs especially the use of social media platforms (Mirembe *et al*., 2019). Because of advancement of ICTs, a lot of information can now be effectively generated, stored, analysed, disseminated and used to inform decisions along the agriculture value chain. The improvement in access to information and associated improvement in data management in agriculture can contribute to increase in productivity and overall household income (Mwesigwa *et al*., 2016). Adoption of appropriate ICTs in agriculture enable farmers make informed decisions along the value chain from pre-production, production and post-production resulting into better farming outcomes (Paul *et.al.,* 2004; Mirembe *et al.,* 2019). Indeed, ICTs enable farmers to make decisions of when to plant based on weather predictions, which varieties, which market to sell to and at what price, among others (Meera *et al*., 2004; USAID, 2010; Asenso and Mekonnen, 2012; Mwesigwa *et al*., 2016; Nakelet *et al*., 2017; Ayim *et al*., 2022). Different ICTs are used by various actors to engage with small-holder farmers key among them include radio, SMS platforms, Voice calls, social media, Mobile and Web applications (Mirembe *et al*., 2019; Ayim *et al*., 2022). The ICTs are not only being used to communicate with farmers, but also promote peer learning and ecosystem engagement among various actors in the value (Nakelet *et al*., 2017). Smallholder farmers can integrate farm management solutions and adoption of better standards through the expert technical advice that can be got from experts who are easily accessed through ICTs such as call centre, mobile and web applications which features like ask the expert, all from expert content available on operation access repertories like YouTube among others (Mirembe *et al*., 2019).

According to the World Economic Forum on Africa, 70% of Africans make a living through agriculture, making it critical to the economies of all African countries (Mamadou, 2016). Nonetheless, agricultural productivity still remains low and food insecurity is still a challenge on the continent. Thus, countries across the continent are exploring approaches and models of how to improve agriculture productivity especially in light of the growing threat of climate change. This has in recent years led to several initiatives in using ICT to improve agriculture productivity (Mirembe, 2021). Give the digital infrastructure challenges on the continent, most of the ICT solutions being adopted to smallholder farmers are text and voice-based services targeting non-smart phones users as they are still the majority on the continent. The analysis also shows that radios are still widely used in disseminating agriculture information to rural farmers, while computers and smartphones are mainly used by large-scale farmers (Ayim *et al*., 2022). The Government of Uganda through its agencies like Uganda Communication Commission (UCC) has continued to implement initiatives to promote the development, access and usage of

appropriate ICT by small holder farmers who make up 70% of the farmers in Uganda. However, although many ICT for agriculture innovation have been developed, several factors still constrain the uptake including limited awareness, low internet and smart phone penetration especially in rural areas, high cost of devices and internet bundles, lack of appropriate digital skills, among others (Mirembe *et al*., 2021)

Methodology

This study adopted a mixed methods approach which included the use of qualitative and quantitative methods of data collection and analysis in order to gain an in-depth understanding of the issues under investigation. The secondary data were collected through an explorative literature review and synthesised using thematic content analysis. Given the nature of the study, respondents to this study were selected using a purposive sampling technique. According to Mirembe (2015), a purposive sampling technique is a non-probability technique of establishing a sample space for a given study. Thus, respondents in this study were selected based on their unique qualities that made them likely to provide the desired opinions and experiences about the use of ICTs in agriculture. The participants were selected from the five regions of Uganda, i.e., Eastern, Western, Central, Northern, and Rwenzori, majority of whom are organized in farmer groups. The key study respondents were smallholder farmers majority of whom were women and youth; Value Chain Actors (suppliers of farm input, produce aggregators, food processors among others); Community Leaders (opinion, cultural), Policy Makers (local and national leaders); and Researchers (Academia, Civic Society Organizations and Journalists). Primary data were collected between July 2022 to January 2023.

Table 1. Matrix of the Study Respondents Target per the Region

No	Category of Respondents	Examples	Method of Soliciting Responses	Totals					
				Central	Northern	Eastern	Western	Rwenzori	
1	Smallholder farmer's	majority which are women and youth	Survey Tool Focus group discussions	150	200	150	200	150	**850**
2	Value chain actors (;	suppliers of farm input, produce aggregators, food processors among others)	Survey Tool	15	15	15	15	10	**70**
3	Policy makers, community leaders	(opinion, cultural, local and national leaders);	Literature, KII	10	10	10	10	10	**50**
4	researchers	civil society organizations and journalists	KII & literature	10	5	5	5	5	**30**
	Total								**1000**

Source: Primary Data 2022

Data collection methods and instruments

Qualitative data were collected using key informant interviews, focus group discussions and desk review, while quantitative data were collected using survey questionnaire.

