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Socio – economic Factors Influencing Access to Agricultural Extension Services among Smallholder Farmers in Western Uganda

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Authors' contributions

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

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ABSTRACT

The low agricultural productivity reported in both cash and food crops across Uganda is attributed to inadequate skills on modern agriculture. Consequently, many studies have recommended that farmers should be trained on modern agriculture through extension service provision. Strikingly, majority of the farmers do not have access to extension services, a situation which contributes to low returns on investment in agriculture. The study determined the number of farmers with access to extension services, compared them against their counterparts without access to extension services and finally determined the factors affecting access to agricultural extension services using primary data collected from 200 farmers in western Uganda. Data were analyzed using descriptive statistics, t-test, Chi – square test and Binary logistic regression model. From the results, 42.5% of

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the farmers had access to extension services, those who had access to extension services reported higher crop yields than their counterparts. The significant factors affecting access to agricultural extension services included age (P<0.05), gender (P<0.05), education (P<0.01), distance to the extension areas (P<0.01), membership to agricultural associations (P<0.10) and access to credit (P<0.05). The policy recommendations include; supporting farmers through quick loans at low interest rates, strengthening and increasing the number of adult literacy programs, increasing the number of extension agents and encouraging farmers to join agricultural associations.

Keywords: Agricultural extension; low productivity; binary logit; Uganda.

1. INTRODUCTION

The agricultural sector in Uganda is characterized by low farm productivity despite its role in food provision, income generation and economic development [1]. This is evident in the yield gaps observed in both food and cash crops. For instance, cassavas' annual production stands at approximately 5,059 kilograms per acre against the optimum yield of 20,235 kilograms per acre, equivalent to a 75% yield gap [2]. Sweet potato presents a yield gap of approximately 20.42 MT/ha annually [3,4]. Maize on the other hand reported a yield of approximately 2,094.50 hg/ha against the 25,275.5 hg/ha [5,2,6,7]. Rice, a crop which can serve as both cash and food crop recorded a yield of 1042 kg/ha against the 4,000 kg/ha potential yield, representing 74% yield gap [8]. In extreme cases, the yield gaps of rice go up to 70% [9]. The major cash crops such as tea, coffee and tobacco have also reported declined productivity [10-15].

The below average agricultural productivity in Uganda is attributed to many factors including lack of practical skills in modern agriculture [16]. Many smallholder farmers tend to use the trial and error methods of farming which do not result into optimum farm yield [17]. In addition, low adoption of modern agricultural technologies and farm inputs such as hybrid seeds, fertilizer and pesticides have all contributed to the low farm output among smallholder farmers [18,19]). Similarly, the outbreak of Covid – 19 has also contributed to the low farm yields due to the interruption of the flow of both farm inputs and outputs [20-22]. Other studies such as Mwaura [23] attributed the low returns on farm investment to failure of farmers to join groups and associations where they can train themselves and acquire the skills. Jimi et al. [24]; Nordjo & Adjasi [25] on the other hand noted that farm productivity is positively related to credit, and that lack of credit delays purchase of farm inputs resulting into low farm output.

However, training farmers through extension services has been found to be one of the strategies for cultivating practical skills on modern farming among smallholder farmers. In addition, extension services are beneficial to farmers in terms of information dissemination about the occurrence and availability of agricultural technologies, better output markets for the farmers, hybrid seeds, among others, which increase crop productivity. Therefore, farmers who have access to extension services are expected to be much better off than their counterparts. This is supported by the studies such as; Danso-Abbeam et al. [26] who reported an increased farm production of 300 kg/ha among farmers who participated in the extension programs than those who did not. Similarly, Kosim et al. [27] reported that sugarcane farmers who participated in agricultural extension programs realized 9.5 tons higher than those who did not participate. Emmanuel et al. [28] also presented the benefits of extension services by reporting an increase in adoption of chemical fertilizers among small scale farmers in Ghana. These were not in odds with the findings of Biswas et al. [29], who presented that agricultural extension increases technical efficiency of farmers. In addition, Maulu et al. [30] noted that extension programs are important in linking farmers to other investors and market opportunities and other development actors for poverty reduction.

