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Gender disparities in agricultural extension among smallholders in Western Uganda

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ABSTRACT

In this study, we aimed to assess gender disparities in access to agricultural extension services and the determinants of access to extension among male and female-headed households in Western Uganda. A cross-sectional survey was conducted to extract primary data from 200 farmers using a semi-structured questionnaire. The collected data were analyzed using descriptive statistics and Binary Logit model. Our findings revealed that majority of the male-headed households had access to extension compared to their female-headed household counterparts. This was also evident in the sources of agricultural extension. The socio-demographic characteristics of farmers also indicated that male-headed households were better off in many areas, for example, male-headed households boasted 498.83 kg/ha maize productivity, while households headed by females produced 405.36 kg/ha, indicating a 94 kg/ha yield gap. Similarly, adoption of agricultural practices was high among the male-headed households than their fellow female-headed counterparts. Finally, the estimates from the Binary Logit revealed that male-headed households' access to extension was influenced by age, education, farm size, crop diversity, and group membership. The predictor variables that significantly influenced female-headed households' access to extension include age, education, experience, household size, farm size, distance to extension, crop diversity, non-farm income, and credit access. The study concluded that there are gender disparities in agricultural extension as evident in the access to, sources and determinants of access to agricultural extension. To bridge the gender gap, the study advocates for more training and extension services to female-headed households regarding access to and sources of extension services.

IMPACT STATEMENT

Extension service provision is one of the pillars of agricultural productivity among the smallholder farmers in Sub-Saharan Africa. The role of agricultural extension services involves linking farmers and the governments. Through extension services, smallholder farmers are able to acquire modern agricultural techniques that increases farm productivity. With increased farm productivity, farmers are able to come out of the catastrophic levels of food insecurity. Female headed households normally report less productivity of major crops, leading to food insecurity amongst them. This research work contributes to the global discussions on access to extension among the male and female headed households. The study presents results on the state of access to agricultural extension services as well as the determinants of access to extension among the male and female headed households. Our findings and recommendations can be adopted by relevant authorities to increase access to extension, leading to higher crop productivity among female headed households. In the long run, there will be a decline in food insecurity as a result of the increased crop productivity among the female headed households.

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Introduction

It is estimated that more than 60% of the Sub-Saharan Africa (SSA) population depends directly or indirectly on agriculture as a source of their livelihood (FAO, 2018a, 2018b; World Bank, 2015). The agricultural sector performs more than just food production but also contributes significantly to the achievement of the first two global Sustainable Development Goals [No Poverty and Zero Hunger] (Langyintuo, 2020; World Bank, 2022). Population growth in SSA has attracted much attention, which has also been aligned to agricultural productivity. The majority of SSA countries need to produce almost three times their current production to meet the increasing food requirements (FAO, 2022; Mango et al., 2018; WFP, 2023). Strikingly, the food required to feed hungry and growing populations is mainly sourced from agricultural activities. Therefore, the agricultural sector requires intensive policies to achieve optimal productivity.

To achieve the desired household food production, agricultural productivity requires modern farm production skills on modern agriculture (Porter et al., 2015; Sanogo et al., 2023). These may include the adoption of modern agricultural technologies, pest and disease management, climate change mitigation strategies, agricultural marketing, post-harvest loss management, and input combinations to attain farm efficiency, among others (Feyisa, 2020; Sanogo et al., 2023). However, such skills are better disseminated through extension services. Through extension agents, the governments of SSA can train smallholder farmers on agricultural productivity, offer them input subsidies, and pass on any agricultural information and advisory services, among other services (Asante et al., 2024). Thus, extension agents play key roles by acting as intermediaries between smallholder farmers and SSA governments (Abdallah & Abdul-Rahaman, 2016; Abdullahi et al., 2021; Atukunda et al., 2022). Similarly, farmers who actively participate in extension programs are far better off than their counterparts without access to extension services in terms of farm productivity (Biswas et al., 2021).

Evidently, there has been a gender biasness in access to extension services and participation in extension programs among Sub-Saharan African households. The majority of the studies conducted in SSA have reported skewed participation in and access to extension programs among male and female-headed households. For instance, Ragasa et al. (2013) reported that female-headed households are less likely to access extension services in Ethiopia, contributing to low agricultural productivity among such vulnerable households. In the same country, Neway and Zegeye (2022) noted that the adoption of agricultural technology was low among female-headed households compared to their fellow male-headed counterparts, which was attributed to the low participation in extension programmes among female-headed households. Masanja et al. (2023) also reported skewed access to extension services among farmers in Tanzania. They specifically observed a higher rate of access to extension among male-headed households than female-headed households. This was also evident in agricultural productivity, food insecurity, and poverty levels among the two gender groups. A policy brief published by UN-Women (2018a, 2018b) indicated gender gaps in agricultural productivity, as male-headed households are far better in terms of farm productivity than their female-headed counterparts. This was attributed to low access to agricultural services, such as extension, inputs, market information, seeds, and fertilizer-improved varieties, among others. These results are similar to those reported in a study conducted in Ethiopia by Gebre et al. (2021), which showed that male-headed maize productivity was 44.3% higher than that of their female counterparts. Similarly, high rates of poverty, food insecurity, and malnutrition have been more evident among female-headed households than among households headed by males in many countries in sub-Saharan Africa (FAO, 2010; World Bank Group, 2018). However, according to the gender equality theory, male and female-headed households should be given equal chances of access to extension, agricultural productivity, access to productive resources, farm inputs, advisory services, among others (Unicef, 2017). This implies that male and female headed households should equally and actively participate in agricultural production without any biasness of any kind. When male and female headed households are given equal opportunities, their productivity and extension gap will be reduced, enabling equal agricultural productivity among them (Kabeer, 2003) and (UN-Women, 2015).

