



Sources, Nature and Characteristics of Agricultural Digital Content Accessed by Smallholder Farmers in Nakuru County, Kenya

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/AJAEES/2022/v40i1031113

Open Peer Review History:

This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: <https://www.sdiarticle5.com/review-history/88409>

Original Research Article

Received 01 May 2022
Accepted 05 July 2022
Published 03 August 2022

ABSTRACT

This paper examined the sources, nature and characteristics of agricultural digital content accessed by smallholder farmers in Nakuru County, Kenya. Descriptive survey design was used in the study. A sample of 130 farmers and 12 Agricultural Extension staff were selected using purposive, proportionate and simple random sampling techniques. Questionnaires and focus group discussion guide were used to collect data. The results of the study indicated that 79.2 percent and 67.7 percent of smallholder farmers received agricultural digital content through listening to the local radio and TV stations that aired agricultural programmes respectively. The findings of the study also revealed that 60.8 percent of farmers used mobile phone calls while 46.9 percent used Short Messaging Services (SMS) to access agricultural digital content. e-books, journal, blogs, websites and pictures were the least used in accessing agricultural digital content among the smallholder farmers. The findings of the study also indicated that the cost of receiving agricultural digital content was relatively fair for texting, making phone calls, listening to agricultural radio programmes and watching agricultural TV programmes. Agricultural digital content received by farmers through radio, TV and mobile phone calls were indicated to be good in terms of timeliness, reliability and details. The language used in receiving digital content through phone calls radio and TV were also scored highly because local language is used for interaction. Texting, phone calls, radio and TV were also rated highly in terms of relevance of content. The study concluded that there is a high interest for agricultural digital content among the smallholder farmers and that they

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are already accessing it majorly through radio, TV and mobile phones. There is need however, to ensure that the content is regulated by the government through an established regulatory body in order to ensure quality agricultural information is disseminated to farmers. The content should also be based on farmers' level of knowledge and skills.

Keywords: E-extension services; agricultural digital content; smallholder farmers.

1. INTRODUCTION

“World population is expected to surpass the 9 billion mark by 2050, and agriculture has to increase the production of nutritious food to meet the growing demand and ensure food security for all. Most of the increase in food production will have to take place in developing countries” [1]. “African countries rely heavily on the agricultural sector as the mainstream for economic growth, employment creation and foreign exchange earnings. Despite its enormous potential the sector still has however continued to lag behind in terms of productivity, mechanization, advisory and extension services, and access to credit and financial markets” (Mukasa et al., 2017).

“There are approximately 1.5 billion smallholder farmers in the world and they provide approximately 80 percent of the food in many developing countries Kenya included. Despite this fact, these farmers tend to be under-resourced and lacking access to improved inputs, rural services and markets, leading to low productivity and a lack of opportunity to break the cycle of poverty. Smallholders in many developing countries remain disadvantaged when it comes to accessing quality Extension and Advisory Services (EAS)” [2]. “The importance of improving agricultural extension service delivery in relation to enhancing access to agricultural information in Kenya has been underscored in the Strategy for Revitalizing Agriculture (SRA) report. The report identifies declining effectiveness of public extension service as one of the factors impeding agricultural growth in the country. In these regard, SRA suggests reforms in the extension systems to create more effective linkages between research, extension and farmers” (Government of Kenya [GOK], 2017).

One innovative way of achieving this is through the use of Information Communication Technologies (ICTs) tools in extension service delivery. Among the ICT tools that have been adopted in order to improve agricultural extension service delivery include digital platforms for sharing agricultural knowledge such as videos used by extension agents to share

agricultural technologies and smartphone applications to diagnose crop diseases and voice messages to access agronomic tips [3], Rupavatharam & Kennepohl, 2018; [4]. Other examples also include phone calls such as those used by pastoralists to access information about grazing resources, YouTube channels that offer advice and training, and chatting applications such as WhatsApp groups developed by extension agents to discuss local farming issues with farmers and peers [5], Muhthali et al., 2018; [6]. All these digital platforms and applications share digital content that has the potential to improve farmers' livelihoods by providing up to date and real-time extension and advisory services that will enhance their decision making for improved yields [7]. The sources, nature and characteristics of agricultural digital content accessed by smallholder farmers in Kenya has however, not been evaluated empirically. This study hopes to bridge this gap.