Key Infomart Interviews (KII). The KII interviews were used to gather opinions from farmer organization leaders, policy makers, researchers, and community leaders. The interviews were administered to at least 10 respondents from each region through physical and virtual interviews on phone call and 60 responses were obtained and their responses were used to generate thematic issues to address the objectives of the study.

Focus Group Discussions (FGDs). At least three (3) FGD comprising of at least eight members each were carried out in each region. The FGDs were carried after administering survey questionnaire and were used to broadly discuss how the farmers acquire their knowledge on farming, their preferred way of acquiring this knowledge and some of the challenges they face during the process. The FGDs were mainly used to generate consensus on thematic issue of interest.

Desk Review. A desk review of secondary data was done. This was conducted to enable the researcher gain an in-depth understanding of the issues from publish literature, but more importantly establish known patterns on the issues of investigation. Both peer reviewed and technical reports material related to the study problem and variables in form of reports, published and unpublished research, journals, electronic journals, websites and databases were used to gain more information on the study problem. Sekaran (2003) classifies these documents as secondary sources of data and asserts that this method saves time and reduces the cost of gathering information.

Survey questionnaire. This was used to collect data from smallholder farmer's majority of who were women and youth and value chain actors (suppliers of farm input, produce aggregators, food processors among others). The questionnaire used had both open ended and closed ended questions. Kothari (2005) considers the questionnaire as the most appropriate instrument due to its ability to collect a large amount of data in a reasonably quick span of time because Closed-ended questions can be more specific, thus more likely to communicate similar meanings and questions to the respondents.

Study Findings

A total of 906 people responded to the study out of a target of 1000 respondents, representing a response rate of 98% which is considered sufficient. Out of the 906 respondents, 53.3% were male and 46.7% were female. Also 47% of the respondents were between the ages of (36-50) while 36.8% were aged 26-35 while 58 (6.4%) of the respondents were Value Chain Actors who were the suppliers of farm input, produce aggregators, food processors among others). Further, 808 (89.2%) were farmers, 25 (2.76%) Policy makers and Community Leaders while 15 (1.66%) were researchers.

The Farmers level of knowledge and content delivery models. In order to establish the levels of farmer knowledge in terms of access to content and ways it is delivered the study sought to establish the current knowledge levels of farmers, the ways of content delivery to the farmers, desired methods for future use by the farmers, challenges faced during the delivery and the proposed solutions.

Level of participation in agricultural training programmes. There are different farmer training programmes organised in the various value chains by the different farmer organisations like NARO, MAAIF, Researchers among others with corresponding

training methods like result demonstrations and on farm-trials; method demonstrations; training of master farmers to train their peers; and analogy and storytelling. These trainings help farmers to incorporate the latest scientific advances and technology tools into their daily operations which increases efficiency, create less harm to the environment, reduce food contamination, among others. Therefore, the study sought to establish the level of participation in these programmes. The results revealed that only 30% of the respondents had participated in at least one agricultural training programmes in their areas in the last 24 months, 56% had not participated in any and 14% were not sure. This means more people are not participating, impling lack of knowledge among respondents as illustrated in the Figure 1 below.