Despite the benefits of agricultural extension services to the farmers, many studies have reported low access to extension services and programs among farmers in Uganda [31,32]. For instance, Atube et al. [33], noted that only 19% of the farmers in Apac and Amuru districts of Uganda had access to extension services. These were in line with the findings of Kwapong & Nkonya [34] who recommended that the

extension sub – sector needed to be improved in order to cover all farmers. Research from other countries also showed that the frequency of farm visits by extension agents was at 21% in Ghana [35]. A similar study by Biswas et al. [29] reported that only 55% of farmers in Bangladesh had access to extension services Similarly, a review study done by Mapiye et al. [36] clearly shows that there is limited access to extension services among the farmers in Sub – Sahara Africa.

However, in order to improve access to agricultural extension among the farmers it there is need to have a knowledge on the current level of access to extension services and its determining factors since it helps in formulating policies to increase the extension access among farmers. In addition, the results of the study provide recommendations to the ministry of Agriculture, Animal Industry and Fisheries targeting increased farm productivity through agricultural extension programs and services.
Previous studies such as Abdallah & Abdul-Rahaman [35]; Ainab [37]; Atsbeha & Gebre [38]; Gatheru et al. [39]; Nagar et al. [40] have presented results of on the factors affecting access to agricultural extension among farmers. However, there is no consensus on this topic. For instance, Ainab [37] reported a negative effect of gender (male) on access to agricultiral extension services while Nagar et al. [40] on the other hand reported a postive effect of gender (male) on access to agricultural extension. Simiallry, Ainab [37] reported an insignificant infleunce of household size on access to agricultural extension while Gatheru et al. [39] depicetd that family size has a positive influence on access to agricyitural extension services. The disparities arising from the finding in the literature call for more empirical studies. In order to bridge the gap, this study sought to determine the number and sources of agricultural extension services, compare farmers with and without access to extension services and determine how socioeconomic factors affect farmers' access to extension services in Western Uganda.

2. MATERIALS AND METHODS

2.1 Study Location

This study was undertaken in Kiryandongo district, Western Uganda (Fig. 1), a low agricultural production area [41]. The district has a population of 132,822 (UBOS, 2018a). More so, 30% of its population lives below the poverty line, yet they depend on agriculture [42]. The favorable climatic conditions and high rainfall especially in the month of August makes farming a major economic activity in this district [42] despite the low productivity.