1.1 Objectives

- i. Determine the sources and nature of agricultural digital content accessed by smallholder farmers in Nakuru County, Kenya.
- ii. Determine the level of accessibility of agricultural digital content among smallholder farmers in Nakuru County, Kenya.
- iii. Determine the characteristics of agricultural digital content accessed by smallholder farmers in Nakuru County, Kenya.

2. MATERIALS AND METHODS

2.1 Study Site

The study was carried out in Nakuru county, Kenya. The County is cosmopolitan with farming communities carrying out diverse agricultural activities hence having varied agricultural information needs and sources for accessing e-Extension services. The County has also initiated a farmer call center which is serving farmers in the entire county by providing e-Extension services majorly through their mobile phones and

social media platforms. Three sub counties namely; Molo, Subukia and Gilgil were selected to represent the three agro-ecological zones of high, medium and low potential in the county [8].

2.2 Research Design, Data Collection and Analysis

The study used descriptive survey design and a sample of 130 smallholder farmers were selected using simple random sampling technique. A structured questionnaire was administered to obtain data on the sources, nature and characteristics of agricultural digital content accessed by smallholder farmers in the study area. For each source of agricultural digital content, the level of accessibility was scored at a 5 point Likert scale of 1 to 5 (*1 = low Access 5 = Very high access*). The characteristics of agricultural digital content from different sources was also determined at a five point Likert scale of 1= *Very Poor* to 5 = *Excellent*. In addition, focus group discussions were carried out to obtain in depth information from farmer representatives and extension agents. Data was then analyzed to obtain frequencies, percentages, means and standard deviations.

3. RESULTS AND DISCUSSION

Table 1 shows the characteristics of the smallholder farmers in the study area. It reveals that 43.1 percent of respondents were male and 56.9 percent were female. "Past studies have

been used to show gaps in the adoption of ICTs due to the influence of gender differences [9]. Majority of the respondents (27.7%) were between ages 45 - 55 years with a mean age of 48 years. This thus shows that most of the respondents were middle aged which may imply possibility of little dependency since they are more robust and productive and can actively participate in farming and other economic activities and are more likely to adopt ICT tools. The distribution of respondents by education level indicates that 66 percent had attained primary level of education, 45 percent having attained secondary level and only 9 percent reaching the tertiary and university level". [8] "However, 5 percent of the respondents had no education at all. The overall findings therefore, shows that majority of the respondents had attained primary level of education and are able to read and write which could influence their ability to use ICT tools to access agricultural information. The average farm size where the farmers practiced their farming activities was 1.9 acres with 92.3 percent of the respondents' farms falling between 0.1-3.99 acres. Only 7.7 percent had land that was more than 4 acres while 1.5 percent had farms that were more than 7 acres. This suggests that a large majority of the respondents were smallholders. Group membership as depicted by the results indicated that 63 percent of respondents were members of a farmer group organization while 37 percent were not affiliated to any farmer group organization" [8].

Table 1. Characteristics of the sampled smallholder farmers

Scale	Characteristic	Percentage
Gender (n = 130)	Male	43.1
	Female	56.9
Age (n = 130)	Less than 25 years	5.4
	26-35	20.8
	36 – 45	19.2
	46 – 55	27.7
	56-65	12.3
	65 years and above	14.6
Highest level of education (n = 130)	None	5.0
	Primary	66.1
	Secondary	45.2
	Tertiary	9.0
	University	9.0
Farm Size (n = 130)	0.1-1.99	53.3
	2-3.99	39.2
	4-6.99	6.2
	7-10	1.5
Farmer Group Membership (n=130)	Yes	63.0
	No	37.0

3.1 Sources of Agricultural Digital Content

Table 2 summarizes the sources of agricultural digital content accessed by smallholder farmers in the study area.