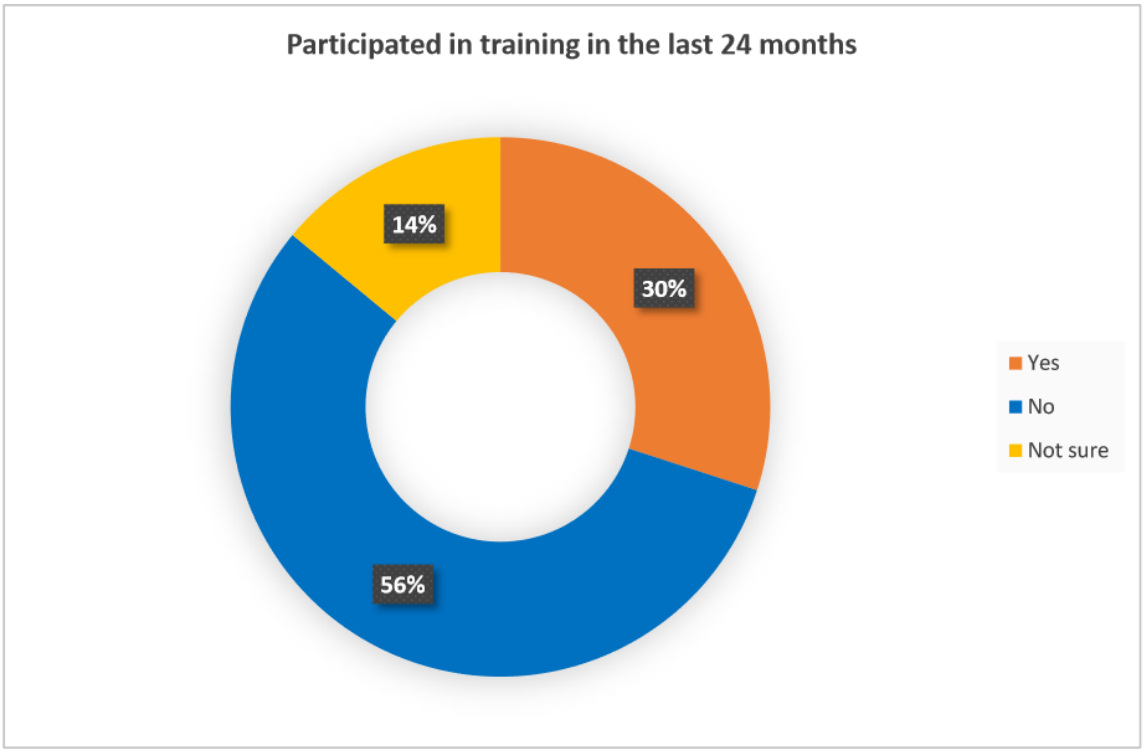

Figure 1. Level of participation in agricultural trainings

Furthermore, in discussions during an interview with a key informant from NARO, the farmer said that;

"Trainings are always organised but the farmers lack interest in participating since they don't find them beneficial to them and the training organised away from their localities, some do cite logistics challenges."

A farmer from a farmers group in Northern Uganda also added that;

"The problem is that these trainings are delivered in English a language many rural farmers do not understand. We wish they would offer them in our local languages so that we can understand"

The clear message from the farmers is that localisation of activities is very critical for them if they are to benefit from the organised programmes such as trainings. It is important for any future trainings to consider activity localisation as a major aspect.

Access to information about farmer trainings. This research sought to establish ways in which the farmers access information about the different training programmes and the results revealed that majority of the farmers get information from Radio adverts (192), followed by weekly markets in the respective districts (188), followed by the district farmer associations (158), fellow friends (108) that have got the information while the least indicated was the use of television (98), followed by newspapers (68), social media (45), surfing the internet (24) and others (25). This implies that respondents stand a high chance of accessing training if they are able to access information through the various channels as illustrated in Figure 2 below.

Access to the different platforms. Farmers were asked to indicate how often they watch, listen to the radio, read a newspaper or magazine, surf the internet, or use social media. From the analysis of results, it was evident that majority (694 - *79.60%)* of the respondents listen to radio daily as they accessed other platforms. Majority (568, *62.69%*) who were using other platforms also indicated that they have never surfed the internet. Related by 486 (*53.64%*) of the respondents who were accessing other platforms indicated never to have used social media while 407 (*44.92%*) indicated that they read newspapers once in a while, 383 (*42.27%)* indicated that once in a while they watch television and 263 (*29.03%)* indicated they watch the television daily. This implies that if access through other platforms is enhanced, participation among respondents will increase more frequently as indicated in Table 2 and Figure 3.

