

The Effectiveness of Audio Media in Enhancing Farmers' Knowledge: The Case of Smallholder Banana Farmers in Western Uganda

<https://doi.org/10.3991/ijes.v7i2.10847>

Mark Kaahwa^(✉)

Vrije Universiteit Brussel, Belgium
Mountains of the Moon University, Kampala, Uganda
mrkcosta@yahoo.com

Chang Zhu

Vrije Universiteit Brussel, Belgium

Moses Muhumuza, Rodgers Mutyebere, Charles Karemera
Mountains of the Moon University, Kampala, Uganda

Abstract—Although audio media has been presented by previous research as a suitable medium for conveying agricultural information, there is limited research in assessing its effectiveness in assisting farmers' gain agricultural knowledge. This study thus undertook to carry out that investigation by involving 1000 smallholder banana farmers in the study which involved a baseline survey, an intervention, and an end line survey. The preliminary survey results showed that 456 farmers had relevant knowledge of farming practices and were removed from the study. However, 541 farmers were lacking the required knowledge regarding proper banana farming practices. This group was assigned to an intervention of radio broadcasts for one month. All broadcasted content was recorded on CDs and circulated to the participants for continued revision. This was followed by the end line survey and the two datasets were compared to establish the change in knowledge levels of the farmers. The tests of variances before the intervention and after the intervention indicated that the two groups being compared are assumed to be approximately equal ($p > 0.05$). Results showed a significant difference in the mean knowledge scores before and after the intervention. Furthermore, independent t-test results reveal a statistically significant difference in the pre- and post-knowledge tests of farmers. In addition, results from Pearson Correlations show that farmers' characteristics such as age, gender, and level of education do not influence the uptake of knowledge on farming practices by farmers. However, results reveal a statistically significant association between the source of information (Radio Broadcast & audio CDs) and knowledge gain regarding most banana farming practices by farmers. This study provides further evidence that audio media in the form of radio broadcasts and audio CDs is a vital source for agricultural information to the rural farmers. Moreover, it can be concluded that farmers' characteristics do not influence knowledge gain for banana farming practices when audio media is used as a medium of information dissemination. And thus, audio media remains

a vital source of information for resource-poor farmers and can greatly enhance their agricultural knowledge when audio media is used as an intervention.

Keywords—Audio media, smallholder banana farmers, farmers' knowledge

1 Introduction and Background Information

In rural and hard to reach areas, information, knowledge, and skills are key factors that can positively enhance agricultural development. However, access to such information is always difficult partly because of limited Information and Communications Technologies (ICTs). For such rural areas, the only accessible and affordable medium of communication is the radio. The information provided by the radio contains fresh ideas and introduces new opportunities to rural farmers [1]. One study by [2] observes that community radio is the most effective and reliable means of communication for the rural farmers and radio has been used across the globe in agricultural extension. This medium of communication is preferred because of its many advantages over other means of communication; it is cheap, crosses geographical barriers, communicates with people in their local and familiar language and it does not require electricity which is a rare resource in most rural communities in Africa. Above all the radio goes beyond literacy barrier and this makes it a convenient medium. It is a flexible medium, community people can perform their routine chores as they listen to agricultural radio programmes. In a related study by [3], it was observed that agricultural knowledge can be imparted into rural farmers located in dispersed geographical areas through the use of ICTs such as radio, audio CDs, TVs, etc. Knowledge and skills regarding proper modern farming practices like the use of quality seeds, fertilizers, insecticides, safety standards, fair pricing, availability of market can be aired through the use of such ICTs. Since such ICTs for example radio can use the local language are very instrumental in helping local farmers who are uneducated and depend upon traditional myths and methods for predicting the season and cultivation. Such farmers are denied the paybacks of modern researches and technology. In this study, we examined the effectiveness of audio media (radio broadcasts and audio CDs) in enhancing smallholder banana farmers' knowledge regarding proper farming practices. The convergence of ICTs has been emphasized in previous studies, for example in the study by [4] it is observed that the merging of the internet with rural radio, could be very effective in disseminating knowledge and information to the resource-poor farmers. Using radio broadcasts supplemented by audio CDs, this study examined the differences in knowledge levels of the farmers before and after an intervention.

This study took a case of small-scale banana farmers because banana is a key crop in Uganda, providing financial support to both rural and urban populations. In addition, it suffices to note that banana is not only a key food crop but also an important source of income for resource-poor farmers. It is estimated that over 75% of Uganda's farmers grow bananas on 1.5 million hectares, an equivalent of 38% of the total land under crops [5]. The crop is regarded not only as the most preferred food crop in the country but also as a high-income contributor through sales in both raw form and

other value-added products such as cakes, local brew, juice, chips, and other food products [6]. However, it is sad to note that few smallholder banana farmers have access to information regarding proper banana farming practices, they have no sufficient knowledge such as the use of mineral fertilizers to replace nutrients in the exhausted soils. Similar farmer challenges are pointed out in a study by [7] where it is observed that the state of affairs of the resource-poor farmers is exacerbated by natural hazards such as land erosion, drought, and floods, which can easily be controlled if farmers were equipped with the necessary protective agricultural information.

Farmers also receive reduced net earnings because of limited bargaining power for farm inputs such as fertilizers, herbicides, and other related inputs. These low rate earnings do not only reduce the capacity of farmers but affects their morale to continue engaging in agriculture. This bizarre situation is blamed on inadequate access to agricultural information and knowledge and can be turned around through the transforming of the agricultural sector by putting in place a proper medium of communication to disseminate information to the rural farmers on proper farming practices such as sustainable land and soil improvement, labour productivity and remunerative market structures. One study by [8] observes that insufficient or complete lack of agricultural information has negative consequences on agricultural production, for instance, lack of planting information can result in poor timing whereby farmers either plant early or late which of course leads to low yields and eventually meagre farm incomes.

Accurate information on weather is vital for timing major agricultural activities including but not limited to land preparation, planting and spacing of crops, harvesting, and storage. All these farm activities if not properly planned can affect crop yields, quality of produce and household incomes. Previous studies have pointed out that accessing information on proper farming practices is key for agricultural development in Africa. For example, in the study conducted by [9] observed that close to 75% of the rural-based and resource-poor farmers in Africa derive their living from agricultural production, but astonishingly they still face severe food shortages and poverty. Unfortunately, most African countries have not demonstrated willingness to provide to smallholder farmers agricultural information which could change this situation. But also, most of the farmers are semi-literate or illiterate which limits their access to printed sources of information about farming and cultivation provided by the government through the ministry of agriculture. The situation is worse, especially in rural areas where 70–80% of the African population lives [7].

One study by [8] observes that a major challenge faced by most smallholder farmers in Uganda is lack of timely agricultural information on which farmers can base to make wise economic decisions for proper allocation of scarce resources. This situation has adversely affected agricultural production. Given the existing deficiencies in agricultural information sources and channels, this study sought to use audio media as an intervention that will guarantee sustainable information flow and sharing for improved decision making and planning for smallholder farmers. However, even if audio media (radio broadcasts and CDs) is a major source of information for smallholder farmers, it remains to be established if it enhances the knowledge of farmers regarding proper banana farming practices. There is inadequate empirical work in this area. Therefore, this study attempts to investigate whether audio media increases the

knowledge of smallholder banana farmers regarding proper banana farming practices. In addition, the paper investigates the extent to which socio-economic factors (*Level of education, source of information gender and age*) influence the uptake of knowledge regarding proper banana farming practices. There is not enough research that has assessed the influence of these socio-economic characteristics in regard to the uptake of knowledge by farmers.