Table 2, 79.2 percent of farmers received agricultural digital content through listening to the local radio stations that aired agricultural programmes aimed at improving farming activities among local communities. Focus group discussions indicated that farmers received agricultural content through local radio agricultural talk shows that were majorly aired at a particular time depending on the radio station. It was indicated in the discussions that agricultural information is usually aired in local languages that is understood by all the respondent and are interactive in nature hence provides two-way communication. As indicated in the discussions most of the local radio stations have different mechanisms to interact with their listeners such as call-in with mobile phones, SMS as well as social media platforms e.g Facebook and Twitter. These platforms provide one on one interaction where, listeners ask questions and get immediate response from expert interviews in real time. Some farmers also indicated that in some cases they could record the talk shows on their mobile phones and this enabled them to be able to listen to them later when required. Respondents gave examples of local radio stations such as Inooro FM a program called '*Mugambo Wa Murimii*' and Changei FM a program called '*Tugetab Temiik*' aired in Gikuyu and Kalenjin languages respectively, and involved experts and local people in development of content. Examples of content aired ranged from crop and livestock production, weather forecasting, post-harvest handling and storage, marketing as well as home nutrition. These corresponds to findings by Okello et al. [10] who found that radio was one of the effective ICT tool for communicating agricultural messages such as technologies and best

practices that can help farmers improve agricultural production.

TV also was highly used with 67.7 percent of famers indicating to use the digital content from TV to access agricultural information. The respondents pointed out that a number of TV channels aired agricultural TV shows that were very educative and captivating because they are visual, provides peer to peer practical learning and are also entertaining in nature. A number of examples were cited by the farmers during focus groups discussions such as "Shamba Shape-up" aired by Citizen TV, Seeds of gold aired by NTV and "*Mugambo wa Muriimi*" aired by Inooro TV. The TV show such as "Shamba Shape-up" as indicated during the discussions involved farmers that cut across East Africa and therefore, farmers were able to share best practices with the help of a range of experts invited to the show.

A local agricultural TV show "*Mugambo wa Muriimi*" aired by Inooro TV in Kenya was also indicated to be complementary in nature with the same show aired on local radio (*Inooro FM*) where farmers indicated that they could listen to the programme on radio and later watch the same show on TV. According to the farmers this was very important in case they missed the programme or part of the content that was aired. The content was also shared to the farmers where they could make a request through an SMS to receive leaflets of the different series aired, for example in the case of "Shamba Shape-up". For the case of "Seeds of gold" farmers also indicated that content could be accessed through daily magazine pull out every Saturday. Studies have shown that radio and TV still dominate as a source of agricultural information among farmers compared to other ICTs due to their ability to reach households at the comfort of their homes and also due to the wider geographical coverage, diverse local languages and dialects that are used by abundant local radio and TV stations (Hailu et al., 2017).

Table 2. Sources of agricultural digital content among farmer respondents

Sources of agricultural digital content	Received (%)	Received (%)
SMS	46.9	53.1
Phone calls	60.8	39.2
Radio Content	79.2	20.8
TV Content	67.7	32.3
Pictures (Accessed from ICTs)	18.5	81.5
e-books/journal/blogs/websites	3.8	96.2

Mobile phones were also found to be frequently used mode of receiving agricultural content with 60.8 percent of farmers making phone calls, while texting was used by 46.9 percent. During the focus group discussions, the respondents indicated that it was more convenient for them to make a phone call than writing a text message to receive agricultural content because its two-way communication, reduces time taken to access the information and is cheap. Phone calls for example were made by farmers to extension officers, agro dealers, buyers of agricultural products, neighbors, friends & fellow farmers, farm laborers among others where, different services were requested and negotiated for.

SMS services also was cited to be used by farmers to also request and receive different services. An example of this as indicated by farmers during focus group discussions was “iShamba” which is an SMS based service available to Kenyan farmers across the country where they can subscribe to it at a fee. In return they are able to receive local weekly weather forecast and market prices for two crops, two nearby markets and two agronomic tips related to their region. Another example is icow which is an SMS service for dairy farmers where they subscribe to receive regular SMS on breeding and production patterns of their cows. These two examples are those that farmers subscribe to and are able to get daily SMS based content. Farmers also were able to get other forms of SMS based content that were generated on request from other service providers such as agro-dealers, veterinary service providers or extension agents. As indicated from focus group discussions farmers noted that SMS services were more cost effective and could be referred to later particularly, where complex information and steps to be followed were shared compared to phone calls. On the other hand, SMS’s were indicated to take more time to write and be responded to compared to phone calls and could

only be utilized by those who are able to read and write.