Increasing farm productivity, food security, and poverty alleviation among vulnerable female-headed households requires studies that present empirical results on the state of gender issues in access to agricultural extension services among households. However, the majority of studies have been conducted

on gender and adoption of technologies (Gebre et al., 2019; Obisesan, 2014), gender and farm productivity (Gebre et al., 2021), and gender disparities in credit access (Hewa-Wellalage et al., 2020), with little work on gender issues in agricultural extension. Gender disparities in access to and determinants of agricultural extension do not seem to be well documented, especially in Sub-Saharan Africa. In addition, the little work done on gender disparity in extension access has also presented varied results, which calls for more empirical studies on gender and agricultural extension. Thus, this study aimed to assess gender differences in agricultural extension among smallholders in Uganda. Specifically, this study aimed to assess gender disparity in access to and sources of extension. The study also aim to assess the determinants of access to extension among male and female-headed households in Western Uganda. It is to our strong conviction that the findings and recommendations from this study will guide policy makers and users on how to improve agricultural extension access and participation among female-headed households. This would reduce poverty, food insecurity and malnutrition among the female headed households. In the long run, farmers' living standards and social welfare will be improved for a better living.

Research objectives

The general objective of this study was to assess gender disparities in agricultural extension among smallholder farmers in Western Uganda. The study is supported by the following specific research objectives.

a. To assess gender disparity in access to and sources of agricultural extension
b. To assess the determinants of access to agricultural extension among the male and female headed households

Literature review

The theories of gender disparity

African Union, AU (2019) and Kabeer (2003), define gender as 'the socially and culturally constructed differences between men and women, boys and girls, which give them unequal value, opportunities and life chances'. There are four major theories that explain gender differences among the farmers. These include socio-cultural theory, selectivity hypothesis theory, evolutionary theory and the hormone-brain theory. According to the socio-cultural theory, gender differences is attributed to the social, cultural, psychological, among other environmental factors. It further explains that cultural influences and physical differences between gender are the main determinants of gender disparity in the today's community (Meyers-Levy & Loken, 2015). Men are muscular and energetic than women, thus attracting division of roles in the society. This leads to men having roles different from women. On the other hand, women's child bearing ability, speed, among others make them attracted to the household work. Thus, men do the hard work including land preparation, decision making, and production while women may help in weeding but make less decisions on the crop types, and have less access to agricultural services.

The selectivity hypothesis theory attributes gender disparity to the fact that male and female poses different strategies and have different ways of processing information. The selectivity hypothesis further explains that females are likely to detect, elaborate more extensively, and use relatively less accessible and more distally relevant information when forming assessments than their fellow male counterparts, leading to gender disparity. On the other hand, males tend to process data selectively than females (Meyer & Levy, 1989). This can result into difference in access to and participation in agricultural extension services among the males and females. The evolutionary theory of gender disparity is based on the effects of human biology such as the evolved mechanisms that humans developed to adaptively address environmental challenges faced by their ancestors. The central premise is that natural selection spawned a human. This leads to different actions and behaviors among the males and females in a given society (Boyer & Barrett, 2015). Hormone-brain theory argues that gender difference arise from the pre-neo, and

postnatal exposure to gonadal hormones, resulting into the brain development permanently and thus the propensities people display. This makes males and females behave differently (Hines et al., 2002).

However, this study is underpinned by the socio-cultural theory of gender differences in the society. From this theory, it is evident that as a result of the cultural and physical differences, male and females tend to have different paths, leading to different resources bases. In the end, there is difference in agricultural productivity since land rights, and access to agricultural services such as extension, input use, among others tend to vary across different socio-cultural settings. It has been reported that males or male headed households tend to be better off in terms of agricultural extension and productivity (Ragasa et al., 2013), agricultural resources (Joseph et al., 2021), adoption of agricultural technologies (Gebre et al., 2019) and (Ndeke et al., 2021), adoption of crop diversification (Ge et al., 2023), livelihood assets (Musa et al., 2024), among others.

Studies on gender issues in agriculture

Wealth of literature exist on gender issues in agriculture. Many studies have outlined gender issues in food security, adoption of agricultural technologies, access to credit, access to resources, access to farm inputs, access to family land, among others. Joseph et al. (2021) conducted a study in Western Kenya to determine gender gaps in access to productive resources among smallholders. Their findings reported gender gaps in access to farm production resources, such as land, farm inputs, and adoption of agricultural technologies, among others. According to their findings, women were less likely to access productive farm resources than their male counterparts. As such, they recommended the prioritization of female farmers to access such resources in order to improve their productivity.

Using Binary logistic model, Neway and Zegeye (2022) analyzed gender differences in technology adoption among 796 farmers in Ethiopia. From their findings, male-headed households had an adoption rate of 87.3%, while the adoption rate of female-headed households was 61.2%. This indicates a 26.1% difference in adoption rates between the two groups. It was evident that male-headed households are much better off in accessing agricultural technologies than their female counterparts. Their results further showed that the adoption of agricultural technologies was influenced gender among other variables. Male household heads had a 12.3% higher probability of adopting agricultural technologies than their female-headed counterparts. Other studies with similar results on gender disparities in technology adoption include Ge et al. (2023), Gebre et al. (2019), Neway and Zegeye (2022), and Obisesan (2014).

Atube et al. (2021) assessed gender responsiveness in the adoption of climate change adaptation strategies in Northern Uganda using a Binary Logit Model. Their study recorded a large gender disparity in the adoption of climate change adaptation strategies. They observed that households headed by males depicted a 0.78 times higher likelihood of adopting climate change adaption strategies than their fellow female-headed households. They also noted that in terms of use of pesticides, male-headed households depicted a 0.66 times higher probability than their fellow female households.

Farm productivity depends largely on access to agricultural credit. Smallholder farmers who are financially constrained may not achieve optimal agricultural productivity. This is as a result of the untimely access to and inadequate purchase of farm inputs and farm machinery, resulting in delayed production. Male-headed households have been reported to have higher credit access than households headed by females. In Kenya, Johnen and Mußhoff (2023) observed skewed access to credit across gender. Male-headed households were reported to have higher access to credit than their fellow female-headed households.