2 Literature Review

2.1 Effectiveness of audio media in information dissemination among small holder banana farmers

In rural Africa, agricultural information and knowledge are vital factors that can propel economic development. Information dissemination and exchange containing new and proper farming practices can fetch new opportunities to the illiterate and rural small-scale farmers [9]. This is supported by another study that found the use of ICTs especially innovative community radio, mobile phone combined with radio, rural community telecentres and farmers' call centres to be the most affordable and reliable means of enhancing agricultural information and knowledge exchange, not only between extension agents and smallholder farmers, but among the small holder farmers themselves [9]. Furthermore, the benefits associated with radio for broadcasting of agricultural information to smallholder farmers have been increased due to the beginning of many private community radio stations in rural areas. Even if majority of these radio stations are profit-oriented, and therefore, promote programmes that are mostly sponsored by private organisations, they at the same time air out a range of agricultural related programmes.

Public radio stations are inclined to air programmes that satisfy the political agenda of the government, rather than farmers [10]. The same idea is supported by [11] who points out that radio is a medium of choice for resource-poor community people because it does not only create awareness of the best farming practices but has the capacity of increasing adoption of innovative agricultural practices for rural farmers with limited means of farm improvement. This echoes well with one study that pointed out that accessing agricultural information at a time when it is needed can enable rural farmers in Africa compete favourably with their counterparts in the developed world. Reliable and timely information can help them increase production, improve marketing which translates into increased outcomes and welfare for the farmers. On the contrary it is observed that gaps in information circulation to the rural farmers inhibit them across the value chain [8]. Furthermore, the study observes that small scale farmers with medium access to information observe how their counterparts are doing things and draw lessons from them. Their source of information is farmer-to-farmer exchange. They transfer this information and knowledge to their own farms. Unlike NGOs that offer information on service-oriented activities, radio and audio CDs are important sources of farm information and are widely used in most rural communities. Radio broadcasts for farmers provide a wide range of agricultural in-

formation including new crop and disease resistant varieties, appropriate chemical use, and weather forecasts.

In the study by [8] it is found that NGOs cooperate with agricultural extension officers for extension delivery to rural farmers. Traders who deal with farm produce such as maize have links with chemical dealers for storage information. The results show that agricultural extension officers do not partner with radio stations to help them share information widely with farmers and this affects rural farmers whose reliable and affordable source of information is the radio. Previous studies have shown that even if face-to-face interaction between extension workers and rural farmers is vital, this cannot satisfy the farmers' agricultural information needs. This is because extension workers are not only few but are ill funded by most African governments. They lack essentials such as transport, training manuals, inputs and other basic training materials. They can hardly address emergency situations like those related to weather such as drought, floods or pest infestation. Consequently, radio broadcasts if well planned and timely communicated to rural peasant farmers could be very effective in addressing rural farmers' information needs and this is because radio reaches almost everyone in the community. This resonates well with one study by [12] where peasant farmers pointed out that the extension agents are not doing a commendable job in solving the issues affecting the rural farmers. Farmers indicated that the extension agents may not be showing equality in the distribution of extension services. In addition, it is noted that unlike other methods of information dissemination, the community radio as an extension tool serves the farmers better because it can take technical information from the agricultural-based research community, including local universities, research institutes, rural development centres and non-governmental organizations (NGOs) and convert this information into the native languages of the peasant farmers.

Findings of the study conducted by [10], indicate that peasant farmers solidly stated that they mostly received agricultural information from fellow farmers and radio daily compared to other sources. This was mainly due to the nature of the information, source and time the programmes were aired on radio and togetherness with each other in the community. Such information was considered immediate and spread widely. Although radio is a preferred medium of communicating agricultural information by most rural farmers, the same study found farmers and extension workers to be effective in the dissemination of agricultural information, for example a respondent in one study observed that other sources used to disseminate agricultural information are less important compared to extension agents. This is because extension agents are easily accessible in urgent and serious situations where rural farmers need information. Farmer to farmer information was also highly evaluated in the same study. However, generally about the effectiveness in information dissemination, audio media was found more effective as an information source than farmer to farmer method of disseminating agricultural information. The reason for this is perhaps the upsurge in access and use of mobile phones, CDs and in addition to many radio stations that promote the call-in services. This echoes well with the study by [13] who observed that the knowledge levels of the peasant farmers who listened to the radio broadcasts on agriculture programme significantly increased compared to the non-

listeners. The study further observed that the peasant farmers who listened to the radio programmes had gained knowledge and altered their attitude toward modern farming compared to their counterparts who did not listen. Findings of this study presuppose that the radio was very instrumental not only in the dissemination of agricultural information but also the mastery of knowledge by the peasant farmers. This was also confirmed by earlier studies for example, [14] observed that nearly half of the farmers who listened to the radio and viewed TV broadcasts reported to have gained more knowledge and were able to adopt improved farming practices. This is consistent with study findings of [15] that show that majority of peasant farmers (82.6%) mentioned that they own radio sets and more than half of them 64.3% observed that radio is a vital and reliable source of agricultural information. This indicates thus, radio broadcasts will benefit many farmers and more could benefit if they only care to listen. A related study has similar sentiments where it is observed that consistent listening by small scale farmers to the radio agricultural programmes equips farmers with valuable knowledge about new farming techniques. The information received enables farmers to gradually and progressively change their methods of farming [16].

However, an assessment of the effectiveness of other agricultural information sources indicates that extension workers scored lowest in the dissemination of agricultural information. The reason for this is perhaps because farmer groups are easily accessible by fellow smallholder farmers and the latter can easily and usually at no cost access any agricultural information they need, this makes extension agents encounter just a few smallholder farmers [17]. Findings of another study by [18] shows that radio across the globe has been very instrumental in creating awareness among farmers. Information regarding modern farming practices such as selection of hybrid seeds, manure and fertilizer application, disease and pest control, this and more can conveniently be disseminated to the farmers with less costs. Farmers have different sources of information as can be illustrated in figure 1. However, for the majority poor, illiterate and rural-based farmers the only reliable and accessible source of information is the radio. Most previous studies in developed and developing countries have stressed the importance of radio in information dissemination to the rural farmers. For example, [19] observed that radio is not only vital in information dissemination but cheap and thus can be afforded by majority farmers. It has capacity to reach larger numbers of dispersed rural farmers. It has no limitations, even the remotest and hard to reach environments, the radio is there. It is a key medium for the rapid dissemination of agricultural information to the rural farmers. This echoes well with other previous studies that found radio to be very key in disseminating information to farmers. It was found that two cohorts of farmers differed significantly; those who listened to the radio agricultural programmes and those who never listened at all but relied on other sources of information. The farmers who listened exhibited better farming practices than their counterparts who did not [12], [13]. Consequently, this study sought to investigate the effectiveness of radio in equipping farmers with knowledge on proper banana farming practices. Of all the information sources the radio supplemented by recorded information on CDs was preferred because in the Ugandan context, although there are a multitude of FM radios they are limited studies that have investigated how useful these radios stations can be in equipping rural farm-

ers with the necessary knowledge and skills. Although, previous research has shown that of all the agricultural information sources, radio is the most suitable medium for the rural farmers, this has not been fully investigated in the Ugandan context with a convergence of ICTs. A summary of some of the sources of information that farmers use is indicated in figure 1.

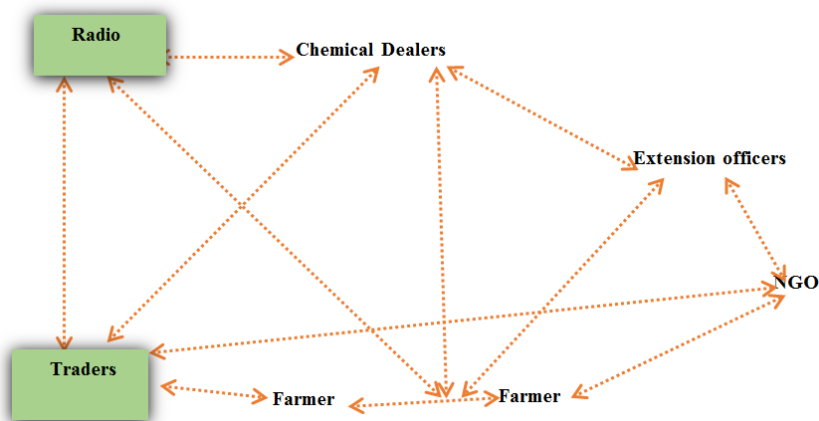


Fig. 1. Authors' blend of the agricultural information sources noted in the Literature reviewed.