Phone calls on the other hand, as indicated by farmers was good in getting quick response, could be used to get instructions and follow-ups though they were more expensive according to them when compared to SMS. The findings correspond to findings by Okello et al. [10] that farmers used phones calls and text messages to access market information because texting in particular was a low-cost mechanism for disseminating price information that could reach a significant portion of the smallholder farmers. Mutunga and Waema [11] however, found that phone calls were more convenient to farmers with low level of education. The finding of this study further shows that, pictures accessed from ICTs and e-books were used by 18.5 percent and 3.8 percent of farmers respectively. Interactive Voice Response (IVR) was not used by any of the respondents to access agricultural digital content.

3.2 Level of Accessibility of Agricultural Digital Content by Smallholder Farmers

Table 3 shows a summary of the scores of level of accessibility of agricultural digital content by smallholder farmers. This included actual agricultural digital content that was accessed by respondents through different ICTs. This was scored at a 5 point Likert scale of 1= *No Access* 2 = *Low access* 3 = *Moderate access* 4 = *High access* 5 = *Very high access*.

The results in Table 3 shows that accessibility to texting, phone calls, radio broadcast, and TV content among the farmers was very high with all of them having a median and mode of 4. Pictures had a poor to moderate availability with a median and mode of 2 and 3 respectively while e-books/journal/blogs/websites had a poor usage level with both median and mode of 2.

Table 3. Central tendencies of level of availability of agricultural digital content among smallholder farmers

Agricultural digital content	Mode	Median	Lower bound	Higher Bound
SMS	4	4.00	1	5
Phone call	4	4.00	1	5
Radio broadcast	4	4.00	1	5
TV Content	4	4.00	1	5
Pictures (Accessed from ICTs)	3	2.00	1	5
e-books/journal/blogs/websites	2	2.00	1	5

(n=130)

3.3 Agricultural Digital Content Usage among Farmer Respondents

The researcher sought to establish whether the information accessed by respondents through various ICT platforms was agricultural related and would enable them to use in their agricultural activities. The results are presented in Table 4.

Table 4 indicates that phone calls are often and always used by the farmers to access agricultural information as it had a mode of 5 and a median of 4. Radio and TV were often used for agriculture-related information with both having a mode and median of 4. Texting and pictures obtained from ICTs sometimes contained agricultural information with a mode and median of 3 for both these digital contents. E-books had a mode of 1 and a median of 2 shows that they were rarely used while no farmer recorded to have ever used IVR Interactive Voice Response (IVR). This shows that the respondents received agricultural digital content in form of text, making calls for enquires and also listening to agricultural radio and TV programmes. These was confirmed through focus group discussion where the discussants indicated that they would subscribe to mobile text to receive alerts on agricultural information such as variety of seeds to plant in a particular region, availability of inputs and new products in the market such as agro-chemical. They further indicated that they listened to farmers' radio and TV programmes that helped

them to learn and improve their agricultural practices.

3.4 Farmer Respondents' Perception on the Characteristics of Agricultural Digital Content

Table 5 presents the scores of smallholder farmers in relation to the various characteristics of agricultural digital content which included cost, timeliness, detail, reliability, language, and relevance. The scores were rated at a five point Likert scale of 1= *Very poor* to 5 = *Excellent*.

The data in Table 5 shows that the cost of the of receiving agricultural content through various ICTs was relatively fair, with farmers indicating that the cost for texting, phone calls, radio and TV programmes having an average mean 3.1 to 3.4. The costs associated with use of ICTs included costs that a farmer incurs in buying airtime, data bundles and charging the phone, buying batteries for the radio, paying for electricity charges and subscribing to TV channels in order to access agricultural information. Discussions from focus groups indicated that farmers' found ICTs to be convenient because it provided them with real time agricultural information and saved them the cost of travelling to access the information. They indicated that they could make calls for example, to public extension agents to find out availability of government subsidized fertilizer and only travel when the fertilizer was in stock.