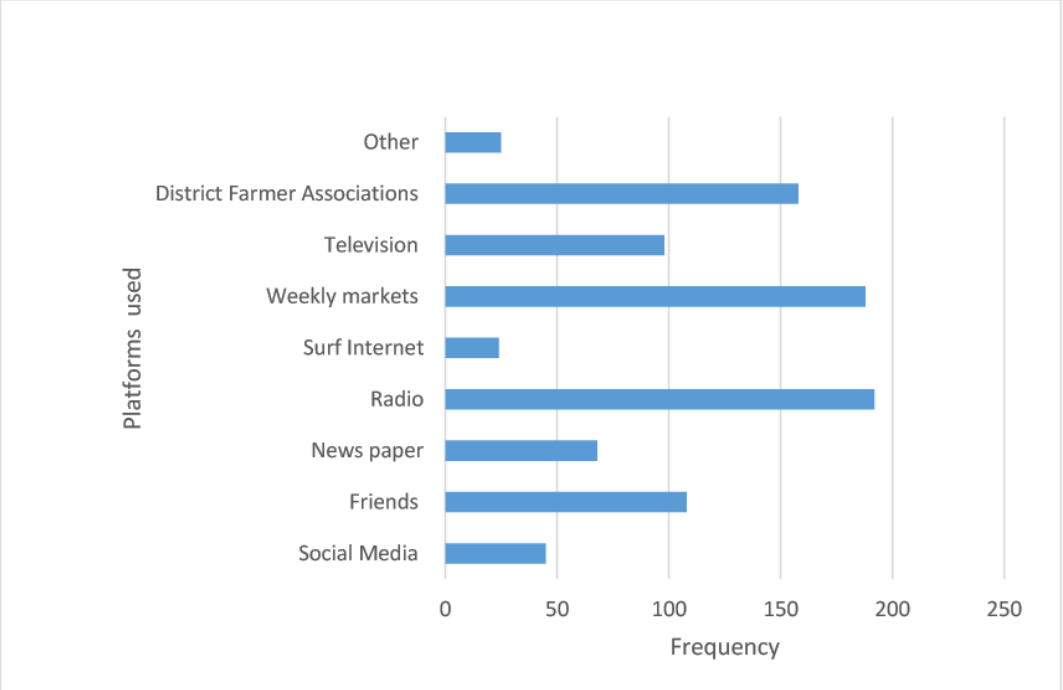

Figure 2. Platforms used to access information on training

Table 2. Rate at which respondents access the different information access platforms

Delivery mode	Once in a while	Daily	Weekly	Monthly	Never
Radio	71	694	103	20	0
Television	383	263	34	60	166
News paper	407	59	49	41	350
Social Media	177	171	50	22	486
Surf Internet	166	101	44	27	568

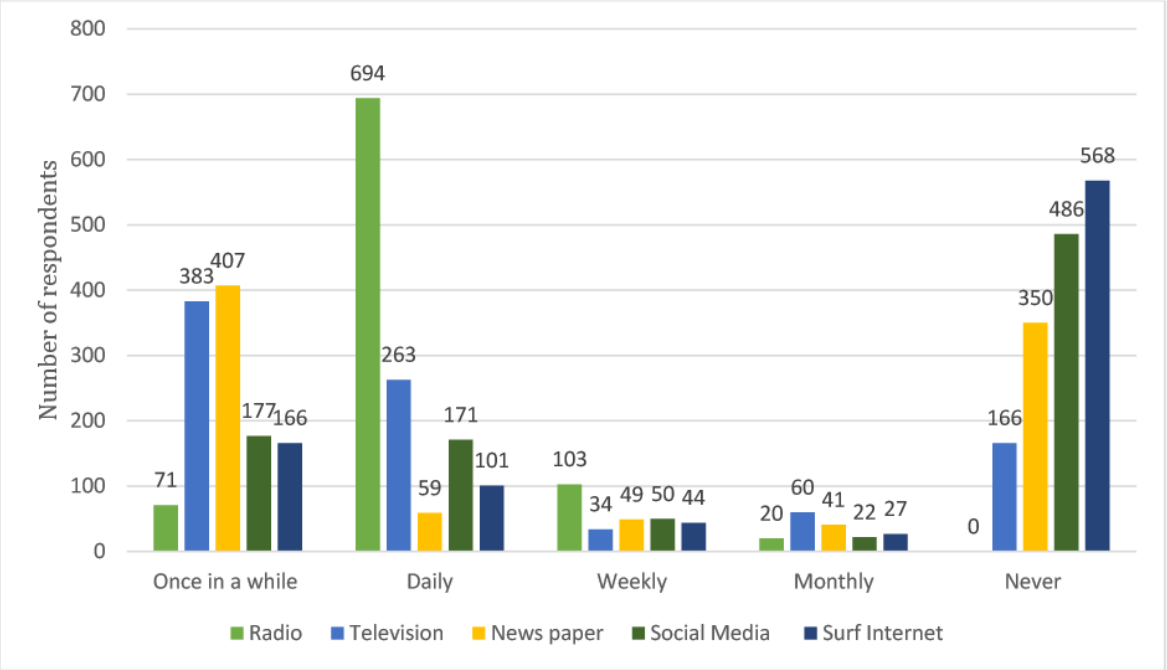

Figure 3. Rate at which respondents access the different information access platforms

Effectiveness of content delivery platforms. From the analysis of results, the most effective mode of content delivery according to the respondents is Farming radio programmes with 522 (57.62%), followed by farmer call centre with 409 (45.14%), then farming TV programmes with 262 (28.92%), farmers magazines with 122 (13.47%) and also SMS platform e.g WhatsApp with 108 (11.92%) as indicated in Figure 4.