A study conducted in Tanzania, Nigeria, and Uganda on gender disparity in agricultural productivity revealed that female-headed households still lag behind in crop productivity (Mukasa et al., 2015). Male-headed households produce much better results than households headed by females. In the three countries, there was less access to land and labor among female-headed households, contributing to low farm productivity. The findings of Mukasa et al. (2015) illustrated that there was a 18.6%, 27.4%, and 30.6% less land productivity among female headed households in Nigeria, Tanzania and Uganda, respectively.

Over the past decades, females have suffered from many social discriminations. First, African tradition did not recognize female's to own land rights. African households allocate their lands to the male gender, while females are left with little acreages (FAO, 2018b; UN-Women, 2018a; 2018b). As such, female-headed households with limited land are vulnerable to low farm productivity. To produce continuously,

Table 1. Summarized literature on gender issues in agriculture.

Author	Country	Methods	Major findings
Ragasa et al. (2013)	Ethiopia	OLS	Female headed households are less likely to access to extension services
Masanja et al. (2023)	Tanzania	Binary logit	Male farmers are less likely to access extension services
Midamba et al. (2022)	Uganda	Binary logit	Male farmers have higher probability of accessing extension services
Atsbeha and Gebre (2021)	Ethiopia	Binary logit	Women headed households are less likely to access extension services
Nagar et al. (2021)	India	Binary Logit	Male headed households have higher access to extension than female
UN-Women (2018b)	Africa	Review	Women have less land rights Women have lower chances of growing high value crops
FAO (2018a, 2018b)	Africa	Discussion	Women own relatively small portions of land than male
FAO (2010)	Africa	Policy brief	Male headed households are more food secure than female headed households
World Bank Group (2018)	Global	Economic HH Consumption Classification	Female headed households are more poor than male headed households
Olajumoke et al. (2021)	Nigeria	Factorial analysis	No significant difference in access to farm inputs among the male and female gender

they tend to lease land to feed their families. It has also been noted that women were denied education opportunities in Africa (Riegle-Crumb, 2019). They were regarded as lesser humans, leading to many social predicaments among the female gender. Similarly, access to labor, farm inputs, and government services seems to be low among the female gender than their male counterparts.

Many African households are characterized by poverty, malnutrition, and food insecurity (FAO, 2005; IFRC, 2021). In SSA, the majority of farming households live below the poverty line, living less than a dollar daily. However, the female gender seems to be highly poor and food insecure compared to their male counterparts (Stephens, 1991). Reports released by the World Bank Group (2018) on the state of poverty across gender indicate that there are higher poverty rates among female-headed households than among households headed by males. Notably, UNPD (2012) also agrees that female-headed households are more severely poverty-stricken than households headed by males.

There is a wealth of research on gender disparity in agriculture, as discussed above (summarized in Table 1). These include gender issues in the adoption of technologies, poverty, food insecurity, finances, group formation and activity, and agricultural productivity. However, gender disparity in extension services has not been adequately and well-studied, especially in SSA. There is a dearth of literature on the determinants of access to agricultural extension among male and female-headed households in SSA. Moreover, the limited work done on gender and extension also tends to produce varied results, which may not be universally accepted for policy implementation globally. For instance, a study by Ragasa et al. (2012) showed access to extension among the male headed households was influenced by age, education, farm size and livestock unit, while female headed households' access to extension was influenced by farm size, livestock unit and proportion of male members. In contrary, a study conducted in Ethiopia by Haile (2016) showed that participation in extension services among women farmers was influenced by market access, marital status, and farmers' age. Thus, gender issues in agricultural extensions should therefore be adequately studied in every region in order to adequately inform region based policy makers and users. Thus, our study aims to determine gender disparity in access to and sources of extension, and assess the determinants of access to extension among female and male-headed households in Uganda. The results from the study will guide the governments of SSA on how to increase access to agricultural extension among both male and female headed households. This will in turn increase food security and reduce poverty among SSA households, especially the vulnerable female headed households.

Materials and methods

Study locale

We purposively selected Western Uganda for this study. Specifically, Kiryandongo district was selected for data collection (Figure 1). Smallholder farmers in Kiryandongo were selected to participate in the

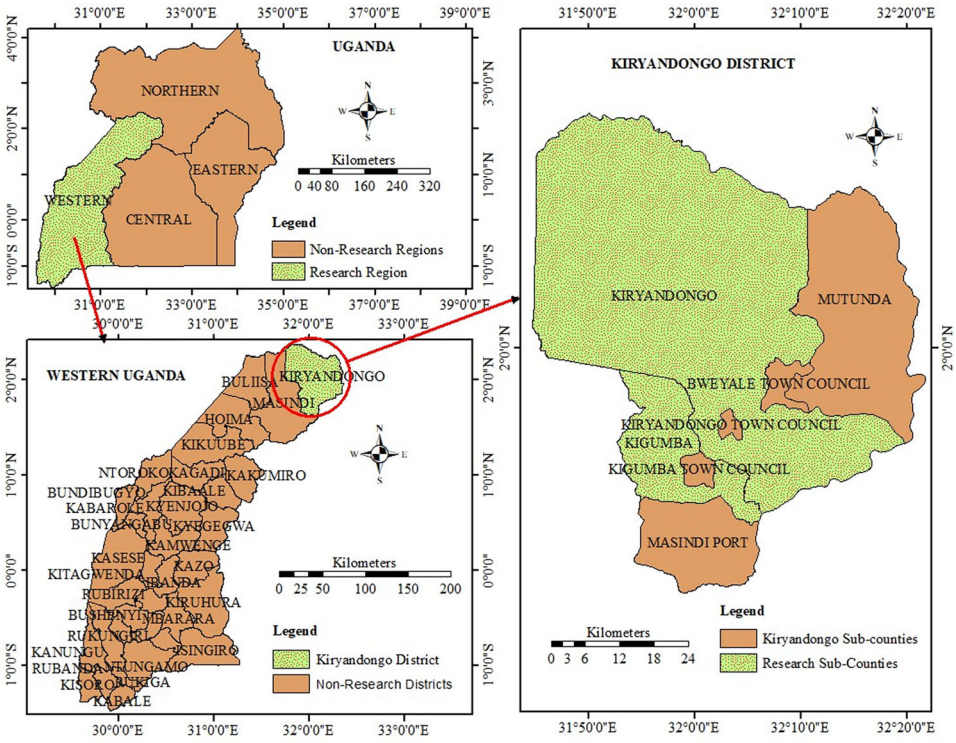

Figure 1. Study locale.

