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Original Article

Factors Limiting the Adoption of Climate-Resilient Agricultural Practices in and Around Oruchiga Settlement

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ABSTRACT

This study was conducted to establish the potential factors limiting the adoption of climate-resilient agricultural practices in and around the Oruchiga settlement. It was a descriptive study employing both qualitative and quantitative approaches for data collection and analysis. Information was gathered from a sample of 322 respondents and other key informants using questionnaires and interviews. Data was analysed using Microsoft EXCEL and SPSS Version 21.0 to generate both descriptive and inferential statistics. The study identified the different climate-resilient agricultural practices used by smallholder farmers including agroforestry, the use of improved crop varieties and livestock breeds, water-smart technologies, soil fertility management, the use of compost and organic pesticides and small-scale irrigation. The study also found that age, family size (labour), size of land, gender, off-farm activities, group membership and access to credit were some of the potential factors limiting the adoption of climate-resilient agricultural practices in the camp. In conclusion, the study confirmed that different climate-resilient agricultural practices are being used by farmers in the area, and these practices have significantly supported food production systems. Despite their great role in agricultural production, the adoption is still constrained by several factors. The study therefore, recommends government to introduce policies that enable farmers to own and cultivate large-scale farms to increase output. Revisiting land policies is paramount if farmers in the area must increase production through adopted climate-resilient agricultural practices. Small-sized land was one of the reasons farmers failed to use recommended practices; therefore, increasing production per unit area through opening new arable land areas would mean that farmers have enough space to try new technologies/practices. The study also recommends that the government 1) consider the farmers' willingness and factors impeding their practice before introducing climate-resilient agricultural practices; 2) create awareness among the farmers about the overall benefits and challenges of climate-resilient agricultural practices; 3) integrate newly introduced practices with farmer-friendly indigenous practices; and 4) follow down-top approach and include farmers in any decision-making processes.

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INTRODUCTION

According to FAO (2019), climate-resilient agriculture refers to a set of practices, techniques, and approaches designed to enable agricultural systems to withstand and adapt to the impacts of climate change while maintaining or improving productivity, sustainability, and livelihoods. It involves the integration of climate change considerations into agricultural planning, management, and decision-making processes to enhance the resilience of farming systems and reduce their vulnerability to climate-related risks (Ademola et al., 2016; Ruel et al., 2017). Climate-resilient agriculture encompasses a range of strategies that may vary depending on the specific agroecological conditions, local context, and farming systems.

Globally, climate change remains a threat to food security systems and one of the biggest challenges of the 21st century (FAO, 2019). It is widely accepted that the ability to contain the pace of climate change by keeping change in temperature rise within the 2°C threshold, in the long run, is now limited, and the global population will have to deal with its consequences (IPCC, 2014). Climate change has posed significant challenges to global food security, agricultural productivity, and rural livelihoods (Dinesh and Vermeulen, 2016). To address these challenges, climate-resilient agricultural practices have emerged as a potential solution (World Bank, 2021). These practices aim to enhance the adaptive capacity of agricultural systems, mitigate greenhouse gas emissions, and promote sustainable agriculture (Mbuli et al., 2021; Chandra & McNamara, (2018). However, despite their potential benefits, the widespread adoption of climate-resilient agricultural practices globally faces several limitations and barriers (IPCC, 2014; World Bank, 2021).

In Africa, climate change is increasingly recognised as one of the greatest challenges facing the agricultural sector (BFS/USAID, 2017). Rising temperatures, erratic rainfall patterns, increased frequency of extreme weather events, and changing pest and disease dynamics pose significant risks to crop productivity, livestock health, and overall agricultural sustainability (Canevari-Luzardo, 2019). In response to these challenges, climate-resilient agricultural practices have gained attention as a means to enhance the adaptive capacity of agricultural systems and reduce vulnerability to climate change impacts (FAO, IFAD, & UNICEF, 2020). These practices aim to improve resource use efficiency, conserve biodiversity, protect natural resources, and promote sustainable livelihoods (Dessie et al., 2019). Despite the potential benefits, the widespread adoption of climate-resilient agricultural practices faces several limitations and

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barriers. These factors can be categorised based on various dimensions, including knowledge and information, access to resources, policy and institutional constraints, socioeconomic factors, technological and infrastructural challenges, and climate variability and uncertainty. Moreover, collaboration among governments, international organisations, research institutions, civil society, and farmers' associations is crucial for developing and implementing effective strategies to overcome these barriers and accelerate the widespread adoption of climate-resilient agricultural practices in Africa.