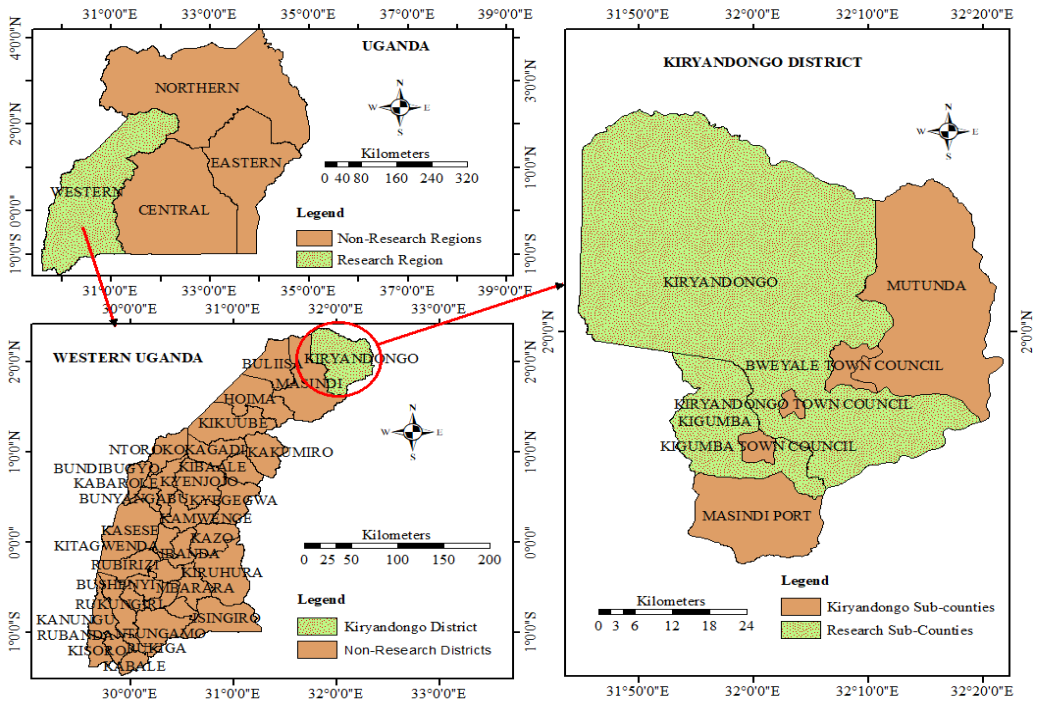

Fig. 1. Study area

2.2 Sampling and Sample Size

This study adopted multi-stage sampling technique to collect data from the farmers. This sampling method was preferred since it allowed us to divide the population into groups without restrictions. In addition, multistage sampling increases flexibility to the researchers to choose the sample carefully, making it easier to collect data from a given population. First, Kiryandongo and Kigumba sub-counties were purposively selected based on the fact that these two sub-counties have the high numbers of cash – food crops farmers [42]. In addition, the two sub – counties were considered for data collection due to the low agricultural productivity. Secondly, Kitwara and Kikube Parishes were purposively selected from each of the two sub-counties. In total a sample size of 200 farmers was arrived at using the formula by Cochran (1977) below who were randomly sampled from the two parishes.

$$\mathrm{n} = \frac{\mathrm{Z}^2\mathrm{P}(1-\mathrm{P})}{\mathrm{e}^2}$$

$$N = \frac{1.96^2 \times 0.846(1-0.846)}{0.05^2}$$

$$N = 200$$

Where;

N = Number of sampled farmers
Z = 95% confidence level = 1.96
e = Error term at 5%
P = Proportion farmers in Kiryandongo district, estimated to be 0.846 [43].

2.3 Data Sources

Before data collection, research assistants were trained on data collection procedure. The questionnaire was pre-tested in order to eliminate any potential problems in using it such as time management, complexity, suitability and appropriateness. Feedback from the pre-test was used to refine the questionnaire. The final questionnaire was loaded into Kobo Collect platform, which was used to collect data using smart phones. The questionnaire consisted of both closed and open-ended questions for adequate coverage. The tool included questions on farmers' socioeconomic and farm characteristics as described in Table 1. All interviews were conducted in line with the World Health Organization (WHO) guidelines on COVID-19 prevention.

2.4 Methods of Analysis

Descriptive statistics were used to determine the frequency of farmers who had access to extension. In addition, farmers who had access to extension services were compared to their counterparts without access to extension. This was done using t-test and chi-square test. To explain the relationship between the hypothesized explanatory variables obtained from literature review and the access to extension, a binary dependent variable was created; those with access to extension as coded as 1 and those without access coded as 0. The study adopted a binary logistic regression model for the analysis. Logit regression model was chosen because there is widespread literature. According to Hensher & Green (2009), the logistic distribution is better in applied research over the Probit model because of computational complexity arising from lack of a closed form for the normal cumulative density function on which the Probit model is based [44].