Table 3. Effectiveness of content delivery platforms

Delivery mode	None	Very High	Moderate
Farming TV programs	85	348	473
Farmer call Centre	32	637	237
Web based content platform	322	136	448
Online **(e-workshops)**	323	143	440
Farming radio programmes	17	733	156
Social media Platforms	196	204	506
SMS platform e.g. WhatsApp	193	215	498
Digital media platforms in public places	225	236	445
Farmers magazine	241	231	434
Custom UNFFE mobile Application	362	185	359

As illustrated in Figure 4, the most effective agriculture content delivery platform was the farmer radio programmes followed by farmer call centre, social media platforms and SMS platforms like USSD and WhatsApp. This shows that the farmers use some form of ICT to get content;

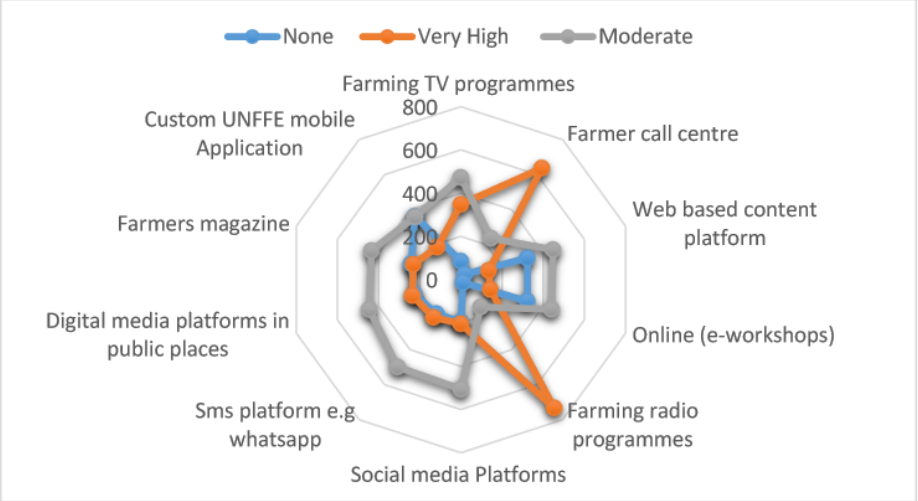

Figure 4. Effectiveness of the content delivery platforms

Preferred time for access. This study further sought to establish the respondents preferred time of access to information (morning, afternoon, evening, night, weekend). These were meant for running live broadcasts for farmer programmes and advertisements on radio, television and access to call centre services. The results revealed that majority of the respondents (535) preferred to receive radio and 452 preferred television broadcasts, 369 preferred use of call centres in the evening time. The morning and afternoon time of the day was less favourable and the deduction from this is that at that time the farmers are busy with their farm activities. Further analysis showed that the weekend was also preferred (since majority of farmers work Monday to Friday) as illustrated in Figure 5.

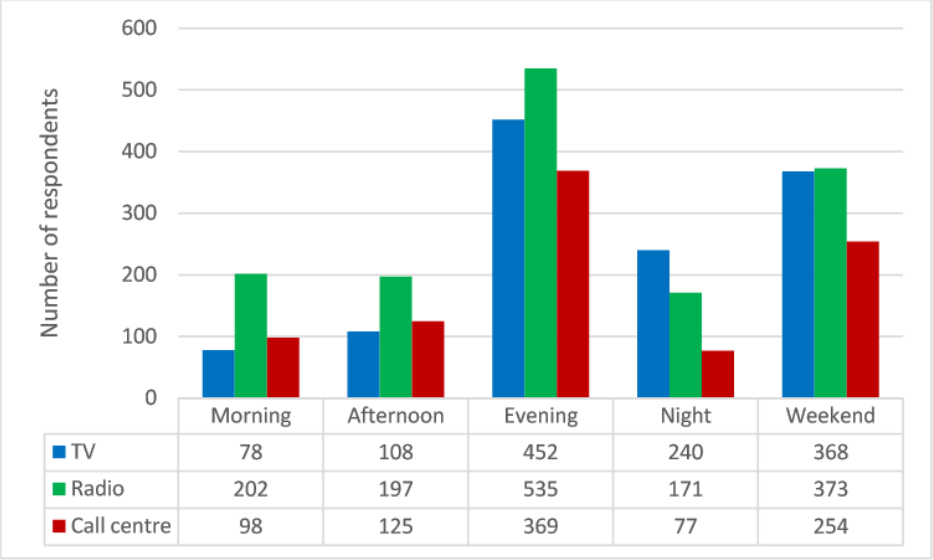

Figure 5. Preferred time for content delivery

Preferred language for delivery of the Agricultural content. This research further sought to establish the farmers preferred language for agricultural content and the results showed that majority 827 (91.38%) preferred local languages (i.e., Luganda, Acholi, Lukiga, Runyakitara, Lusoga, Ateso, among others) followed by English language with 442 (48.79%) as illustrated in Figure 6 below.