In Uganda, climate change is quite evident, as evidenced by a continuous rise in temperature and change in rainfall patterns (Amin et al., 2015). The country is highly vulnerable to the impacts of climate change due to its dependence on rain-fed agriculture and its diverse agroecological zones (FAO & UNDP, 2018). Irregular rainfall patterns continue to be experienced with intense downpours causing floods in many parts, which appear in cycles with severe droughts. To enhance the resilience of the agricultural sector and mitigate climate risks, the adoption of climate-resilient agricultural practices has gained prominence in the country (Atube et al., 2021; Eshete et al., 2020). These practices aim to improve productivity, promote sustainable resource management, and enhance the adaptive capacity of farmers. However, the widespread adoption of climate-resilient agricultural practices in Uganda faces several limitations and barriers. For example, the lack of knowledge and awareness about climate change and climate-resilient agricultural practices is a significant barrier to adoption. Many farmers, particularly smallholders, have limited exposure to climate change concepts and the available adaptation options. Insufficient extension services, inadequate access to climate information, and low levels of education contribute to this knowledge gap. Moreover, limited financial resources and lack of access to credit prevent farmers from investing in climate-resilient technologies, inputs, and infrastructure (Ogada et al., 2014).

In the Oruchiga refugee settlement camp, climate change is evident with its effects on crops and livestock production significantly experienced (Atube et al., 2021). It has contributed to the high poverty level in the camp, which is currently at 35.9% compared to the country level of 21.4% (FAO, 2017). The major effects of climate change include loss of quality and quantity of natural biodiversity, soil erosion and flooding. Varying rainfall patterns have affected both land preparation and food production leading to lower yields (Atube et al., 2021). Similarly, occasional rise in temperature affects moisture retention by soil, which leads to the wilting of crops, hence lower yields contributing to food insecurity. Climate change adaptation has therefore, been highly necessary to cope with the inherent challenges hampering food productivity. CRA practices have been promoted as a means to achieve resilience while at the same time reducing environmental degradation. However, there is still a low adaptive capacity for these practices, which continuously affects the food security and income levels of the growing refugee population in the camp (Atube et al., 2021).

Understanding the factors limiting the adoption of climate-resilient agricultural practices is crucial for developing effective interventions and policies. Addressing these barriers requires a comprehensive approach that combines awareness-raising, knowledge dissemination, capacity-building, financial support, policy reforms, institutional strengthening, technological innovation, and infrastructure development. Collaboration among local governments, research institutions, civil society organisations, and farmers' associations is essential to overcome these limitations and promote the widespread adoption of climate-resilient agricultural practices in the area.

Statement of the Problem

Uganda has witnessed a general decline in food production and access in recent years (FAO & UNDP, 2018). Since 2008, the country has been witnessing severe food insecurity problems in refugee settlements, depicted by a high proportion

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(87%) of the population having no access to food in the right amounts and quality (Atube et al., 2021). A UNCHR report of 2021 indicated that more than one hundred thousand refugees were food insecure, of whom 65.7% solely depend on food relief (Atube et al., 2021). To combat the food insecurity situation in refugee settlements including the Oruchiga refugee settlement camp, the government in collaboration with UNHCR and NEMA, promoted the implementation and adoption of CRA practices to cope with the effects of climate change on food systems (Atube et al., 2021). Climate-resilient agricultural practices have the potential to mitigate these risks and enhance the adaptive capacity of farmers. Despite the multiple benefits of CRA practices and the deliberate efforts by the government and development partners to encourage farmers to invest in them, CRA practices are not well adopted due to factors unknown to the researcher. Understanding the factors that hinder the adoption of climate-resilient agricultural practices is crucial for developing effective strategies to promote sustainable agriculture and build resilience in the face of climate change. This study aims to identify and examine the factors limiting the adoption of climate-resilient agricultural practices in and around the Oruchiga settlement.

The main purpose of this study was to establish the potential factors limiting the adoption of climate-resilient agricultural practices in and around the Oruchiga settlement.