study. Both large and small scale farmers were selected to participate in the study, without any biasness on the level of production. Kiryandongo is bordered by the Nwoya, Oyam, Apac, and Masindi Districts. The coordinates of the district are 02 00 N, 32 18E. The district covers a total area of 3621 Km^2, which is mainly used for agricultural activities. The population comprises of approximately 380,000 people. The sustainable weather and climate in Kiryandongo attracted several households to farming as a source of livelihood. The district receives an average of 292 mm rain days per year. Women engage in several economic activities that provide livelihoods for their families in this district. It is evident that women are active not only in agricultural activities but also in other economic ventures. Agricultural activities that have attracted women in this region include crop (maize, tobacco, beans, cassava, vegetables, among others) and livestock production. Despite women's active participation in economic activities in Kiryandongo, Abigaba (2015) observed a gender imbalance in terms of access to productive resources. They reported that women are always left behind in terms of access to agricultural services, resources, and land rights. As such, several projects have been implemented by the Kiryandongo district leadership, aiming to empower women to undertake economic activities. For example, there are business skills trainings, including agribusiness and farm management training, which target female entrepreneurs. Thus, this region becomes the target area, especially for gender disparity studies.

Data sources, sampling and sample size

Convenience sampling technique was used to collect data from the farmers. Convenience sampling was selected because it is cheap and easier to use (Manikas et al., 2023; Ruzzante & Bilton, 2021). It has been widely used and proven to be one of the best sampling methods which reduces non-response rate in agricultural studies (Al-Jabri & Sohail, 2012; Joseph et al., 2021; Ruzzante et al., 2021; Shahnaz Mahdzan, 2013). Farmers were sampled based on their availability during the study. Similarly, those who were available and consented to participate in the study were randomly selected. The study employed a semi-structured questionnaire (Appendix 1) to collect data from farmers. Open Data Kit (ODK) was specifically used by experienced and trained research assistants to collect data from the farmers. The enumerators who understood the local languages assisted farmers who faced challenges in reading and writing (Acholi, Langi, and Swahili) in the study area. The sample size was determined using a formula by

Cochran (1963). We began data collection in Kiryandongo sub-county and then summarized in Kigumba sub-county. The data collection process took three weeks, starting from 3rd to 24th September, 2021. Data were then downloaded from the ODK server, cleaned, and analyzed using an econometric model.

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

$$n = \frac{1.96 \times 1.96 \times 0.85\ (1-0.85)}{0.0025}$$

$$n = 200$$

Where P is the proportion of farmers' population, which is 0.85 (UBOS, 2018a), n is the number of sampled farmers, and Z is the 95% confidence interval.

Ethical clearance and consent seeking

After developing the data collection tool, we sought ethical clearance from the Gulu University Research Ethics Committee (GUREC). We were then given the opportunity to defend our work before the committee. After successfully defending and submitting all the required documents, our study was approved by the Gulu University Research Ethics Committee (GUREC) under Approval Number: GUREC-084-20. Similarly, the Chief Administrative Officer of Kiryandongo District wrote an introductory letter that allowed us to collect data from the farmers with the help of the District production officer. Similarly, we also sought voluntary written consent from the farmers. The farmers voluntarily consented to participate without coercion. All ethical considerations were followed during the study period. Written informed consent was obtained for participation in the study. At the time of the study, there was Covid -19 outbreak. To avoid the spread of the Covid – 19 pandemic during the study, we developed Covid -19 prevention measures, which were also approved by GUREC.

Econometric analysis

Gender was coded as an independent categorical variable, where males were coded as 1 (male), 0 (otherwise), and female. As such, there were columns for both male-headed households (1-male-headed households, 0-otherwise) and female-headed households (1-female-headed HH, 0- otherwise). Factors affecting access to extension services among male and female-headed households were independently determined using a Binary Logistic Model (BLM). The BLM has been widely applied in agricultural research to assess the influence of socio-economic factors on binary independent variables. BLM was therefore selected because the dependent variable in this study was binary, also called dichotomous. Authors such as Atube et al. (2021) adopted BLM to estimate the determinants of CSA adoption in Northern Uganda; Alemu (2021) explored BLM to assess how socio-economic factors influence participation in trainings in Ethiopia; In Rwanda, Nahayo et al. (2017) determined drivers of smallholders' participation in crop intensification; Okeyo et al. (2020) assessed how socio-economic factors influence sorghum production in Kenya; Using BLM, Masanja et al. (2023) studied the drivers of access to extension in Tanzania. BLM is specified below. Equation 1 represents the probability of access to extension, Equation 2 represents the probability of no access to extension, and Equation 3 represents the binary logistic Equation, which is a combination of Equation 1 and 2.

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

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

$$ln\left(\frac{Pi}{1-Pi}\right) = x_i\beta + e_i \quad (3)$$

where Pi is the probability of accessing extension services while $1 - Pi$ on the other hand is the probability of no access to extension, β is the coefficient to be estimated, and e_i is the error term. X_i is the explanatory variable in Table 2.

Table 2. Variables included in the analysis.