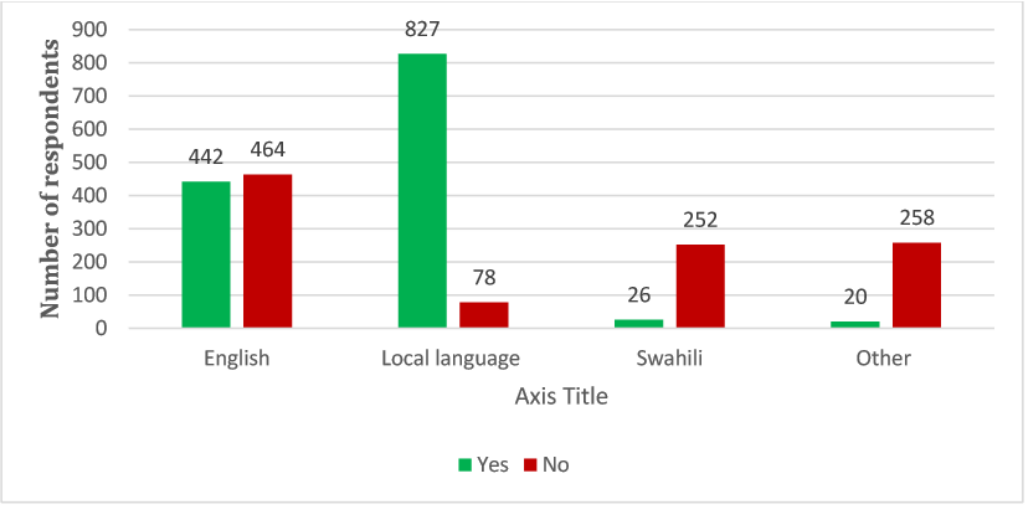

Figure 6. Preferred language for agricultural content to be delivered

In terms of desired services from an effective ICT platform, the respondents indicated a high preference in acquiring information on pests and disease management services (417), Farmer call centre services (396), marketing information and linkages (329), wealth information (230), farm records management services (224), farming enterprise selection advisory services (213) and continuous learning services (204) as shown in Figure 7.