Hypothesis

Ho: There are no potential factors limiting the adoption of climate-resilient practices in and around the Oruchiga settlement

MATERIALS AND METHODS

The study was carried out around the Oruchinga refugee settlement in Isingiro District in southern Uganda. The settlement started in 1959 as a transit camp for refugees of Rwandese origin who were affected by tribal clashes in Rwanda. Presently, the refugee settlement hosts more than 8,000 refugees from Burundi, the DRC, and Rwanda. Agriculture is the main economic activity in the area with an emphasis on food crops like sweet potatoes, beans, cassava, maise, bananas, groundnuts, onions, and cabbage. The average rainfall received in the area is about 1000 mm per annum. There are two rainfall regimes: the first season begins in March to May and the other in August to November. These are punctuated by two dry spells in June to July and between December and February. The area experiences a mean annual maximum temperature of 20 ^{0}C and a mean annual minimum temperature of 14.5 ^{0}C. High temperatures are recorded in the months of January-March and July-September, which are months that correspond to dry spells. CRA practices have been promoted to improve the food security situation of households amidst the harsh climatic conditions. The choice of the area was because it had witnessed continuous food shortages resulting from low agriculture sector performance caused by alternations in temperature and rainfall.

A descriptive design engaging both qualitative and quantitative approaches was used to gather and analyse responses from farmers and other key informants. The qualitative approach was used to gather respondent’s views, feelings, knowledge, and opinions using interviews, while the quantitative approach was used to capture quantifiable responses using questionnaires. Data was gathered from 322 respondents.

The study employed both simple and purposive sampling techniques in the selection of respondents. Simple random sampling was applied in the selection of farmers. This was achieved by getting a list of farmers from each enterprise with the help of the area extension service provider on the day of data collection. The purposive sampling method was used in the selection of key informants like the agricultural extension service provider and local leaders.

A semi-structured questionnaire was designed and used to collect data from farmers. The questions were designed in English and later translated into local languages to make the questions more simple, clear, and understandable to the farmers/respondents. The tool was checked for

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completeness, coded, and entered into SPSS version 2.1 software for cleaning and analysis. Minor mistakes committed during data collection were corrected in the field. Upon the completion of data collection and editing in the field, systematic organisation of raw data was done to facilitate data analysis.

Both descriptive and inferential statistics were generated and used in interpreting results. Continuous variables (age in years, education in years, acreage, and quantity harvested) were analysed using mean, variance, and standard deviation, while frequencies and percentages were applied to categorical variables (such as gender and marital status). Multivariate analysis using correlations and regression statistics was performed to assess the possible associations between the dependent and independent variables and significant relations with the dependent variables. Data outputs were presented in tables.

RESULTS

The study was relatively dominated by females (63.9%) compared to males (36.1%). The average age distribution was 29.23 ± 2.129 years. More than half (70.3%) of the respondents were married, 25.7% were unmarried, and 13% were either widowed or separated. The majority (38.5%) of the respondents had secondary education, 29.5% had a university education, 18.6% had primary education, and 13.3% had no formal education (see *Table 1*).

Table 1: Bio-demographic characteristics of the households

Household Characteristics		**Total (*n*=322)**
Gender of respondents	Female	206 (63.9%)
	Male	116 (36.1%)
	Age (mean ± Std. D)	29.23 ± 2.129 years
Marital status (%)	Single	83 (25.7%)
	Married	226 (70.3%)
	Others	13 (43%)
Education level (%)	None	43 (13.3%)
	Primary	60 (18.6%)
	Secondary	124 (38.5%)
	University	95 (29.5%)

On average, most `households size constituted 4.49 ± 1.322 members. The average size of the land was 2.67 acres. More than half (68%) of the respondents owned land, 29.8% used hired or paid land, while 2.2% were given land by the government. 57.8% used family labour on the farm, while 42.2% used hired labour. The majority (48.4%) of the respondents practised subsistence farming, 27.6% commercial farming, while 23.9% practised both commercial and subsistence agriculture. 65.5% owned crop enterprises, 14.3% owned animal enterprises, and 20.2% had a mixture of both animal and crop enterprises (see *Table 2).*

As presented in *Table 3* below, 20.8% of the respondents used agroforestry, 18.3% used compost and organic pesticides, 16.5% used water-smart technologies, 13.9% used improved crop varieties, 13.7% improved livestock breeds, whereas 10.6% and 6.2% reported soil fertility management and small-scale irrigation respectively.