2.2 The influence of socio-economic factors on the uptake of knowledge regarding proper farming practices through audio media.

In this study we also sought to establish the influence of socio-economic factors such as level of education, gender, age and source of information on the uptake of knowledge regarding proper farming practices. Socio-economic factors can either negatively or positively influence farmers' knowledge which in turn can affect productivity. According to [10], the use of ICTs in most developing countries for the provision of relevant agricultural information to rural farmers largely depends on the socio-economic background of each individual farmer in the agricultural sector.

In a related research, it is observed that access to agricultural information and knowledge are key socio-economic factors that foster agricultural development in the world. Agricultural information is crucial in enhancing agricultural production of smallholder farmers. The information is obtained from various sources, depending on the type and uses to which the information is intended for. Agricultural information is normally generated from different digital sources and disseminated to smallholder farmers through different channels of communication. However, for the rural and remote areas of Africa, radio is the most affordable communication channel for the rural population. Farmers' reliance on agricultural extension, as the major sources of information and knowledge, has been the greatest hindrance to agricultural production in most rural areas in Africa. It has been found that some of the sources of information to farmers are unclear and counterproductive [10].

Today more than ever before, access to information and acquisition of knowledge are not only key drivers of socio-economic transformation but also the most important factors of development across the globe. Rural farmers have limited access to agricultural information and this affects agricultural productivity. Agricultural information is usually obtained from different sources and circulated to rural farmers through different channels, but out of these, radio has so far proven to be the most affordable and accessible to rural farmers [10]. This view is also supported by [8] who argues that with an ever-increasing population and land fragmentation, the perpetual decline in soil fertility, environmental degradation, increased crop pests and diseases, smallholder farmers need knowledge and information that can help them improve the quality of their production. Therefore, providing appropriate information on proper farming practices can greatly enhance their living standards. In the study by [14], no significant relationship was found between demographic characteristics such as age, land holding, extension services, social participation, and mass media participation. This finding is supported by the study by [20] who observed that there was no significant correlation between education level and knowledge gain by peasant farmers. However, there was a slight difference in knowledge acquisition, knowledge gain was slightly higher among the literate farmers when compared to illiterate ones. The contribution of both women and men to agricultural production is significantly high and yet their access to agricultural information and resources differs. For example, despite their contribution to agricultural production, many rural women do not have as much privilege to access information as men. These gender disparities majorly caused by the socially constructed relationship between women and men negatively affects not only access to agricultural resources but even access to information which key to agricultural production [21]. This gender gap in agricultural production is also confirmed by [22] who observes that in some of the developing countries, there is limited contact between men and women and in cases where we have more men as extension workers than women, the latter are less likely to access agricultural extension services with a presumption that agricultural information received by men will dribble down to women and other household members. However, on the contrary findings of one study by [23] did not find this to be the case.

3 Theoretical Framework for the Study

This research uses the Diffusion of Innovations Theory authored and propagated by [24] in his Diffusion of Innovations and expounded on in Communication of Innovations: A Cross Cultural Approach by [25]. This work explains the process by which new ideas, concepts, thoughts and innovations move through channels among people of a given social system. For elaboration, check the SMCRE Model (Source-Message-Channel-Receiver-Effect) in Figure 2. In this model (S) stands for Source and this could be some agricultural agency or any NGO poised to disseminate agricultural information to the farmers, (M) stands for message, and this could be any advice regarding some agricultural information to the farmers such as site selection, planting and spacing, fertilizer application or disease and pest control, The message reaches

the farmers through a conduit or channel, in this model abbreviated as (C). This channel could be a radio, fellow farmers, farmer groups, government or extension agents. In this study the channel was MMU community radio “Amagezi Murro-Knowledge is power” 105.2 FM. In the model (R) stands for receiver and in this study, these were the small holder banana farmers organised under radio listening clubs and (E) indicates the effect. This means what farmers do with the agricultural information. For example, do farmers change their long held traditional farming practices to proper and modern farming practices? In this study, the knowledge levels of the farmers were assessed before the intervention of radio broadcasts. We did broadcast agricultural information for one month to the farmers who were found lacking knowledge regarding proper banana farming practices. The (E) is what happens after farmers have received the agricultural information. In this model, it is not only enough to know the source of information through which farmers get information but is imperative to know whether the source of information is effective or not. This knowledge is important because it would assist policy makers in making decisions whether to uphold or change the channel of communication. However, it should be noted that this study did not focus on other scales of the model, it focused on the effect of agricultural information (i.e. What farmers do with the agricultural information they receive). These other aspects will either be handled by other researchers or by us in further studies. The main interest of this study has been to focus on the ‘E’ or the effect of agricultural information on smallholder banana farmers’ farming practices.

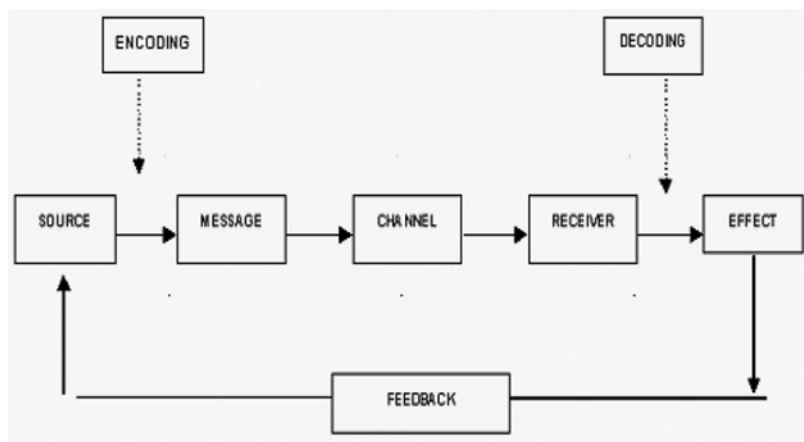


Fig. 2. Source-Message-Channel-Receive-Effect Model by Rogers & Shoemaker (1971)

4 Methods

This study used a mixed design approach to assess the effectiveness of audio media in enhancing smallholder banana farmers’ knowledge regarding proper banana farming practices. The underlined research objectives were investigated in this study:

1. To assess the effectiveness of audio media in enhancing smallholder banana farmers' knowledge regarding proper banana farming practices.
2. To evaluate the extent to which socio-economic characteristics (*age, gender, level of education and source of information*) influence the uptake of knowledge regarding proper banana farming practices.