Table 4. Central tendencies for agricultural digital content usage for agriculture

Digital content	Mode	Median	Lower bound	Higher Bound
SMS	3	3.00	1	5
Phone call	5	4.00	1	5
Radio broadcast	4	4.00	1	5
TV Content	4	4.00	1	5
Pictures (Accessed from ICTs)	3	3.00	1	5
e-books/journal/blogs/websites	1	2.00	1	5

(n=130)

Table 5. The average scores of farmers' perceptions of characteristics of agricultural digital Content

Digital content characteristics	SMS	Phone Calls	Radio Content	TV Content	Pictures	e-book /journals
Cost	3.1	3.4	3.2	3.2	2.9	2.8
Timeliness	3.1	3.4	3.5	3.6	2.8	2.4
Detailed	3.1	3.4	3.5	3.7	3.2	2.4
Reliability	3.1	3.5	3.6	3.5	3.3	2.6
Language	3.5	3.9	3.8	3.7	3.4	2.8
Relevance	3.5	3.7	3.8	3.6	3.4	3.4

Pictures and e-books /journals/ blogs/ websites were also fairly scored though as indicated by the results over 90 percent of the respondents did not have access. The timeliness of receiving agricultural information through the various ICTs was indicated to be good except for pictures and e-books/ journal/ blogs/ websites. As indicated by the results the timeliness of receiving information from radio (3.5) and TV (3.6) was relatively good as farmers indicated from focus group discussion that most of the programmes were based on seasons and were tailored to their needs. According to Naruka et al. [12] timeliness of agricultural information is very crucial for farmers' access. Regarding the amount of details of information provided by the specific ICTs resources information received by farmers through radio was scored 3.5 and TV 3.7 tending towards very good. Discussions from focus groups indicated that the information aired through the programmes they listened to was very informative to the farmers. As indicated by farmers the information from TV in particular was very educative because they could follow the agricultural practices being done practically. They also suggested that some programmes were aired on both radio and TV and one could listen to the radio while in the farm and also follow the same programme later on TV after work hence, the two complementing each other. A good example of this was "*Mugambo wa Muriim*" aired by Inooro Citizen Radio and TV stations.

In relation to reliability, radio, phone calls and TV were scored to be good with a mean average of 3.5 and above meaning that farmers relied on these tools majorly as their information source. They indicated that they relied on these sources because they trusted them as a source of agricultural information and was believed by farmers to be credible. The language used in receiving agricultural information through phone calls radio and TV had the highest score of 3.9, 3.8 and 3.7 respectively majorly because the language used was their local language. The farmers who had access to e-books/journals/websites scoring them to be fair in the language used which they indicated to be majorly in English. In terms of relevance of information all the ICTs were rated fairly above 3.4. Texting, phone calls, radio and TV being the most highly rated at a mean of 3.5 and above in terms of relevance of content. In particular radio and TV programmes are aired in local languages which makes the content very relevant to the farmer. This agrees with the finding by Kante et al. (2018) who found that farmers preferred radio

and mobile phones due to their ability to give relevant and efficient information on financial and agricultural information services. Nakasone and Torero [13] also in their findings reports that relevant agricultural information particularly provided through mobile phones are very critical in agricultural extension. Fafchamps and Minten (2012) however, found out that there was no impact of agricultural information that was based on "push scheme" (push messages are those that are sent out to a persons' mobile phone without them initiating a request for the information) through texting. The possible reasons according to them was due to push contents not being specific to farmers' concerns and the content being complex. This could be an indication that when the content provided does not meet the information needs of the farmers they might not likely utilize the content provided to them. Mittal and Mehar [14] posits that access to reliable, timely, and relevant information can help significantly and, in many ways, to reduce farmer's risks and uncertainty, empowering them to make good decisions.

4. CONCLUSION

Agricultural digital content is majorly accessed by smallholder farmers through mobile phones, radio and TV. These platforms majorly offer content in local languages based on seasons along the agricultural value chain. The digital content provided to the farmers offers an avenue through which farmers can access up to-date, real-time agricultural information either directly or through advisory services hence can enhance decision making and improve yields.

5. RECOMMENDATIONS

Policy makers need to ensure that agricultural digital content development is well coordinated and regulated and also stakeholders' participation is considered in order to ensure quality agricultural information is disseminated to farmers. This will ensure customized, tailored and targeted agricultural content are delivered to farmers. The government, mobile and internet service providers could also make provisions for subsidies for mobile phone airtime, data bundles and internet subscriptions to increase affordability for farmers at all time when seeking agricultural information.

CONSENT

As per international standard or university standard, respondents' written consent has been collected and preserved by the author(s).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
<https://www.sdiarticle5.com/review-history/88409>