At the bivariate level, the adoption of CRA practices had a moderate association with age (*x^2* = .567, p= 0.018), a very strong association with family size (*x^2* = .812, p= 0.001), a moderate association with land size (*x^2* = .487, p= 0.022), a moderate relationship with gender (*x^2* = .446, p= .035), a strong association with religion affiliation (*x^2* =.624, p= 0.002), a very strong association with knowledge on CRA practices (*x^2* = .732, p= 0.004), a very strong association with membership to a farmer group (*x^2* =.793, p= 0.002), and a very strong association with credit access (*x^2* = .855, p= .000) (see *Table 4*)**.** However, the adoption of CRA practices

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presented no significant association with factors like the level of education, farming experience, marital status, tribe, and information access.

Table 2: Household socioeconomic background

Household Characteristics		Total (*n*=322)
Family size (mean ± Std. D)		4.49 ± 1.322 members
Size of the land in acres (mean ± Std. D)		2.67 ± .757 acres
Land ownership	On the land	219 (68%)
	Hired and paid	96 (29.8%)
	Given by government	7 (2.2%)
Type of labour used on the farm	Family	186 (57.8%)
	Hired	136 (42.2%)
Type of farming practised	Commercial farming	89 (27.6%)
	Subsistence farming	156 (48.4%)
	Both	77 (23.9%)
Agricultural enterprises on the farm	Crop enterprises	211 (65.5%)
	Animal enterprises	46 (14.3%)
	Both	65 (20.2%)

Table 3: Climate-resilient agricultural practices used by smallholder farmers within the settlement camp.

Climate-resilient agricultural practices	Total (*n*=322)
Agroforestry	67 (20.8%)
Use of improved crop varieties	45 (13.9%)
Improved livestock breeds	44 (13.7%)
Water-smart technologies	53 (16.5%)
Soil fertility management	34 (10.6%)
Use of compost and organic pesticides	59 (18.3%)
Small scale irrigation	20 (6.2%)

Table 4: Association between the adoption of CRA practices and associated factors at the bivariate level.

	Adoption of CRA practices	
Factors	Chi-Square	Sig.
Age	.567	.018
Level of education	.044	.833
Family size (labour)	.812	.001
Experience in farming	.766	.096
Land size	.487	.022
Gender	.446	.035
Marital status	.790	.285
Religion affiliation	.624	.002
Income status	.493	.174
Knowledge of CRA practices	.732	.004
Membership in farmer group	.793	.002
Access to credit	.855	.000
Reoccurrence of pests and diseases	.174	.068

Results of the logistic regression model for the potential factors limiting the adoption of climate-resilient agricultural practices in and around the Oruchiga settlement are presented in Table 4.7 above. The coefficients explained the changes in the probabilities of the outcome as a result of a

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unit change in the explanatory variables. The adoption of climate-resilient agricultural practices was used as the outcome category in the equation. Thirteen factors were hypothesised, and only seven remained statistically significant at the multivariate level, including age, family size (labour), size of land, gender, off-farm activities, group membership and access to credit.

Table 5: Logistic regression results for the adoption of CRA practices and associated factors.

Adoption of CRA practices [a]			B	Std. Error	Sig.	Exp(B)	95% CI for Exp(B)	
							Lower	Upper
Yes		Intercept	-17.252	1.791	.000			
	Age	In years	1.346	.581	.021	3.842	1.230	3.997
	Education	In years	-.009	.045	.833	.991	.908	1.081
	Family size	Members	2.316	.691	.001	2.862	1.432	10.937
	Experience in farming	In years	-.069	.042	.099	.934	.860	1.013
	Size of land	Acres	2.165	.973	.026	8.712	1.294	15.658
	Gender	Male	.770	.372	.038	2.159	1.042	4.474
		Female	0[b]	.	.	.	.	.
	Marital status	Single	-1.256	1.001	.210	.285	.040	2.027
		Married	-1.459	.937	.119	.232	.037	1.458
		Widowed	-1.854	1.099	.091	.157	.018	1.349
		Separated	0[b]	.	.	.	.	.
	Religion	Catholic	.143	.296	.629	1.153	.646	2.059
		Anglican	.017	.015	.247	1.017	.988	1.046
		Muslim	.511	.560	.321	2.974	.974	2.974
		Others	0[b]	.	.	.	.	.
	Income status	High	.941	.633	.137	2.562	.742	8.850
		Medium	1.231	.676	.068	3.425	.911	12.873
		Low	0[b]	.	.	.	.	.
	Knowledge of CRA practices	Yes	.900	.343	.005	2.460	1.255	4.822
		No	0[b]	.	.	.	.	.
	Group membership	Yes	-1.072	.345	.002	.342	.174	.674
		No	0[b]	.	.	.	.	.
	Access to credit	Yes	2.174	.765	.002	1.929	.817	2.055
		No	0[b]					
	Reoccurrence of pests and diseases	Yes	-.148	.158	.347	.862	.633	1.175
		No	0[b]					

a. Dependent variable: Adoption of CRA practices
b. The reference category: no
c. This parameter is set to zero because it is redundant.