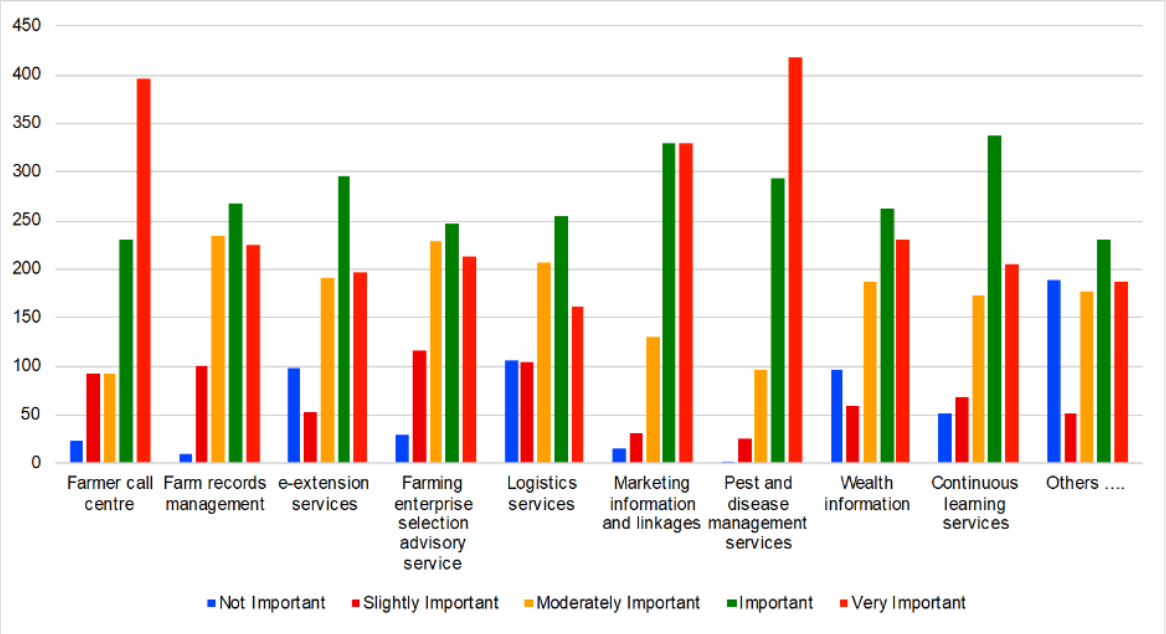

Figure 7. Desired services for an effective smallholder farmer ICT platform

Challenges faced by farmers in accessing content. As a means to establish the possible ways ICT can be used to improve knowledge transfer and content delivery to smallholder farmers, this research further sought to establish the key challenges faced by smallholder farmers to access and use ICT;

i. Majority of the farmers (687/808) indicated the limited awareness about the potential of ICTs and the lack of sufficient digital literacy skills among smallholder farmers,
ii. A significant number of the respondents (623/808) indicated that infrastructure challenges such as weak network coverage and high costs of access devices like televisions, smartphones and radios.
iii. A total of 531 farmers (65.7%) indicated the limited availability of appropriate content for agriculture especially on radio programme
iv. About 75.5% of the farmers indicated that, the high cost of internet is affecting their ability to use internet-based services for information sharing and communication.
v. A total of 380 indicated that lack of localised digital content is a major constrain,
vi. About 463 farmers indicated that limited access to electricity and the high cost of solar is a key challenge limiting their access and usage of ICTs.

Conclusion

Agriculture is one of the indispensable sectors in Uganda and the rest of the world with a potential once coupled with ICT to accelerate development. Today, there are several projects and programs that have been implemented with the purpose of increasing ICT uptake within the agriculture sector. Since the majority of the small holder farmers live in rural areas, they have limited the access to ICTs and adoption of ICT in their agriculture practices is therefore low.

During the study, it was noted that access and use of ICT amongst the small holder farmers

varied depending on factors such as age, time and day of access, type of ICT, language used, type of content beings disseminated, among others. It was evident that majority of the ICTs that were popular to the small holder farmers were those that aired information for free such as radio. The most listened to programs were in the evening since majority of the farmers are at home at that time followed by the weekend programs. Generally, there are several ways through which farmers access vital information across the different levels of the agriculture value chain. The modes in use include radios, weekly markets, TVs, friends, among others. The farmers seemed to appreciate more the traditional media avenues such as TVs and Radio since they did not incur extra costs while accessing them like they would when using the phones.

Levels of participation in agricultural training programmes was very low due to the several factors highlighted, i.e., lack of awareness of existence of these programmes, the languages used to deliver the programmes which are not well known to the farmers, among others. It is therefore important for such programs to be offered in the local languages and at preferred time of the day.

Farmer organizations and the Government should put in place strategies to improve information access among farmers. This information needs to be localized to the small holder farmers and delivered to them using the preferred means. The traditional media means are the most preferred and should be used to reach out to the farmers. Advertisements and alerts should be used more often. More investments into localized content should be done so that such content is offered out for free via the extension workers. Also, to increase access to agriculture content by farmers, Uganda Communication Commission (UCC) should ask media houses to support airing out the content freely as part of community outreach. Furthermore, UCC can explore the use of digital advertising boards in strategic public spaces like markets, hospitals, among others, to deliver the digitized and localized agriculture content. It was noted that a large group of small holder farmers did not have access to smart phones which barred them from accessing content that requires internet connectivity. Therefore, it is important that agriculture application developers also focus on developing applications that are not internet connectivity intensive and those that can be used by non-smart phones to allow more accessibility.

Acknowledgement

This study was conducted under the general programme of the ICT4 farmers initiative with the kind financial support from Uganda Communications Commission (UCC) and technical support from Uganda National Farmers Federation (UNFFE)

Declaration of No Conflict of Interest

The authors declare that there is no conflict of interest in the paper

References

Asenso-Okyere and Mekonnen, D.A. 2012. The Importance of ICTs in the Provision of Information for Improving Agricultural Productivity and Rural Incomes in Africa. UNDP Regional Bureau for Africa.

Ayim, C., Kassahun, A., Addison, C. and Tekinerdogan, B. 2022. Adoption of ICT innovations in the agriculture sector in Africa: a review of the literature. *Agric & Food Security* 11 (22) https://doi.org/10.1186/s40066-022-00364-7

Dagne, T. and Oguamanam, C. 2018. ICTs in agricultural production and potential deployment in operationalizing geographical

indications in Uganda. *SSRN Electronic Journal* DOI 10.2139/ssrn.3241169

Kothari, C. R. 2005. Research Methodology: Methods & Techniques. New Age International (P) Limited Publishers, New Delhi.