Variables	Type	Measurement	Expected effect	Reference
Age	Continuous	Years	Age reduces access to extension	Enoch Kwame et al. (2023)
Education	Continuous	Years	Education increases access to extension	Wossen et al. (2017)
Experience	Continuous	Years	Experience increases access to extension	Eticha (2021)
Household size	Continuous	Number	Household size increases access to extension	Atsbeha and Gebre (2021)
Farm size	Continuous	Acres	Farm size increases access to extension	Nagar et al. (2021)
Distance to extension	Continuous	Kilometers	Distance reduces access to extension	Abdallah and Abdul-Rahaman (2016)
Crop diversity	Continuous	Number of crops	Crop diversity increases access to extension	Keba and Kedir (2020)
Non – farm income	Dummy	1 – Yes, 0 – Otherwise	Non – farm income increases access to extension	Alemu (2021)
Membership to groups	Dummy	1 – Member, 0 – Otherwise	Group membership increases access to extension	Gatheru et al. (2021)
Farm Sub – county	Dummy	1 – Kiryandongo, 0 – Otherwise	Farmers in Kiryandongo easily access extension	UBOS (2018a)
Access to credit	Dummy	1 – Access, 0 – Otherwise	Credit increases access to extension services	Gatheru et al. (2021)

Table 3. The socio – demographic difference between the male and female headed households.

Socio – demographic variables	Male Headed Household	Female Headed Household	Mean difference	t/chi2 statistics
Age	40.71 ± 13.76	41.19 ± 11.92	0.47	0.212
Education	6.58 ± 4.77	5.29 ± 4.26	1.28*	−1.650
Experience	17.68 ± 12.67	16.46 ± 11.92	1.21	−0.584
Household size	7.52 ± 3.42	7.34 ± 3.38	0.18	−0.320
Market distance	3.12 ± 1.80	2.79 ± 1.85	0.33	−1.103
Farm size	4.16 ± 1.76	2.79 ± 1.64	1.36**	−1.271
Crop diversity	3.87 ± 0.39	2.69 ± 0.59	1.17*	1.926
Group member	0.80 ± 0.21	0.82 ± 0.22	0.02	0.395
Credit	0.78 ± 0.32	0.62 ± 0.28	0.14***	0.927
Number of extension visits	5.23 ± 2.12	3.32 ± 1.32	1.91**	1.860
Inorganic fertilizer adoption	0.61 ± 0.12	0.49 ± 0.14	0.12**	1.444
Pesticides adoption	0.53 ± 0.32	0.36 ± 0.12	0.16**	2.026
Hybrid seeds adoption	0.64 ± 0.23	0.38 ± 0.16	0.26***	0.748
Crop productivity (Kg/ha)	498.83 ± 385.30	405.36 ± 364.90	94.50**	−0.929

Socio-demographic difference between the male and female headed households

The socio-demographic differences between male-headed and female-headed households are presented in Table 3. There was a slight insignificant difference in the age of the household head among female and male-headed households. The mean age of the male-headed household head was 40.17 years while that of the female-headed household was 41.2 years. There was a significant difference in the years of education of the household head between male and female-headed households. The male-headed household head's education years were 1.2 years higher than that of female-headed household heads (UBOS, 2018b). Both farming experience and household size were not significantly different between male and female-headed households. However, male-headed households had more farming experience and more household members than their female household headed counterparts (UBOS, 2020).

The results further revealed that female-headed household resided 0.33 Km from the markets than male-headed households. However, this difference was not statistically significant. In the African tradition, the female gender mostly have less land rights; as such, land acreage allocated to them tends to be much lower than that of males. In this study, the results also reported a significant difference in farm size among male and female-headed households (FOWODE, 2012). Male headed households had 4.16 acres while their female counterparts had 2.79 acres, depicting a difference of 1.36 acres (Giovarelli et al., 2013). Similar observations were also made for the number of crops produced by the two groups. Male-headed households have been reported to produce significantly more crops than female-headed households. Specifically, male-headed households produced an average of 4 crops, whereas female-

headed households produced a mean of 3 crops (Ge et al., 2023). There was a significant difference in the proportion of farmers with access to credit between the two groups. Of the meal-headed households, 78% had access to credit, while only 62% of the female-headed households had access to credit (Johnen & Mußhoff, 2023).

The results further indicated that there were significantly more visits by extension agents among households headed by males than females. The male-headed households reported 5.23 visits per production season, while female-headed households were visited 3.32 times per production season (Ragasa et al., 2013). In terms of agricultural practices, 61% of the male-headed households adopted inorganic fertilizers in their farms, while only 49% of the female-headed households used inorganic fertilizers. Pesticides and hybrid seeds were adopted by 53% and 64% of male-headed households respectively, while only 49% and 36% of female-headed households adopted pesticides and hybrid seeds, respectively. Similar gender difference in adoption of agricultural technologies was also evident in the study conducted by Neway and Zegeye (2022) in Ethiopia. There was a gender difference in the crop productivity between the two groups. Male headed households reported 498.83 kg/ha of maize while households headed by female produced only 405.36 kg/ha, reporting a significant difference of 94.50 kg/ha. A study by Ragasa et al. (2013) also reported a higher productivity of male headed households than their fellow female headed counterparts. From the results, it is evident that male-headed households are much better than female-headed households in nearly all parameters. In conclusion, gender gaps vary across farmers' socio-demographic characteristics as discussed above.

Gender and access to extension

Figure 2 shows the results for gender and access to extension services. There was a difference in the proportion of farmers who have access to extension in terms of gender. The results indicate that 88.30% of male headed households had access to extension services, while only 76.6% of the female headed households had access to extension services. On the other hand, only 11.76% of male headed households reported that they were not visited by extension agents, while 24.4% of female headed households had no access to extension services. The results show that many male headed households had access to extension services than their female headed household counterparts. In contrast, there were more female farmers who did not have access to extension services than their male counterparts. The results presented in Figure 2 are supported by the findings of Ragasa et al. (2013), who reported a skewed access to extension among the male and female headed households in Ethiopia. They noted that female headed household are less likely to access agricultural extension than male headed households, leading to a skewed access to extension among the two groups. It was also evident in the study