The coefficient of age was positive and had a significant association with the adoption of climate-resilient agricultural practices at 5 percent. Old age increased the log of the probability of farmer's adoption of climate-resilient agricultural practices by 3.842, implying that a unit increment in age increased the chances of adopting climate-resilient agricultural practices by 3.8 [AOR = 3.842; (95% CI: 1.230 - 3.997); p = .021]. The stated null hypothesis that there was no significant association between age and adoption of climate-resilient agricultural practices was rejected.

Family size increased the log of the probability of households adopting climate-resilient agricultural practices by 2.862. Bigger households were 2.8 times more likely to adopt climate-resilient agricultural practices compared to small households [AOR = 2.862; (95% CI: 1.432 - 10.937); p = .001]. The stated null hypothesis of there being no significant association between

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family size and the adoption of climate-resilient agricultural practices was rejected.

Land size increased the log of the probability of households adopting climate-resilient agricultural practices by 8.712. Farmers with big-sized land had 8.7 chances of adopting climate-resilient agricultural practices compared to those with small-sized land [AOR = 8.712; (95% CI: 1.294 - 15.658); p = .026]. The stated null hypothesis of there being no significant association between the size of land and the adoption of climate-resilient agricultural practices was rejected.

Similarly, the coefficient of gender was positive and had a significant association with farmers' adoption of climate-resilient agricultural practices at 5 percent. Males were 2.2 times more likely to adopt climate-resilient agricultural practices compared to females [AOR = 2.159; (95% CI: 1.042 - 4.474); p = .038]. The earlier stated null hypothesis was rejected.

Similarly, being knowledgeable about CRA practices increased the log of the probability of adopting climate-resilient agricultural practices by 2.460. Farmers with knowledge of CRA practices had 2.4 chances of adopting the practices compared to those who lacked the knowledge [AOR = 2.460; (95% CI: 1.255 - 4.822); p = .005]. In this case, the stated null hypothesis that there was no association between having knowledge of CRA practices and the adoption of CRA practices was rejected.

Unlike the presence of off-farm activities, the coefficient of group membership was negative but had a significant association with farmers' adoption of CRA practices, implying that belonging to a group decreased the log of the probability of farmers adopting CRA practices.

Farmers who belonged to groups were .342 times less likely to adopt CRA practices compared to those who never belonged to groups [AOR = .342; (95% CI: .174 - .674); p = .022]. The stated null hypothesis that there was no significant association between group membership and adoption of CRA practices status was rejected.

Lastly, access to credit increased the log of the probability of adopting climate-resilient agricultural practices by 1.929. Farmers with access to credit services had 1.929 chances of adopting climate-resilient agricultural practices compared to those that had no access to credit [AOR = 1.929; (95% CI: .817 - 2.055); p = .002]. In this case, the stated null hypothesis that there was no association between access to credit and the adoption of CRA practices was rejected.

DISCUSSION

The study found that there are various climate-resilient agricultural practices used by smallholder farmers within the settlement camp. For example, agroforestry emerged as a practice that was widely practised by farmers. Agroforestry is the cultivation and use of trees and shrubs with crops and livestock in agricultural systems. It seeks positive interactions between its components, aiming to achieve a more ecologically diverse and socially productive output from the land than is possible through conventional agriculture. The most commonly adopted system was a banana and coffee system. To support the findings, Sahman & Zhang (2018) stated that agroforestry is a set of land-use practices involving the deliberate combination of trees with agricultural crops and/or animals on the same land management unit in some form of spatial arrangement or temporal sequence. There are lots of possible combinations of food products, including crops and fruits, fodder, mulch/green manure, and timber. Trees may, for example, be planted around homesteads (home gardens), along fences, on farm boundaries or on crop or pasture land. The introduction of trees or shrubs creates a more diverse, productive, and ecologically sound land use and environment.