Equation 1 specifies the probability of having access to extension services while equation 2 presents otherwise according to Jaza et al. [45]. Equation 3 combines both equation 1 and 2 to specify Binary logistic model as noted by Berk [46]. Lastly, the fourth equation presents the determination of binary logistic marginal effects, obtained by differentiating equation 2 above with respect to X_k as illustrated in equation 4

$$\Pr(Y=1) = \phi\left[\sum_{k=1}^{k} \beta_k X_k\right] (1)$$

$$\Pr(Y=0) = 1 - \phi\left[\sum_{k=1}^{k} \beta_k X_k\right] (2)$$

$$logit(P) = \ln\left(\frac{P}{1-P}\right) = \beta_0 + \beta_1(\mathrm{X}_1) + \beta 2\mathrm{X}2 + \ldots + \beta 9\mathrm{X}9 + \varepsilon 9 \quad (3)$$

$$\frac{\partial Pr(Y=1)}{\partial X_k} = \phi\left[\sum_{k=1}^{k} \beta_k X_k\right] \times \beta_k (4)$$

Where;

P = probability of joining a group,
1- P = probability of not joining a group,
X_1 to X_{12} = predictor variables (Table 1)
β_0 = coefficient of intercept
β_1 to β_9 = regression coefficient to be determined
ε_9 is the error term

Table 1. Study variables

Variable	Description
Dependent variable	
Access to agricultural extension services	1 if the farmer has access to extension services, 0 - otherwise
Independent variables	
Age	Farmers' age in years
Gender	1 if the farmer is male, 0 – otherwise
Education level	Number of years the farmer spent in school
Marital status	1 if the farmer is married. 0- otherwise
Farming experience	Number of years in farming
Farm size	Size of the land under agriculture in acres
Access to credit	1 if the farmer has access to credit, 0 – otherwise
Member to association	1 if the farmer is an association member, 0 – otherwise
Family size	Number of people living in the house
Distance to the market	Distance to the nears market in kilometers
Farm yield	The total yield in Kilogram per hectare

3. RESULTS AND DISCUSSION

3.1 Demographic Characteristics of Farmers with and without Access to Extension Services

The results presented in Table 2 showed that the average age of the farmers was 40.73 years, implying that farmers were still in the potential age of production. This was also illustrated by Guo et al. [47], who noted that the active age of farmers ranges from 25 to approximately 45 years. Farmers with access to extension were significantly ($P<0.05$) older than their counterparts. The average number of years spent in school was 6 years for all farmers. This is an indication that majority of the farmers did not attain post – secondary education level as reported by Houessou et al. [48]. However, farmers who had access to extension spent significantly ($P<0.10$) more years in school than those who had no access to extension.

On average, the farming experience was 17 years, a finding similar to that of Okello et al. [49]. The mean distance to the nearest market was 4.04 Km. This was also reported by Okello et al. [49]. Their study reported that the mean distance to the trading centers among rice farmers in Northern Uganda was 3.72 Km. Farmers who had access to extension were located nearer to the markets than their counterparts. There was however no statistical difference between the distance to the nearest market for those with access and those without. The average land size was 1.75 hectares, with no statistically significant difference among the two groups of farmers. This agrees to the results of Mwaura [23], who reported an average farm size of 1.45 hectares in among farmers in Uganda. In terms of crop yield, farmers' yield stood at 2,698.55 kg/ha. Farmers who had access to extension had 638.10 kg/ha higher farm yield than their counterparts, which was statistically significant.

The results showed that 81.5% of the respondents were married. There was a statistically significant difference in marital status between the two sub – counties at 5% level of significance. On average, 76.5% of the farmers were male. The difference in gender was also statistically significant at 1%. About 81% of the farmers belonged to different agricultural groups. There was no statistically significant difference in group membership in the two sub-counties. This is in line with the findings reported by Midamba [6] and Ronald et al. [50].

3.2 Access to and Sources of Agricultural Extension Services

The results presented in Table 3 include access to and sources of agricultural extension services among the farmers. Striking, the results clearly confirmed low number of farmers who received extension services. Out of the sampled farmers, only 42.50% had access to extension services. On the sources of extension, there were three main sources. These included extension agents, farmers' groups and radio & television. Majority of farmers (98%) accessed extension services from farmers' groups.