4.1 Study design and procedure

A total of 1000 participants was included in this study. Multi-stage and convenient sampling techniques were used. In the first stage, 4 districts out of 7 districts in the Rwenzori region were selected. The second and third stages involved the selection of sub-counties and zones respectively. The fourth and final stage involved the selection and generation of lists of households from each zone. In each zone, 20 participants were sampled from each of the 50 selected zones in the Rwenzori region. Zones selected were only those where MMU radio signals were very clear. Information regarding radio coverage and the specific zones where MMU community radio signals were very clear was obtained from the radio station at MMU. Before selecting participants for this study in June 2017, we made pre-survey visits to each of the selected zones in a district. The visits were intended to achieve the following: 1. To confirm that the radio signals are clear in that zone, 2. To request the Chairperson Local Council 1 (C/P LC1) to randomly select and make a list with phone contacts of 20 smallholder banana farmers from his/her village and 3. To request the C/P LC1 to accept to work with the principal investigator in the mobilization of the identified participants. Two months later, in August 2017, we conducted a needs analysis study involving all the identified households with the intention of establishing their knowledge levels regarding proper banana farming practices. Data from this survey was analysed and two cohorts were identified. One cohort consisted of farmers who were found doing well regarding proper banana farming practices and the other cohort contained farmers who were found lacking almost in all aspects of the farming practices. The focus of this research was on the latter cohort. This group was organised into radio listening clubs (RLCs) and a well-structured leadership was put in place consisting the chairperson, secretary, and timekeeper. Researchers have pointed out that radio listening groups or forums are on the increase as listenership models. One study by [26] defined a radio forum or listening club as a “small listening and discussion group that regularly meets according to the broadcast schedule to listen and discuss the content of a given special radio programme”. This was followed by identifying and hiring two agricultural specialists from the School of Agriculture and Environmental Sciences who were tasked to develop and broadcast content to the cohort that was found lacking knowledge regarding proper banana farming practices. Each RLC was given a small radio set with batteries that were estimated to last for a month. They were also given a broadcast schedule and asked to follow the schedule and meet at an identified meeting place to listen to the radio broadcasts. The radio programmes lasted for a month and they were very interactive whereby the members from different RLCs were given a chance to call in and give their opinions on the programme or ask questions. To supplement the radio broadcasts, we developed CDs containing all the con-

tent on proper banana farming practices and distributed them to all the RLCs in the 50 zones. This audio information was intended to assist the farmers either fully grasp the content or comprehend some aspects of the content that were missed or not understood during the radio broadcasts. After a period of 6 months, a period hoped to be long enough for the smallholder banana farmers to have put in practice what they were taught, we conducted an end line survey. As can be seen in the results section, baseline survey data was compared with end line survey data to establish if there are any significant changes in knowledge before and after an intervention of radio broadcasts on proper banana farming practices.

4.2 Participants

Participants in this study were 1000 smallholder banana farmers drawn from 50 villages in Kabarole, Kyenjojo, Bunyangabu and Kamwenge districts in Western Region in Uganda. Out of 1000 respondents, 456 respondents were found with the necessary knowledge regarding proper banana farming practices and these were left out at the baseline survey level. The target group of this study was the 544 respondents who were found lacking as regards the recommended farming practices. Out of 544 respondents, 2 died before the end line survey and 2 declined to participate in the study. Therefore, 540 respondents filled the questionnaire completely and participated in observations. Out of these respondents, 420 (77.7%) were male while 120 (22.2%) were female. These results indicate that the majority of smallholder farmers are males. This supports the findings of [15]; [17] who in their research found that there were more male farmers than females. Respondents were also asked to indicate their age and most respondents 185 (34.2%) were aged 50 years and above, between 30 to 39 were also slightly many 152 (28.1%), between 40 to 49 were 134 (24.8%) and the least in number 69 (12.7%) were aged between 20 to 29 years. Participants were also required to indicate their level of education and most of the 317 (58.6%) indicated to have completed Primary level, while those who indicated to have completed secondary were 130 (24.0%), a small number 31 (5.7%) indicated to have finished tertiary and 62 (11.5%) indicated to have not attained any level of education.

4.3 Instruments and measurements

We used a questionnaire and observation checklists in the collection of quantitative and qualitative data respectively. Some of the items used in the questionnaire were drawn from validated studies such as [29]; [30]. The rest of the items were self-developed. In addition, the instrument was checked to verify proper wording, completeness, and appropriateness for content validity by professors at the Faculty of Agriculture and Environmental Sciences. Finally, the instrument was checked and approved by the project supervisors. Training of research assistants and translation of the instrument into Rutooro language was done ahead of data collection by a Rutooro-native professor with bias in agricultural extension and instructional strategy. The instrument was administered by the first author assisted by 9 research assistants. The instrument includes the following scales of measurement: site selection, land prepara-

tion, planting and spacing, fertilizer, manure and pesticide use, weed management, soil and water management, pruning and de-suckering, pests and disease management, staking, harvesting, storage, and marketing. Qualitative data was collected through the use of structured observation. Research assistants were asked to reach the 110 randomly selected households and after filling the questionnaire to request the household head to observe the plantations, while at the plantation as can be seen on the results section, they were to indicate on the observation checklist whether they have observed recommended or not recommended practices. To analyze the results, a two-step analytic process was employed. We first arranged responses per each category or theme based on the farming practices. Second identifying the key observed items per each farming practice based on the frequency of occurrence so as to determine the percentages of observed recommended or observed not recommended farming practices. A summary of results from the observation checklist is shown in the results section.

4.4 Data analysis

This study collected both quantitative and qualitative data. For the former, descriptive statistics were used to analyse demographic data of the respondents such as age, gender, level of education, electronic gadgets owned, etc. Second, the assumption of homogeneity of variances was tested and satisfied via Levene's F test with $p > 0.05$. This was done as a basis of comparison for the two groups before and after an intervention. The comparison in terms of means and standard deviation to assess the change in means before and after the intervention was performed and results showed a change after the intervention of audio media. We ran independent t-test to assess if they are significant changes between the two groups after the intervention of audio media. We also used Person correlation to establish the association between farmers' demographic characteristics and knowledge gain regarding proper banana farming practices. The quantitative findings of this study are substantiated by the observations made by enumerators during the end line survey. A summary of observations is made from various respondents with whom we interacted during our study. Given in the results section are some extracts from the observations made.

5 Key Research Findings

In this section, we present our study results starting with quantitative findings which are followed by a summary of extracts from the observation checklists. Observation results come from the randomly sampled households from the 50 villages where the research was conducted.

5.1 Effectiveness of audio media in enhancing smallholder banana farmers' knowledge regarding proper banana farming practices.

Results regarding the effectiveness of audio media in enhancing knowledge of banana farmers on proper farming practices indicate that there was a change in the knowledge levels of smallholder banana farmers after an intervention of live radio broadcasts supplemented by audio information on CDs. The mean scores of the 50 out of 61 items in table 3 increase after the intervention was done via Radio broadcast and audio CDs. Forty-five items through all practices have shown a big change after the intervention with an increase of more than 0.5 scores, showing significance in t-tests as described in the next paragraphs. Examples of such items are the method used to clear the land, time of land preparation, size of holes dug, number of suckers per plant, time of de-suckering, etc. Before running the t-tests the assumption of homogeneities of variances was tested and satisfied via Levene's F test. This is consistent with studies done by [27]; [28] where they observe that homogeneity of variance and normality are vital and should precede tests like t-tests and ANOVA. Homogeneity of variance results indicate $F(6)=10.673$, $p=.017$ for market research, $F(10)= 0.758$ with $p= 0.404$ for site selection, $F(6) = 0.398$, $p= 0.551$ for land preparation; $F(6)= 0.424$, $p= 0.523$ for planting; $F(14)= 0.004$, $p= 0.952$ for fertilizers and manure application, $F(6)=5.318$, $p= 0.061$ for weed management, $F(8)= 0.027$, $p= 0.873$ for Soil and Water Management, $F(16)= 2.811$, $p= 0.113$ for Pruning & de-suckering, $F(8)= 0.327$, $p= 0.583$ for pests and disease management, $F(6)=2.121$, $p= 0.196$ for staking Management and $F(12)= 0.349$, $p= 0.566$ for Harvesting storage and marketing. The tests of variances before the intervention and after the intervention indicate that the two groups being compared are assumed to be approximately equal ($p > .05$).