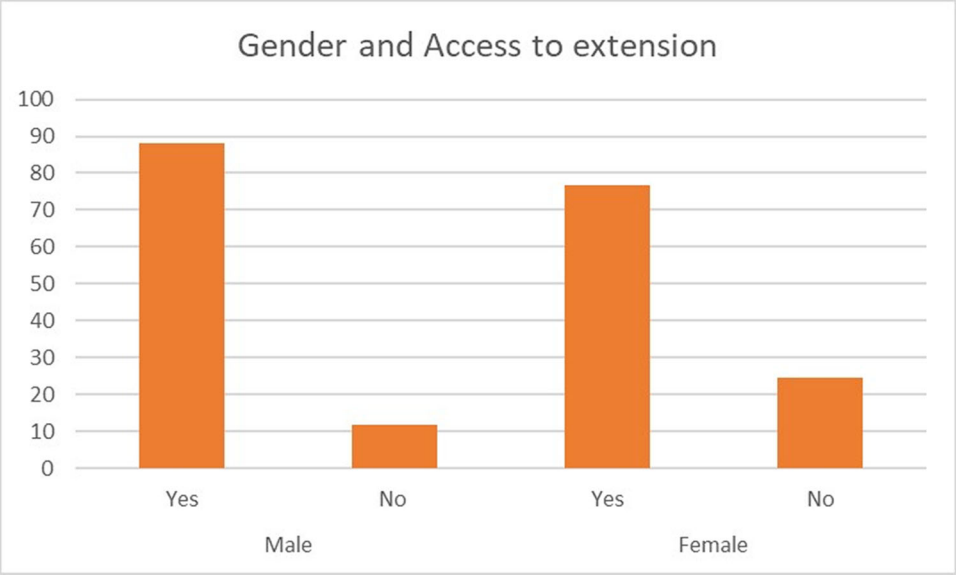

Figure 2. Gender and access to extension.

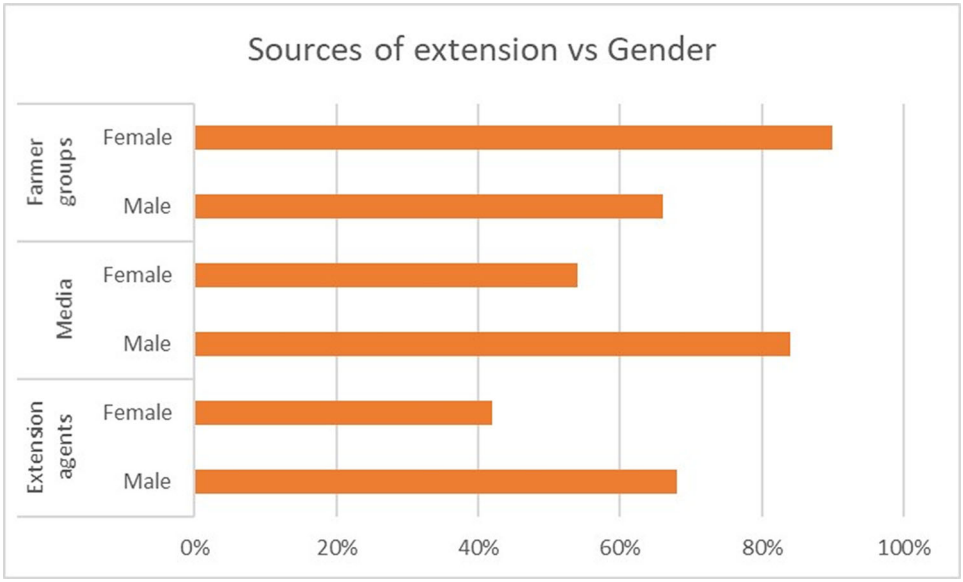

Figure 3. Gender and sources of extension.

conducted by Neway and Zegeye (2022) that female headed households have less access to extension as their study reported that 93.3% of the male headed households had access to extension while only 64% of the female headed households had access to extension.

Gender and sources of extension services

Farmers reported three major sources of extension services available to them (Figure 3). These included farmer-based groups, the media, and government extension agents. There was a significant gender disparity in access to the sources of extension services. Starting with the farmer groups, the results (Figure 3) indicate that 90% of the female farmers had access to farmer group extension services, while only 66% of the male farmers reported group-based extension services. This indicates a 24% gap in group extension between the two groups. It is worth noting that, in terms of farmer group extension, female farmers were better off because they had a higher proportion in group membership than their male counterparts. This is consistent with the results by Charness and Rustichini (2011), who observed that female-headed households are more active in groups, which leads to higher access to extension than male-headed households. Similarly, there were gender gaps in access to extension from media sources. Specifically, the results indicate that 84% of male-headed households had access to media extension, while only 54% of female-headed households reported media as one of the sources of their extension services. This is attributed to the fact that male-headed households can easily access media devices such as radio, television and other ICT gargets such as smart phones easily than the female-headed households as reported by Hashemi et al. (2022). This also reports a 30% gap in media extension between male-and female-headed households. Similarly, extension agents had a gender gap of 26%. This is evident as 68% of the male-headed households reported extension agents as one of their sources of extension, while only 42% of the female-headed households reported that they were visited by the extension agents (Nagar et al., 2021). In terms of gender and sources of extension, it was concluded that there are gender differences in access to the three sources of extension services. Males were better in accessing extension from extension agents and media while females were much better at accessing extensions from farmer groups.

Determinants of access to extension among male-and female-headed households

The determinants of access to extension services among male and female-headed households are presented in Table 4. The model results were generally significant, indicating that all coefficients were not equal to zero (i.e., $p < 0.01$). The Pseudo-R squared values were also within the accepted range. The age of the farmer had a significant influence on access to extension services for both male and female-

Table 4. Determinants of access to extension among the male-and female-headed households.