Table 2. Comparison of farmers with and without access to agricultural extension services

Variables	Overall N=177 Mean ± SD	Has access N=85 Mean	No access N=115 Mean	Mean difference (Absolute)
Continuous variables				
Age of the Household head (Years)	40.73 ± 13.50	40.06	45.34	0.64**
Education (Years)	6.28 ± 4.68	7.72	6.03	1.22*
Farming experience (Years)	17.40 ± 15.65	18.75	17.16	4.8
Household size (Number)	7.48 ± 7.00	7.30	8.51	0.5*
Distance to the nearest market (Km)	3.04 ± 2.79	3.01	3.22	0.06
Agricultural land size (Ha)	1.75 ± 1.54	1.62	1.86	0.24
Farm yield (Kg/Ha)	2,698.55 ± 1,260.56	3,017.60	2,379.50	638.10**
Categorical variables				
Farmer is Married (1-Yes ,0-No)	0.81	0.91	0.72	0.19***
Farmer is Male (1-Yes, 0-No)	0.76	0.86	0.67	0.19***
Access to credit (1-Yes, 0-No)	0.73	0.66	0.81	0.15**
Group member (1-Yes, 0-No)	0.81	0.84	0.78	0.06

, ** & * represents the mean statistical significance at 10%, 5% and 1% respectively, for the categorical variables, proportions are used instead of means*

Table 3. Access to and sources of extension services

Access to extension services	Frequency (N)	Percent (%)
Yes	85	42.50
No	115	57.50
Sources of agricultural extension		
Extension agents/workers	78	91.76
Farmers groups	80	97.50
Radio & Television	55	68.75

3.3 Factors Affecting Agricultural Extension Services

3.3.1 Binary logit model fit

Understanding the fitness of the model is important in determining whether the model is sufficient enough to explain the relationship between dependent and independent variables under consideration. The major key issues which need to be considered in model fitness include the pseudo-R squared, P-value of the model and the Loglikelihood. A significant P-value is considered as sufficient while a pseudo-R squared value ranging between 0.20 to 0.40 is considered extremely good as recommended by Mbachu et al. [51]. This study met all the minimum threshold needed to present the results, i.e., Pseudo – R^2 = 20.8%, %, Prob > chi^2 = 0.0005 and Log likelihood = -65.489289.

The results depicted that access to agricultural extension services significantly (P<0.05) declined with an increase in farmer's age. The negative association between access to agricultural extension services and farmers' age can be attributed to the fact that farmers tend to be less active and productive as their age increases. On the other hand, younger farmers are active, implying that they can easily access extension services than their older counterparts. This however is inconsistent with the findings of Gatheru et al. [39], who reportd a postive effect of age on access to extension servives. However, Abdallah & Abdul-Rahaman [35] reported a negative and insignificant relationship between access to extension and farmers' age in Northern Ghana. The disperities between the two may have been attributed to the varition in the study locations.

The results showed that there was a positive and statistically significant (P<0.05) relationship between gender of the farmer and access to agricultural extension. The positive relationship between the could be due to the fact that male

Table 4. Binary logit estimates for the socio – economic factors affecting access to agricultural extension services

Socio – economic factors	Coefficient	Standard errors	Marginal effects	Standard errors
Age of the farmer	-0.034**	0.014	-0.005**	0.002
Farmer is male	0.756**	0.360	0.158**	0.090
Sub- county	-0.358	0.296	-0.058	0.048
Education level	0.095***	0.030	0.015***	0.004
Farmer is married	0.221	0.402	0.039	0.078
Farming experience	0.017	0.014	0.002	0.002
Family size	-0.042	0.042	-0.006	0.006
Farmer has access to credit	0.673**	0.316	0.134**	0.073
Farmer belongs to an association	0.549*	0.325	0.110*	0.078
Size of the agricultural land	0.054	0.077	0.008	0.012
Distance to the extension centers	-0.248***	0.277	-0.040***	0.044
Farm yield	0.003	0.220	0.005	0.035
Constant	2.278	1.716	-	-
Summary of the model fit	Number of observations= 200, Pseudo – R^2 = 20.8%, Prob > chi^2 = 0.000 and Log likelihood = -65.489			
Significance levels	* = 10%, ** = 5%, *** =1% significance levels			

farmers are mostly the household heads, who make household decisions. Unlike the female counterparts, they are quick, fast and always updated on agricultural programs which include extension services. Similar findings were reported by Nagar et al. [40]. Similarly, a study by Ragasa et al. [52] noted that female farmers were less likely to access agricultural extension services than their fellow male counterparts, implying that there was a positive association between being male and access to extension services.