After, the researcher performed the t-test to assess if there are significant changes after the Radio broadcast. It was found out that the independent samples t-tests were associated with a statistically significant effect before and after the radio intervention and specifically in the following practices: (i) Marketing [$t(6)= -2.481$ with $p= 0.048$, ($p < 0.05$)], (ii) land preparation [$t(6)= -4.518$, $p= 0.004$, ($p < 0.05$)], (iii) planting and spacing [$t(18)= -5.685$, $p= 0.000$, ($p < 0.05$)], (iv) fertilizers, manure application [$t(14) = -3.402$, $p= 0.004$, ($p < 0.05$)], (v) staking management [$t(6)= -5.620$, $p= 0.001$, ($p < 0.05$)], (vi) weed management [$t(6)= -2.759$, $p= 0.033$, ($p < 0.05$)], and (viii) harvesting storage & marketing [$t(12)= -2.540$, $p= 0.026$, ($p < 0.05$)]. However, on the contrary there was no statistical significant change before and after an intervention for farming practices such as site selection [$t(10)= -.404$, $p= 0.575$], soil and water management, [$t(8)= 0.660$, $p= 0.528$], Pruning and de-suckering [$t(16)= -3.177$, $p= 0.113$] and pests & diseases [$t(8)= -0.074$, $p= 0.943$]. Therefore, those practices which showed a significant increase in mean after the intervention of audio media (Radio Broadcast & audio CDs) have at the same time shown a significance change in t tests with p-values less than .05. Meaning that the changes observed after carrying the intervention to the farmers were largely attributed to the Audio media.

Table 1. Knowledge gain by smallholder banana farmers before and after the intervention of audio media

Sr. No	Practices	Before Mean (SD)	After-Mean (SD)	Change in Mean
Site Selection				
Ss1	Nature of the site for banana plantation	1.81(.81)	2.36(.89)	0.55
Ss2	Type of soil	2.24(.52)	2.56(.75)	-0.32
Ss3	Depth of the soil	2.01(.64)	1.14(.88)	-0.87
Ss4	Nature of the surrounding	1.25(.57)	2.25(.57)	1
Ss5	Tested the soil to determine the nutrients	1.85(.35)	2.65(.47)	0.8
Land Preparation				
Lp1	Method used to clear the land	1.11(.79)	2.31(.54)	1.2
Lp2	Time of land preparation	0.63(.71)	3.58(.72)	2.95
Lp3	Time of digging holes	1.68(.62)	2.41(.67)	0.73
Lp4	Size of holes dug	1.10(.29)	2.72(.45)	1.62
Planting and Spacing				
Ps1	Time of planting	1.01(.49)	1.93(.25)	0.92
Ps2	Type of planting material	1.00(.62)	2.11(.62)	1.11
Ps3	Source of planting material	0.03(1.12)	2.63(1.1)	2.6
Ps4	Variety/cultivars	1.00(.39)	2.10(.39)	1.1
Ps5	Inter-cropping	0.11(.48)	1.38(.48)	1.27
Ps6	Crops used to intercrop	1.11(1.55)	2.47(1.2)	1.36
Ps7	Knowledge regarding spacing	1.02(.46)	2.11(.46)	1.09
Ps8	Planting bananas in rows	0.64(.48)	1.28(.44)	0.64
Ps9	Space between holes	1.11(.81)	1.91(.59)	0.8
Fertilizer application & pesticide use				
Fp1	Organic fertilizer in the garden	1.34(.47)	2.22(.41)	0.88
Fp2	Main source of organic fertilizer used on the plot	1.11(.71)	1.59(.88)	0.48
Fp3	Inorganic/chemical fertilizer on the garden	1.22(.41)	1.71(.45)	0.49
Fp4	Time of application of fertilizer/manure	1.12(.77)	2.71(.88)	1.59
Fp5	Method of fertilizer application	1.18(1.04)	1.95(1.1)	0.77
Fp6	Source of information about type and method of fertilizer application	2.35(.55)	1.99(.85)	-0.36
Fp7	Type of fertilizer used	0.75(.61)	2.44(.63)	1.69
Weed Management				
Wm1	Type of weeds in the plantation	1.20(1.86)	5.04(1.8)	3.84
Wm2	Method of weeding	0.78(1.03)	2.63(.99)	1.85
Wm3	Reason for the choice of method	1.65 (1.26)	2.78(1.0)	1.13
Wm4	Time of weeding,	1.52 (.76)	2.50(.78)	0.98
Soil & Water Management				
Sm1	Problems of soil and water loss	1.36(.48)	1.42(.49)	0.06
Sm2	Method of soil and water conservation	4.80(2.79)	4.40(2.7)	-0.4
Sm3	Knowledge regarding the application of the above methods	1.57(.49)	1.25(.43)	-0.32
Sm4	Time of applying the above methods	2.60(1.33)	1.47(.86)	-1.13
Pruning & de-suckering				
Pd1	Number of suckers per plant	1.15(.88)	2.48(.73)	1.33
Pd2	Time of de-suckering	0.43(.86)	1.55(.85)	1.12
Pd3	Nature of the corm after harvesting	1.83(.60)	3.36(.66)	1.53
Pd4	Tools used for de-suckering	0.69(.70)	3.47(.82)	2.78
Pd5	Plantation Pruning	1.31(.46)	1.91(.46)	0.6
Pd6	Number of leaves left per plant	1.49(.82)	1.58(.86)	0.09
Pd7	Tools used for pruning	1.83(1.19)	1.89(.68)	0.06
Pd8	Time for pruning	1.06(.68)	1.58(.85)	0.52

<i>Pests & disease Management</i>				
Pm1	Common pests in your farm	1.86(.85)	3.30(.91)	1.44
Pm2	Common diseases in your farm	2.35(.52)	2.62(1.6)	2.27
Pm3	Methods of pests and diseases control	1.35(1.28)	1.62(1.1)	0.27
Pm4	Source of information about management	3.01(1.11)	2.01(1.0)	-1
Pm5	Quality of information received	2.39(.76)	1.57(.74)	-0.82
<i>Staking Management</i>				
Sm1	Staking in the plantation	1.17(.37)	2.31(.46)	0.14
Sm2	Reasons for staking	1.08(.28)	2.07(.27)	0.00
Sm3	Staking stage after flowering	0.77(.98)	2.98(.52)	2.21
Sm4	Staking materials,	1.06(.42)	2.03(.38)	0.97
<i>Harvesting, storage & Marketing</i>				
Hm1	Stage of maturity at harvesting	1.68(.49)	1.95(.78)	0.27
Hm2	Reasons for harvesting	1.13(.33)	2.41(.49)	1.28
Hm3	Method/Tool of harvesting	2.53(.45)	1.69(.57)	-0.84
Hm4	Site for storage	1.37(.74)	1.73(.78)	0.36
Hm5	Preservation done	1.47(.22)	2.02(1.0)	0.55
Hm6	Forms of marketing your bananas	1.16(.62)	2.35(1.4)	1.19
Hm7	Selling at the prevailing market price	1.34(.47)	2.34(.47)	1
	Valid N (listwise)			0.53

5.2 Findings from observation

To substantiate findings of the quantitative data “see table 2”, this study also made use of observation checklists, where we examined recommended farming practices based on the works of [29]; [30]. Only practices that could easily be observed from the banana plantations were included. On the overall, findings show that a big number of respondents to have adopted the proper banana farming practices as can be seen in table 2. However, in some cases flaws were observed for example (40%) of the farmers were found not to have implemented proper de-suckering as many suckers were seen per plant, also almost half (45%) of the observed smallholder banana farmers had a variety of different types of bananas in the same plots of land. This is bad because mixing many varieties in the same garden, encourages pests and diseases. Regarding staking no enough windbreaks were seen in and around the plantation. Farmers were not doing well either as some banana plantations looked to be infested with diseases such as sigatoka as could be seen from ripening young bananas and bananas with yellow leaves

Table 2. Recommended and not recommended banana farming practices observed during end line survey