	Male headed Households			Female headed households		
Predictor variables	Coefficient	Standard Error	*p* - Value	Coefficient	Standard Error	*p* – Value
Age	−0.036**	0.018	0.049	−0.397*	0.213	0.062
Education	0.065**	0.030	0.034	0.252***	0.360	0.001
Experience	−0.015	0.018	0.993	0.429***	0.136	0.002
Household size	−0.004	0.050	0.935	−0.837***	0.309	0.007
Farm size	0.193**	0.100	0.053	0.387**	0.186	0.038
Distance to extension	−0.139	0.097	0.154	−0.188**	0.012	0.016
Crop diversity	0.810**	0.390	0.012	0.860***	0.802	0.001
Non – farm income	0.010	0.021	0.631	0.556***	0.178	0.002
Membership to groups	0.047***	0.046	0.002	0.602	0.459	0.680
Farm Sub – county	−0.377	0.352	0.284	0.470	0.975	0.132
Access to credit	0.512	0.600	0.393	0.542***	0.868	0.003
Constant	0.014***	0.091	0.001	0.568	0.123	0.200
P - value	0.001			0.0087		
R – squared	0.248			0.6902		

headed households. A unit increase in the age of the farmers was associated with a 3.6% and 4% lower likelihood of accessing agricultural extension among the male and female-headed households, respectively. The productivity of smallholder farmers tends to decline as their age increases. In the long run, they become less active and, thus, may not easily access extension services. Because of this, there is less access to extension services among the aged farmers. Existing literature have also agreed with the negative effect of age on household access to extension services among the male and female headed households, for example, similar results were reported by Jack et al. (2020), who showed that age reduced farmers' participation in extension activities in Nigeria. In addition, the findings from a study conducted in Ghana by Tham-Agyekum et al. also reported a negative effect of age on demand for training through extension services. However, our findings contradict that of Ragasa et al. (2013), who observed that access to extension increases as farmers' ages increase.

Education had a significant influence on access to extension among male and female-headed households. For the male-headed households, education would increase access to extension by 6.5%, while for female-headed households, a unit increase in education years would increase the chances of accessing extension by 25.2%, implying that education had a higher magnitude among female-headed households than male-headed households. For both male- and female-headed households, education increases awareness, networks, and social capital, which in turn increases access to extension services. In a study conducted by Masanja et al. (2023) in Tanzania, the variable education was reported to be a pathway through which farmers enhance their production skills, resulting in increased access to extension programs. In Ethiopia, Haile (2016) recommended women's adult literacy programmes after reporting that education increases access to extension services among the farmers. However, a negative and insignificant effect of education on access to extension services was reported by Abdallah and Abdul-Rahaman (2016).

The results indicated that farming experience had a positive and significant effect on access to extension services among female-headed households. Strikingly, farming experience had an insignificant effect on access to extension among male-headed households. The study found that a unit increase in farming experience increased access to extension by 43% among female-headed households. As female-headed households tend to gain additional years of farming, they also increase their skills and networking among themselves and extension agents. Thus, highly experienced farmers can access extension services easily than those who are new in farming. However, there was an insignificant relationship between farming experience and access to extension among the male headed households. In a study conducted in Ghana by Danso-Abbeam et al. (2018), farming experience was a positive predictor of participation and access to extension activities. Similarly, Alemu (2021) also reported that the intensity of attendance to the extension based programmes was positively influenced by farming experience. However, our findings are inconsistent with those of Abdallah and Abdul-Rahaman (2016). In their study, they illustrated that farming experience has a negative effect on extension access.

In African tradition, the number of family members is closely associated with the dependency ratio. As the household size increases, the dependency ratio also increases. This has resulted in many shifts in resources to food production and purchase. In this study, we observed a negative effect of household size on female-

headed households' access to extension services. Large households were associated with an 83.7% lower chance of accessing agricultural extension among female-headed households. However, family size had an insignificant effect on male-headed households' access to extension. In Tigray, Atsbeha and Gebre (2021) present contrary results, which showed that family size increases access to extension programs among female farmers. However, our results are similar to Eticha (2021), who posed that family size was a positive determinant of participation in agricultural extension services among smallholders in South West Ethiopia.

Several authors have reported that females have fewer land rights in Africa (FAO, 2018b; UN-Women, 2018a; 2018b). This impedes agricultural productivity among them (Farha, 2000). In this study, the results indicate that farm size had a positive effect on access to extension for both male and female-headed households. Notably, the magnitudes for male- and female-headed households are 19.3 and 38.7%, respectively. Even though both groups were significantly influenced by farm size, the magnitude was larger among female-headed households than among male-headed households. This is consistent with the findings of Masanja et al. (2023), who discussed how farm size increases farmers' access to extension services in Tanzania. Moreover, Ragasa et al. (2013) examined gender issues in agricultural extension in Ethiopia and reported land size as a major positive determinant of access to extension services among the male and female household heads. However, Atsbeha and Gebre (2021) reported a negative effect of farm size on access to extension among women poultry farmers in Tigray.

Because the majority of extension services are organized in nearby markets and trading centers, the distance to such extension centers influences the rate of access to extension services. Farmers located near the training centers where extension programs are conducted have easy access to such extension programs. However, their fellows who are located far away may not end up attending the extension programs. We found that distance to the extension centers had a negative and significant effect on access to extension for both male- and female-headed households. A unit increase in the distance to the extension centers would reduce access to extension for male- and female-headed households by 14% and 18.8%, respectively. Our results agree with the findings of Sumo et al. (2022), who noted that distance not only reduces access to extension but also demand for extension programs. In addition, Haile (2016) observed that access to markets increases access to agricultural extension, implying that shorter distance to the market also increases timely access to and participation in extension services. Therefore, farmers who are located near the markets can take advantage of the easy accessibility to increase their access to extension.

The number of crops produced by a farmer determined the rate of access to the extension. Farmers who produce many crops may have higher access to extension services than their counterparts who rely on single crops. The results further showed that crop diversity significantly influences access to extension for both male- and female-headed households. A unit increase in the number of crops produced by the two groups would increase access to extension by 81% and 86% for male and female-headed households, respectively. In a number of studies such as those conducted by Abro (2017), Hufnagel et al. (2020), Maru et al. (2022), and Mekuria and Mekonnen (2018), crop diversity has been identified as a key win-win strategy that increases farm income and food security. With increased farm income, farmers would tend to have a higher rate of access to extension.