A section of respondents reported the use of compost and organic pesticides. These practices were used with the aim of building soil resilience, improving soil health, building soil carbon, reducing erosion, and increasing the water retention capacity of the soil. These are important factors that improve resilience. This finding was in agreement with Osumba et al. (2020), who

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noted that compost and organic manures are key in strengthening soil properties, including nutrients, aeration and water-holding capacity.

Respondents reported water-smart technologies as another climate-resilient agricultural practice used by smallholder farmers within the settlement camp. Water-smart technologies like micro-irrigation, rainwater harvesting structures, cover-crop method, reuse of wastewater, and drainage management have been widely adopted in the camp with the aim of improving productivity. These practices have supported farmers to decrease the effect of variations in climate. In support of the findings, Liben et al. (2018) also reported water harvesting and management technologies as a strategy to secure water resources in areas affected by climate change. Therefore, the provision of supplementary water to croplands through irrigation and the use of efficient irrigation measures can enhance carbon storage in soils through enhanced yields and residue returns.

Respondents mentioned the use of improved crop varieties, such as hybrid varieties, which are tolerant to climate variations. Patterns of drought may need various sets of adaptive forms. Drought tolerance is the ability of a plant to maintain its biomass production during arid or drought conditions. Some plants are naturally adapted to dry conditions, surviving with protection mechanisms such as desiccation tolerance, detoxification, or repair of xylem embolism. Other plants, specifically crops like corn, wheat, and rice, have become increasingly tolerant to drought, with new varieties created via genetic engineering. In support of the findings, Woolf et al. (2018) stated that the mechanisms behind drought tolerance are complex and involve many pathways that allow plants to respond to specific sets of conditions at any given time.

Respondents further reported soil fertility management as part of the climate-resilient agricultural practices adopted by smallholder farmers. Managing these soils involves increasing their physical quality while maintaining or improving their fertility. The common practices used in managing soil fertility include applying organic substrates such as manures and composts, reducing tillage and retaining crop residues, and conserving water. In support of the findings, Escarcha et al. (2018) stated that a large proportion of agricultural land has been degraded due to excessive disturbance, erosion, organic matter loss, salinisation, acidification, or other processes that curtail productivity. Managing these soils involves increasing their physical quality while maintaining or improving their fertility. Practices that reclaim productivity and restore carbon storage include nutrient amendments, applying organic substrates such as manures and composts, reducing tillage and retaining crop residues, and conserving water.

The potential factors limiting the adoption of climate-resilient agricultural practices in and around the Oruchiga settlement were determined using logistic regression at a 95% confidence interval and 5% level of probability. Age was identified as a strong predictor in the adoption of climate-resilient agricultural practices. Old age increased the log of the probability of a farmer's adoption of climate-resilient agricultural practices, whereby the more the age, the more the chances that an individual would adopt and use the practices. However, there is a controversy in the literature when explaining the relationship between age and level of farmer adoption of any new farm technology. Older farmers are rigid in adopting new technologies. Perhaps this is because of investing several years in particular practices, which makes them unwilling to risk trying out completely new farming methods. In support of the findings, Harvey et al. (2018) observe that the age of a farmer may positively or negatively influence the decision to adopt new technologies. Older farmers have more experience in farming and are better able to assess the characteristics of modern technology than younger farmers, and hence, a higher likelihood of adopting the practice.

Family size increased the probability of households adopting climate-resilient agricultural practices. Relatively bigger households were more likely to adopt climate-resilient agricultural

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practices compared to small households. The bigger the household, the more the chances of getting labour. Labour is an important constraint in the adoption of new technologies, particularly those technologies that are labour-intensive. Labour availability can be measured as the proportion of household members who contribute to farm work. The proportion of household members available to provide labour positively influences the adoption of agricultural practices. The number of household members who provide farm labour is positively associated with the probability of participating in soil fertility management practices. This finding is comparable to findings by Mbuli et al. (2021), who mentioned that due to the high labour demand for applying animal manure, households with a high number of members working on the farm are more effective since household labour is the most important source of labour supply for smallholder households, given that low incomes constrain hiring paid labour. Moreover, there are moral hazards associated with hired labour calling for considerable supervision, which raises the real cost of household labour beyond the observed wage rate. Therefore, the lack of adequate labour accompanied by the inability to hire paid labour can seriously hinder participation in soil fertility management practices.