Farming practices	Observed (Recommended)	Percentage (%)	Observed (Not recommended)	Percentage (%)
1. Intercropping	Coffee, beans and other annual crops such as legumes were seen planted in the banana planation.	87 (79%)	Bananas were intercropped with heavy feeders, non-legume (cover crops) such as sugarcane, yams, irish potatoes, maize, egg plants, cassava while other plantations no intercropping is done	23 (21%)
2. Spacing	Plantation are well spaced to	79 (72%)	Plantations heavily compacted.	31 (28%)

	about 3m x 3m (10ft x 10 ft) between and within holes. Space between holes is appropriate		No spaces within banana plantations	
3. De-suckering	Not more than three pseudo stems were seen per plant. Suckers seen were in varying ages.	66 (60%)	Many suckers were seen per plant, and most farmers indicated that they were purposely left there for planting in the next season	44 (40%)
4. Nature of the plantation	Banana plants were seen planted in blocks as recommended	82 (75%)	Bananas planted in straight lines allowing easy penetration of winds	28 (25%)
5. Banana varieties	Either cooking, beer, roasting or dessert bananas were observed in the plantation	61 (55%)	Many varieties were observed in the same garden or plots	49 (45%)
6. Manure and fertilizer application	Cow dung, poultry and goat residues were seen and appeared to be well covered.	68 (62%)	Organic fertilizer was seen in a few gardens, it was either just spread or piled and open to the sun.	42 (38%)
7. Weeding	Adequate control of weeds is evident. Banana plantations were free of heavy weeds. Mulching is applied, farmers were seen pulling by hand a few weeds in the plantation.	76 (69%)	Heavy and thick weeds such as couch grass and black jack were observed in the banana gardens. There is no or little control of weeds.	34 (31%)
8. Windbreaks	Trees such as castor oil plants were seen planted in and around banana plantation boundaries	64 (58%)	No any windbreaks were seen in and around the plantation	46 (42%)
9. Mulching	Dry mulches like elephant grass, coffee husks, maize stems etc. were well spread in the plantations. In addition, drainage channels were properly dug across the plantations	85 (77%)	No mulching and drainage channels seen in the plantation done	25 (23%)
10. Pruning	Plantations looked well kempt and only old and dry leaves were removed.	95 (86%)	Plantations appeared dark with dry banana leaves all over.	15 (14%)
11. Staking	Branched castor oil plants and timber were used to stake tall and heavy bananas	95 (86%)	No any staking observed	15 (14%)
12. Pests and disease control	Banana plantation appeared to be free from weevils and nematodes	63(69.3%)	Plantations looked to be infested with diseases such as sigatoka as could be seen from ripening young bananas and bananas with yellow leaves	47(51.7%)

5.3 The extent to which socio-economic characteristics influence the uptake of knowledge regarding proper banana farming practices

The second objective sought to investigate the extent to which socio-economic characteristics such as level of education, gender, age and source of information in-

fluence the gain in knowledge regarding proper banana farming practices by smallholder banana farmers that participated in this study. To achieve this aim, we ran Pearson correlation “see table 3”. The research wanted to find out to what extent does age contribute to the best farming practices however, results from Pearson Correlation tests between age and farming practices reveal a negligible association (Pearson correlation r lie between 0.01 and 0.09 or below 0). Furthermore, results also indicate that there is a low association between soil and water management with the age ($r = .139, p = .001$).

Similarly, regarding respondents' gender, the Pearson correlation have shown that the gender and farming practices have a negligible association with gender ($r = .029, p = .507$). These results indicate that the effect if any is small and insignificant. Additionally, the Pearson correlation showed that the level of education and harvesting & storage management have a low association [$r(541) = .144, p = .053$], and on the other side the relationship with the level of Education and other farming practices are not related at all. The researchers affirm that this was caused by the fact that all farmers were subjected to follow the radio broadcast practices and the practices were easy to implement without further technicalities either in terms of content or context. There is also a belief that the farmers share their experiences as well.

However, the Pearson correlation showed that there is substantial association between the Radio information broadcast & CDs and knowledge about site selection $r(541) = 0.615, p > 0.05$, pruning & de-suckering $r(541) = 0.664, p > 0.05$. It was observed at the same time there is a strong relationship between the radio broadcast and land preparation and also staking management with $r(541) = 0.745, p > 0.05$, $r(541) = 0.867, p < 0.05$. On the other hand, radio information sharing has demonstrated a moderate relationship with other farming practices” see table 3”.

Table 3. The influence of socio-economic characteristics on knowledge gain by smallholder banana farmers

		SS	LP	P&S	FMP	WM	S & WM	P & D	P&DM	SM	HS&M
Resp. Age	<i>r</i>	-.003	.067	.045	.036	.012	.139**	.009	.010	-.032	.078
	<i>p</i>	.936	.119	.295	.681	.787	.001	.833	.821	.536	.294
											183
Resp. gender	<i>r</i>	.043	.060	-.056	-.009	-.069	.029	-.011	.015	.012	.005
	<i>p</i>	.319	.162	.193	.920	.109	.507	.797	.729	.817	.947
											183
Level of Educ	<i>r</i>	.042	-.001	-.049	.025	.029	.008	-.018	.106*	.048	.144
	<i>p</i>	.333	.974	.250	.770	.502	.852	.686	.014	.347	.053
											182
Source of information	<i>r</i>	-.076	.208**	.352**	.132	.011	.214**	.392**	-.041	.111*	-.020
	<i>p</i>	.076	.000	.000	.127	.806	.000	.000	.340	.031	.785

Note: SS-Site Selection, LP-Land Preparation, P&S-Planting and Spacing, FMP-Fertilizer, Manure and Pesticide use, WM-Weed Management, S &WM-Soil and Water Management, P&D- Pruning & De-suckering, P&DM-Pests and Disease Management, SM-Staking Management, HS&M- Harvesting, Storage and Marketing.

** . Correlation is significant at the 0.01 level (2-tailed).

* . Correlation is significant at the 0.05 level (2-tailed).

6 Discussion

This study investigated the potential of audio media in enhancing farmers' knowledge regarding proper banana practices. The study was guided by two objectives; to assess the effectiveness of audio media in enhancing smallholder banana farmers' knowledge regarding proper banana farming practices and to evaluate the extent to which socio-economic factors influence farmers' uptake of knowledge regarding proper banana farming practices. In the context of Uganda with abundant FM radio stations and limited agricultural extension services to smallholder farmers, it is imperative to establish if audio media (radio broadcasts and audio CDs) could be helpful in equipping farmers with knowledge regarding the proper farming practices.

6.1 The effectiveness of audio media in enhancing smallholder banana farmers' knowledge regarding proper banana farming practices

Before the intervention of audio media (radio broadcasts and audio CDs) smallholder farmers had poor initial knowledge regarding proper banana farming practices on most banana farming practices especially the time of land preparation, tools used for de-suckering, planting, method of weeding, etc. However, based on our findings there was evidence of improvement in the knowledge levels of majority smallholder banana farmers on almost all farming practices after making an intervention. Our findings are consistent with the study by [31] where the effectiveness of community radio programme was investigated through knowledge test whereby knowledge levels of rural women were assessed before and after they listened to a community radio programme. Just like our study, this study found significant changes in the pre-test and post-test scores of overall knowledge of the small-scale farmers who participated in the study. Nevertheless, quantitative findings revealed that some farming practices, such site selection, soil and water management, pruning & de-suckering, and pests & diseases management did not show a statistically significant change before and after the intervention. This is perhaps due to the nature of the practices themselves, as they cannot easily be changed and also some of them may be caused by external factors on which the farmers do not have any control.