There was a positive relationship between access to credit and access to agricultural extension services. Farmers who had access to credit had a 13.40% higher probability of accessing agricultural extension services. Credit services enable farmers to join groups which have set financial requirements for their members. From these groups, farmers are able to access information about the extension services. This was also reported by Atsbeha & Gebre [38].

Belonging to an association was positively and significantly (P<0.10) associated with access to agricultural extension services. Farmers who were members to agricultural associations had 11.0% probability of accessing agricultural extension services. The positive association could be due to the peer farmers' trainings, information disseminations and sharing of ideas within the agricultural associations, thereby increasing the level of access to agricultural extension services. This agrees to the findings of Abdallah & Abdul-Rahaman [35].

The distance from a farmer to the extension areas where the extension agents meet farmers had an inverse relationship with access to agricultural extension services. This implies that the shorter the distance the higher the probability of accessing agricultural extension services. The results from the marginal effects showed that farmers who were located near the extension areas had 4.0% probability of accessing the extension services. This was attributed to the fact that farmers who were near the extension areas can access the services easily and timely than their counterparts who are located far away. This agrees with the findings of Abdallah & Abdul-Rahaman [35].

Education was positively and significantly (P<0.01) related to access to agricultural extension services. An increase in the number of years a farmer spent in school would increase the probability of accessing agricultural extension services by 1.5%. This was because of the skills, knowledge and awareness that farmers benefit from as they advance their studies. Moreover, education improves the reasoning ability, which in turn increases farmers' eagerness to access the agricultural extension services. This conforms to the findings of Nagar et al. [40]. They found out that farmers who spent more years in school had significantly higher

probability of accessing agricultural extension services than their counterparts.

4. CONCLUSION AND POLICY RECOMMENDATIONS

The declining agricultural productivity reported in many crops in Uganda is attributed to inadequate skills on modern agriculture among the farmers. Past studies have recommended that extension agents should train farmers on modern methods of farming to increase farm productivity. Existing literature has also depicted that indeed agricultural extension services are beneficial to smallholder farmers. Against this, there is low access to extension services among many farmers. The study therefore determined the number of farmers with extension services, compared farmers with and without access to extension services and finally assessed the factors affecting of access to agricultural extension services. The results showed that 42.5% of the farmers had access to agricultural extension services from extension agents, farmers' groups and Radio & Television. The results from the comparison showed that farmers with access to the extension services were better off than their counterparts in terms of crop yield. On the factors affecting access to the extension services, the results showed that age, gender, education level, access to credit, group membership and distance to the extension areas had significant effects on access to agricultural extension services.

The study arrived at a conclusion that the socio-economic factors affecting access to agricultural extension services in western Uganda/ Kiryandongo district were age, gender, education level, access to credit, group membership and distance to the extension areas. In particular, farmers who were male, younger, more educated, belonged to an association, had access to credit and lived closer to extension services more likely to access the extension services.

Based on the results, the study recommended the following strategies towards increased access to agricultural extension services among smallholder farmers;

The positive effect of education level on access to extension services implies that farmers who are highly educated are more likely to access the extension services. The government should therefore set up new adult literacy programs while strengthening the existing ones in order to educate farmers.

The government should set up new adult literacy programs while strengthening the existing ones in order to educate farmers.

There is need for financial institutions to support farmers through quick and low interest rates loans so that farmers can access them easily and timely.

Farmers should be encouraged to form and join such groups and associations.

There is need for the government to increase the number of extension agents for wide coverage. The available extension agents should focus more on empowering women and encouraging them to attend agricultural extension programs.

CONSENT

Informed consent was sought from the respondents before conducting the face-to-face interviews.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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