Ma, D. C. 2007. Purposive Sampling as a tool for informant selection. *A Journal of Plants, People and Applied Research* 5: 147-158.

Magesa, M. M. 2015. Linking rural farmers to markets using ICTs. Working Paper 15/12. Technical Centre for Agricultural and Rural Cooperation (CTA).

Mamadou Biteye. 2016. 70% of Africans make a living through agriculture, and technology could transform their world. World Economic Forum on Africa. https://www.weforum.org/agenda/2016/05/70-of-africans-make-a-living-through-agriculture-and-technology-could-transform-their-world/

Meera, Shaik N., Anita Jhamtani and Rao, D.U.M. 2004. Information and Communication Technology in Agricultural Development: A Comparative Analysis of Three Projects from India. Agricultural Research and Extension Network, Network Paper No. 135.

Ministry of Finance, Planning and Economic Development (MoFPED). 2019. National Budget Framework Paper FY 2020/21. MoFPED, Kampala

Mirembe, D. 2015. The threat nets approach to information system security risk analysis. ISBN 978-90-367-8139-8, University of Groningen, SOM Research School

Mirembe, D.P. 2021. Digitalisation of Agriculture in Africa: Challenges and Areas of Action. RUFORUM Triennial Thought Pieces: ISSUE 09.

Mirembe, D.P. and Lubega, T. J. 2019. State of Information Communications Technology (ICT) for Agricultural Innovations in Uganda. Technical Report. Uganda Communications Commission.

Mirembe, D.P., Obaa, B. B. and Ebanyat, P. 2015. Developing and piloting a Multi-Channel ICT-Enabled Model to enhance University engagement with Smallholder Farming Communities in Uganda. *African Journal of Rural Developmen*t 1 (1): 13 – 21.

Mpirirwe, H., Mirembe, D. P., Lubega, J. and Agaba, J. E. 2021. E-learning platforms and security mechanisms used by educational institutions in Kampala, Uganda. *International Journal of Information Technology, Communications and Convergence* 4 (1): 47-62.

Mwesigwa, E., Tulinayo, F.P. and Mirembe, D.P. 2016. Enhancing agricultural knowledge sharing among smallholder farmers in Uganda: An evaluation of mobile and web technologies. Regional Universities Forum for Capacity Building in Agriculture (RUFORUM), Kampala

Nakelet, H. O., Isubikalu, P., Obaa, B., Ebanyat, P., Okello, D. and Mirembe, D . 2017. The benefits and challenges of using ICTs to strengthen university-farming community engagement in Uganda. *African Journal of Rural Development* 2 (1): 41 – 53

Nakitto, M. H., Mirembe, D. P., Waako, C., Lubega, J., Kibukamusoke, M. and Nambogo, F. 2022. The influences of Open Access of Online Health Information on Patient Compliance to Professional Healthcare Providers Prescription in Kasangati Town Council, Wakiso District Uganda. *Advances in Social Sciences Research Journal* 9 (8): 602–616.

National Planning Authority (NPA). 2013. Uganda Vision 2040. National Planning Authority, Kampala.

National Planning Authority (NPA). 2020. Third National Development Plan (NDPIII) 2020/21 – 2024/25. National Planning Authority, Kampala.

Paul, J., Katz, R. and Gallagher, S. 2004. Lessons from the Field: An Overview of the Current Usage of Information and Communication Technologies for Development. pp 5-11. In: Digital Dividend/World Resources Institute

Riley, M. 2008. Experts in their fields: farmer-expert knowledge and environmentally friendly farming practices. *Environ. Plan. A* 40: 1277-1293

Sekaran, U. 2003. Research Methods for Business: A Skill-Building Approach. 4th Edition. John Wiley & Sons, New York

Uganda Bureau of Statistics (UBOS). 2020. The Uganda National Household Survey 2019/2020. 1st ed. UBOS, Kampala.

URSB, ARIPO and EU. 2013. Report of the workshop on geographical indications and origin marketing. Kampala. Retrieved from http://ec.europa.eu/agriculture/events/2013/giworkshops/uganda/report_en.pdf

USAID. 2010. ICT to Enhance Farm Extension Service in Africa. Briefing Paper. USAID

USAID. 2013. Using ICT to enhance marketing for small agricultural producers. Briefing Paper. USAID.