To substantiate quantitative findings, this study also used observation method and results reveal increase in knowledge levels after the intervention as indicated by improved farming practices for example 79% of the farmers were able to plant as a recommended practice perennial crops such as legumes in their banana plantations and 75% of the farmers had banana plants planted in blocks as recommended. The same improvement is noticed in almost all other banana farming practices. This indicates that the radio broadcasts supplemented by audio CDs were of great benefit to the farmers who before the intervention showed low levels of knowledge. In this study, when asked about their source of agricultural information, more than half of the farmers 51.3% mentioned the radio, while 13% mentioned extension workers, farmer

groups 27.4%, TV and newspapers 2.2% and 6.6% respectively. This indicates that radio can be very instrumental in extending information to the rural farmers despite the fact that extension agents are taken to be the official medium for agricultural information to the farmers. This resonates well with a study by [10], who found that peasant farmers mostly received agricultural information from fellow farmers and radio daily compared to other sources. Our study findings are congruent with [17] whose study on the assessment of the effectiveness of other agricultural information sources found that extension workers scored lowest in the dissemination of agricultural information. The reason for this is perhaps because farmer groups can easily be reached by fellow farmers and normally at no cost. Although in their study [32] observed that traditionally, the primary sources of access to innovative farming information for both rural and resource-poor farmers are agricultural extension agents, our study provides additional evidence that radio is key in enhancing knowledge levels of rural farmers.

However, our findings indicate that even if on the overall smallholder farmers demonstrated to have gained knowledge regarding proper banana farming practices, some farmers were found to be lacking in some aspects of agriculture, for example, 45% of the farmers contrary to what is recommended many varieties were observed in the same garden or plots. Mixing many varieties in the same garden encourages pests and diseases. Based on our observation this could be prompted by the small pieces of land where people are living as most land is highly fragmented due to increased population. More still 46.2% of the farmers never applied organic fertilizer in their plantations, this was mostly observed in the villages of Kabarole and Bunyangabu districts and the reason for this could be perhaps the soils are fertile and self-sustaining and thus no need for manure or fertilizer application. One absurd finding is that even if farmers have tried to follow the recommended farming practices, in some areas diseases such as Sigatoka and banana bacterial weevil (BBW) have persisted as could be seen from the ripening of young bananas and bananas with yellow leaves. More than half of the respondents 51.7% were affected. This situation could be explained by the lack of agricultural information or advice to rural farmers. This calls for urgent government intervention otherwise farmers' plantations will be wiped out, leaving them without any means of survival. However, this notwithstanding, overall findings showed audio media (radio broadcasts and audio CDs) to be effective in terms of knowledge gain by the farmers and this is not only showed by increased mean scores after implementation the intervention but even from the observation results. Likewise, one study found radio programmes related to agriculture to be vital in equipping farmers with farming methods, so as the farmers listen to the programmes they steadily change their old-fashioned farming methods to not only new but recommended methods [33].

6.2 The extent to which socio-economic factors influence the uptake of knowledge regarding proper banana farming practices

The second objective of this study sought to evaluate the extent to which socio-economic characteristics such as age, gender, level of education and source of infor-

mation influence the uptake of knowledge regarding proper banana farming practices. Studying socio-economic characteristics of farmers is vital if they are to be helped improve farming, for example, one study found that the use of ICTs in most developing countries for the provision of relevant agricultural information to rural farmers largely depends on the socio-economic background of each individual farmer in the agricultural sector [10]. Nevertheless, this study found no significant relationship between age and all other banana farming practices. However, there was a low association between soil and water management.

Additionally, regarding respondents' gender, the Pearson correlation revealed that gender and farming practices have a negligible association. Moreover, the Pearson correlation also showed no statistically significant relationship between the level of education and farming practices but there was a low association between level of education and harvesting & storage management. Our findings resonate well with the findings by [14] who found no significant relationship between demographic characteristics such as age, land holding, extension services, social participation, and mass media participation. Furthermore, the findings of this study are supported by a study of [20] who observed that there was no significant correlation between education level and knowledge gain by peasant farmers. Nonetheless, this study contrary to ours found a slight difference in knowledge acquisition, knowledge gain was slightly higher among the literate farmers when compared to illiterate ones. The researchers affirm that this could have been caused by the fact that all smallholder farmers that participated in this study were subjected to participate in the radio broadcasts and revise the content taught by listening to the audio CDs. The information was easy to implement without further technicalities either in terms of content or context. In addition, the radio broadcasts were delivered in the local language of the farmers which they understand very well. The radio programme presenters were natives of the region and endeavoured to do anything possible to simplify the content. There is also a belief that the farmers share amongst themselves their experiences as well. All these considerations could have been enabling factors when it came to content mastering and implementation.

However, study findings showed a positive correlation between the source of information and knowledge gain by smallholder banana farmers regarding site selection and pruning & de-suckering. More so, results indicated a strong relationship between the Radio broadcast and land preparation and staking management. On the other hand, audio media as a source of information sharing has demonstrated a moderate relationship with other farming practice.

7 Conclusions, Implication & limitations

The first outcome of this study is that we found audio media in the form of radio broadcasts and audio CDs to be the main source of agricultural information for the category of farmers included in this study. Audio media was also found to have played a significant role in assisting farmers gain knowledge on proper banana farming practices. Although smallholder farmers had low knowledge about most banana

farming practices before the intervention, there was a significant change in knowledge levels after implementing the interposition of audio media. This change therefore is attributed to this intervention. The second outcome of this research is that socio-economic characteristics mainly age, gender and level of education do not have significant influence on knowledge gain regarding proper banana farming practices by smallholder farmers. However, source of information (radio broadcast and audio CDs) was observed to positively influence knowledge gain of farmers. This could be because of the advantages associated with the medium such as easy accessibility, information aired in the local language, flexibility as one can listen as they carry out other chores, being economical etc.

However, what this study did not do, which could be undertaken in future research, was to assess the effectiveness of audio media compared to other sources of agricultural information such extension workers, farmer groups, farmers' experience etc. Nevertheless, the findings from this research can contribute in numerous ways because no study of this kind has been conducted in the Ugandan agricultural sector to evaluate the influence of audio media (radio broadcast & audio CDs) on knowledge uptake regarding proper banana farming practices by smallholder farmers. This study will not only act as a guide but also a point of reference for agricultural managers at different levels of government and private sector in selecting the kinds of media technologies to use in disseminating agricultural information to rural farmers. A clear understanding of how effective audio media (Radio broadcasts and CDs) is regarding enhancing farmers knowledge on proper banana farming practices is vital for policy makers especially in the Ministry of Agriculture, yet this aspect has not been sufficiently addressed by previous research. Therefore, findings from this research if taken seriously will be a great relief to the already strained agricultural sector in terms of extension services. Radio could be subsumed as a suitable alternative means of agricultural extension to the resource-poor farmers in the region.