Group membership was a positive significant predictor of access to extension among the male-headed households. However, for female-headed households, group membership has a positive but statistically insignificant effect on access to extension. Specifically, male-headed households belonging to farmer groups had a 4.7% higher probability of accessing extension services than their counterparts, who were non-group members. Currently, especially in SSA, groups and associations have emerged as social network platforms where farmers come together to learn from each other. Groups and associations help farmers save, borrow, bargain for better prices, and access government services, among others (Adekunle, 2018; Omotesho, 2016). Thus, joining and active participation is an important pathway for accessing government extension services for both male and female-headed households. This is in line with the findings of Danso-Abbeam et al. (2018), who illustrated that group membership increased extension access in Ghana. Similarly, Masanja et al. (2023) opined that group membership was a positive determinant of access to agricultural extension in Tanzania. Thus, belonging to farmer groups can be used as a strategy to access cheap agricultural extension among the farmers.

Credit access was found to have a positive significant effect on access to extension services among female-headed households. For male-headed households, credit had a positive but insignificant effect

on access to extension. The positive and significant effect of credit on female-headed households' access to extension may be attributable to the low rate of access to credit among female-headed households. As such, those with access to credit were able to access extension centers. Credit also plays a significant role in farm input purchases, access to market information, the adoption of modern technologies, and access to extension programs (Arslan et al., 2014; Kadzere, 2016; Louis Kasekende, 2016). In the studies conducted by Makate et al. (2019); Moahid et al. (2021); Saleem (2008), it was reported that credit plays a significant role in ensuring that farmers have access to extension services. Moreover, Danso-Abbeam et al. (2018) added that credit not only increases access to extension but also participation in agricultural extension programmes. In India, Nagar et al. (2021) argued that availability of agricultural credit plays a role by ensuring that farmers are able to access extension programmes in time.

Conclusion and recommendation

Agricultural extension plays a significant role by acting as a pathway between the government of Uganda and smallholder farmers. Farmers are able to access agricultural services such as farm inputs and advisory services through agricultural extension. Attributed to low agricultural productivity among the female headed households, this study aimed to assess gender disparities in agricultural extension services. The study was motivated by the lack of well-documented findings on the state of gender disparities in agricultural extension in Western Uganda. We conducted a cross-sectional study of 200 farmers in Western Uganda to assess gender disparities in access to extension. The findings from the socio-demographic characteristics indicated that male-headed households were much better off than their female-headed counterparts in many areas. Male headed households had higher education levels, higher crop productivity, and higher use of hybrid seeds and fertilizers, among others. The findings on access to agricultural extension services also showed that there were more male-headed households with access to extension than their fellow female-headed households. Similarly, the results indicated that there were more female-headed households who did not have access to extension services than households headed by males. A similar trend was also observed in the sources of agricultural extension. The estimates from the binary logistic model showed that there were more predictors that had significant influence on female-headed households' access to extension than male-headed households. Predictor variables such as age, education, farm size, and crop diversity had significant influences on access to extension among both male-headed and female-headed households. However, access to extension by male-headed households was influenced by age, education, farm size, crop diversity, and group membership. The predictor variables that significantly influenced female-headed households' access to extension include age, education, experience, household size, farm size, distance to extension, crop diversity, non-farm income, and credit access.

In conclusion and from the first objective of the study, there is gender disparity in access to and sources of agricultural extension. First, there is a higher proportion of male-headed households who had access to extension than female-headed households. This was also evident in the farmers' socio-demographics as male-headed households were much better off. This implies that the low agricultural productivity among the female headed households may be attributed to poor access to extension among the female-headed households in Uganda. This may also contribute to the high food insecurity and poverty among the female-headed households since crop productivity and food security are closely related as reported in the majority of gender studies in Sub-Sahara African countries. From the second objective, the study concluded that there were many predictor variables which significantly influenced access to extension among the female-headed households than the male-headed households as mentioned above. Therefore, it is right to conclude that socio-economic determinants have significant positive and negative effects on access to extension among male and female-headed households in Uganda.

Policy implications

- Extension agents should mainly target female-headed households and train them on other ways of accessing agricultural extensions, such as media and farmer groups, among others. This will increase the level of access to extension services among female-headed households.

- Extension agents should extend their extension services to older farmers. This includes both male- and female-headed households and train them.
- Distance to the extension centers had a negative and significant influence on access to extension among female-headed households. Thus, extension agents should reach female-headed households located far away from the extension centers. Similarly, the government should set up more extension centers to support female-headed households.
- Credit access had a positive influence on access to extension services among female-headed households. Extension agents should train female-headed households on how to access credit from financial institutions with low interest rates.
- There was low productivity, which was attributed to the low use of hybrid seeds and fertilizers among female-headed households. Extension agents should train such households in crop productivity through the adoption of agricultural technologies.
- Male headed households should continue joining and participating in farmer groups, as they increase their probability of accessing extension services.

Areas for further studies

Gender issues in agricultural extension is a significant study that provides policies for upholding food security among the female headed households. From past research reports, female headed households tend to be highly vulnerable to food insecurity as a result of low farm productivity, which is also attributed to poor access to extension. While our study focused on one district, we recommend further studies on gender disparity in agricultural extension in other regions of Uganda. Such studies should include the constraints limiting access to extension among the female headed households. This would provide complete results and policy implications on access to extension among the female-headed households.

Authors' contribution

This study was conducted by two authors: Dick Chune Midamba and Kevin Okoth Ouko. The two authors participated in the conception and design, analysis and interpretation of the data, drafting of the paper, revising it critically for intellectual content, and final approval of the version to be published. All authors agree to be accountable for all the aspects of this study.

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Data availability statement

The data that support the findings of this study are available from the corresponding author [Dick Chune Midamba, midambadick@gmail.com] upon reasonable request.

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