8 References

- [1] Khanal SR. Role of radio on agricultural development: A review. *Bodhi: An Interdisciplinary Journal*. 2011;5(1):201-6. Retrieved from <https://doi.org/10.3126/bodhi.v5i1.8054>
- [2] Srivastava A. Socio-economic Transformation of Under-privileged Communities by Community Radio imitating Ancient Tradition of Oral Teaching. *GSJ*. 2018 Feb;6(2):233. Retrieved from <http://wdfindia.org/images/SOCIO-ECONOMIC-TRANSFORMATION-OF-UNDER-PRIVILEGED-COMMUNITIES-BY-COMMUNITY-RADIO-IMITATING-ANCIENT-TRADITION-OF-ORAL-TEACHING.pdf>
- [3] Ferroni M, Zhou Y. Achievements and challenges in agricultural extension in India. *Global Journal of Emerging Market Economies*. 2012 Sep;4(3):319-46. Retrieved from <https://doi.org/10.1177/0974910112460435>
- [4] Munyua H, Adera E, Jensen M. Emerging ICTs and Their Potential in Revitalizing Small-Scale Agriculture in Africa. *Agricultural information worldwide*. 2009 Jan 1;2(1). Retrieved from <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.855.2532&rep=rep1&type=pdf>

- [5] Nowakunda K, Tushemereirwe W. Farmer acceptance of introduced banana genotypes in Uganda. *African Crop Science Journal*. 2004;12(1):1-6. Retrieved from <https://www.ajol.info/index.php/acsj/article/view/27656>
- [6] Ochola D, Jogo W, Ocimati W, Rietveld A, Tinzaara W, Karamura DA, Karamura EB. Farmers' awareness and perceived benefits of agro-ecological intensification practices in banana systems in Uganda. *African Journal of Biotechnology*. 2013;12(29). Retrieved from <https://doi.org/10.5897/AJB12.2868>
- [7] Dey BL, Prendergast R, Newman D. How can ICTs be used and appropriated to address agricultural information needs of Bangladeshi farmers? *GlobDev* 2008. 2008 Dec 13:21. Retrieved from <https://www.aesanetwork.org/how-can-icts-be-used-and>
- [8] Drafor I. Access to information for farm-level decision-making. *Journal of agricultural & food information*. 2016 Oct 1;17(4):230-45. Retrieved from <https://doi.org/10.1080/10496505.2016.1213170>
- [9] Nazari MR, Hasbullah AH. Radio as an educational media: Impact on agricultural development. *The Journal of the South East Asia Research Centre*. 2010; 2:13-20. Retrieved from https://www.researchgate.net/publication/258517524_Radio...
- [10] A. Abdullahi, C. G. a. P. D. Enhancing Farmer to Farmer Information Exchange through the use of Mobile Phones in Nigeria. *international Journal of Information Technology and Business Management*, 2013 pp. 40-45. Retrieved from <http://www.iitbm.com/22%20volume/3%20Information%20exchange%20through%20IT..pdf>
- [11] Hudson HE, Leclair M, Pelletier B, Sullivan B. Using radio and interactive ICTs to improve food security among smallholder farmers in Sub-Saharan Africa. *Telecommunications Policy*. 2017 Aug 1;41(7-8):670-84. Retrieved from <https://doi.org/10.1016/j.telpol.2017.05.010>
- [12] Nyareza S, Dick AL. Use of community radio to communicate agricultural information to Zimbabwe's peasant farmers. In *Aslib Proceedings 2012 Sep 14 (Vol. 64, No. 5, pp. 494-508)*. Emerald Group Publishing Limited. Retrieved from <https://doi.org/10.1108/00012531211263111>
- [13] Tahmeena K., & Onkargouda K. *Relevance of Radio for Promoting and popularizing Organic Farming: A literature review*, Karnataka, India: Global research Analysis International, 2013. Retrieved from https://www.academia.edu/20955103/Relevance_of_Radio_for
- [14] Krishnamurthy AT. *Study on Radio Listening and Televiewing Behaviour of Farmers in Karnataka* (Doctoral dissertation, University of Agricultural Sciences, GKVK).
- [15] Nwachukwu CA. Adoption of Organic Agricultural Technologies: Implications for Radio farmer Agricultural Extension Programmers in Imo State, Nigeria. In *Scientific and Technical Information and Rural Development IAALD XIIIth World Congress, Montpellier 2010 Apr (pp. 26-29)*. Retrieved from <https://www.researchgate.net/publication/228873178...>
- [16] Chapman R, Blench R, Kranjac-Berisavljevic G, Zakariah AB. Rural radio in agricultural extension: the example of vernacular radio programmes on soil and water conservation in N. Ghana. *AgREN Network Paper*. 2003 Jan; 127:2. Retrieved from https://www.researchgate.net/publication/42765522_Rural..
- [17] Sultana DT. Information access through radio programs on organic farming. *International Journal of Academic Research and Development*, indexed, refereed, peer reviewed and open access journal. 2018;3(1):931-4.
- [18] Khanal SR. Role of radio on agricultural development: A review. *Bodhi: An Interdisciplinary Journal*. 2011;5(1):201-6. Retrieved from <https://doi.org/10.3126/bodhi.v5i1.8054>

- [19] Sultana DT. Information access through radio programs on organic farming. *International Journal of Academic Research and Development*, indexed, refereed, peer reviewed and open access journal. 2018;3(1):931-4.
- [20] Oyesola OB, Obabire IE. Farmers' Perceptions of Organic Farming in selected Local Government areas of Ekiti State, Nigeria. *Journal of Organic Systems*. 2011 Jan 1;6(1). Retrieved from [https://www.organic-systems.org/journal/Vol_6\(1\)/pdf/6\(1\)...](https://www.organic-systems.org/journal/Vol_6(1)/pdf/6(1)...)
- [21] Kakade Onkar. An Evaluation Study of Farm-Radio Lessons on Sericulture'. Dept. Mass Communication and Journalism, Karnataka University Dharwad-580003, 1995.
- [22] Anaglo JN, Boateng SD, Boateng CA. Gender and access to agricultural resources by smallholder farmers in the Upper West Region of Ghana. *Journal of Education and Practice*. 2014;5(5):13-9. Retrieved from <https://www.iiste.org/Journals/index.php/JEP/article/...>
- [23] FAO. *The State of Food Insecurity in the World 2010. Addressing Food Security in Protracted Crisis*. 2010 Rome: FAO Retrieved from https://www.researchgate.net/publication/257864672_The...
- [24] Rogers EM. (1995). *Diffusion of innovations*. New York: Free Press.
- [25] Rogers EM, Shoemaker FF. *Communication of Innovations; A Cross-Cultural Approach*. Retrieved from <https://www.amazon.com/Communication-Innovations-Cross...>
- [26] Rogers EM, Braun JR, Vermilion MA. Radio forums: a strategy for rural development. Retrieved from <https://www.ponline.org/node/497272>
- [27] Cochran WG. Some consequences when the assumptions for the analysis of variance are not satisfied. *Biometrics*. 1947 Mar 1;3(1):22-38. Retrieved from <https://www.jstor.org/stable/3001535>
- [28] Eisenhart C. The assumptions underlying the analysis of variance. *Biometrics*. 1947 Mar 1;3(1):1-21. Retrieved from <https://www.jstor.org/stable/3001534>
- [29] Beinempaka, A., Kato, H., Mulera D. & Obwol-Ametto, T. *Principles and Practices of Agriculture: 1990 Volume 1*, London: Macmillan, pp 78-79.
- [30] NARO (National Agricultural Research Organization). *Agriculture in Uganda: Crops; Volume II*, Fountain, Kampala, 2005 pp 20-68.
- [31] Sharma A, Kashyap SK. Community radio: a community media module for empowerment of rural women. *Media Asia*. 2015 Oct 2;42(3-4):180-91. Retrieved from <https://doi.org/10.1080/01296612.2016.1142245>
- [32] Isaya EL, Agunga R, Sanga CA. Sources of agricultural information for women farmers in Tanzania. *Information Development*. 2018 Jan;34(1):77-89. Retrieved from <https://doi.org/10.1177/0266666916675016>
- [33] Khanal SR. Role of radio on agricultural development: A review. *Bodhi: An Interdisciplinary Journal*. 2011;5(1):201-206. Retrieved from <https://doi.org/10.3126/bodhi.v5i1.8054>

9 Author

Mark Kaahwa works for the Vrije university Brussel in Belgium and also works for the Mountains of the Moon university, Kampala, Uganda. (mrkcosta@yahoo.com)

Chang Zhu works for Vrije Universiteit Brussel in Belgium.

Moses Muhumuza, Rodgers Mutyebere, and Charles Karemera are with Mountains of the Moon University, Kampala, Uganda.

Article submitted 2019-04-12. Resubmitted 2019-05-14. Final acceptance 2019-05-14. Final version published as submitted by the authors