Land size increased the probability of households adopting climate-resilient agricultural practices. Farmers with big-sized land had more chances of applying climate-resilient agricultural practices than those with small-sized land. This study finding is in agreement with Dinesh and Vermeulen (2016), who stated that farm size can positively influence adoption because farmers with large farm sizes can experiment with new technologies on a portion of land without worrying about endangering the family's food security. In addition, the benefits from the large-scale adoption of new technologies are absolutely large for larger farms.

Gender had a positive log of probability and had a significant association with farmer's adoption of climate-resilient agricultural practices, where males were more likely to adopt climate-resilient agricultural practices compared to females. There is no doubt that men would adopt climate-resilient agricultural practices compared to females because traditionally, males tend to dominate in activities that bring cash/income to the family as breadwinners, and females dominate in non-cash family activities. More so, the culture of Uganda takes men as the sole custodians of the community and family property. As such, they are in charge of the decision-making process, which includes how to utilise land and agricultural resources. Women are, however, more involved in activities like small animal rearing, crop planting, weeding, and harvesting. This is comparable to findings by Dessie et al. (2019), who stated that the household head is the implicit key decision maker for the household. Male-headed households in developing countries have higher access to resources and information that give them greater capacity to adopt.

Similarly, having knowledge of CRA practices increased the probability of adopting them. Farmers with knowledge of CRA practices had more chances of adopting the practices than those who lacked the knowledge. The greatest constraint faced by poor farmers to use recommended agricultural practices is a lack of knowledge. In order to overcome this constraint, there is a need to greatly enhance investment in extension services so that farmers get the right message at the right time. In comparison with the findings, Kebeda et al. (2019) stated that practice-oriented research, capacity-building, and extension, as well as improving access to agricultural information, are some of the key strategies that can improve the uptake of agricultural technologies by farmers.

Group membership was negative but had a significant association with farmers' adoption of CRA practices, implying that belonging to a group decreased the log probability of farmers adopting CRA practices. Farmers who belonged to groups were less likely to adopt CRA practices compared to those who never belonged to groups. This finding contradicts the findings by Sahman & Zhang (2018), who stated that group formation promotes cohesion, knowledge sharing and

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farmers' access to inputs and financial capital. They further argued the impact of group mobilisation on technology adoption is easier since it was easier to access the required capital to purchase the technology. One of the factors that encourage farmers to work in collaborative marketing groups (CMG) is the sense of security by members of the CGM in adopting new innovations. Individual farmers do not feel isolated in taking the risks associated with adopting new technologies, as the effect of adopting a particular innovation is felt by everyone in the group.

Access to credit increased the probability of adopting climate-resilient agricultural practices. Farmers with access to credit services had more chances of adopting climate-resilient agricultural practices compared to those who did not. In support of the findings, Rugege et al. (2017) stated that credit is very useful in purchasing inputs such as improved seeds and other inputs. Hence, access to credit is expected to influence the effectiveness of the adoption of resilient practices positively.

CONCLUSION

The study confirmed that there are different climate-resilient agricultural practices used by smallholder farmers within the settlement camp including agroforestry, use of improved crop varieties and livestock breeds, water-smart technologies, soil fertility management, use of compost and organic pesticides and small-scale irrigation. These practices have a significant effect on the food production systems of the locals in the camp. The study also finds that age, family size (labour), size of land, gender, off-farm activities, group membership, and access to credit are the potential factors limiting the adoption of climate-resilient agricultural practices in and around the Oruchiga settlement.

Recommendations

Since the study discovered that the application of different climate-resilient agricultural practices had a significant effect on food production systems, it is paramount that these specific or a combination of practices be promoted to boost agricultural production in the area. There is a need for government extension agents to intensify awareness creation on the usefulness of climate-resilient agricultural practices for sustainable production and environmental protection for adoption by farmers.

Farmers' ideas, local experiences, and perceptions are extremely overlooked. However, farmers' willingness to accept and invest in CRA farming practices is strongly correlated with biophysical, socioeconomic, and institutional factors. Therefore, any agroecological farming plans should 1) consider the farmers' willingness and factors impeding their practice before introducing climate-resilient agricultural practices; 2) create awareness among the farmers about the overall benefits and challenges of climate-resilient agricultural practices; 3) integrate newly introduced practices with farmer-friendly indigenous practices; and 4) follow down-top approach and include farmers in any decision-making processes.

The lack of capital to invest is among the key factors limiting farmer's adoption of climate-resilient agricultural practices. The government should, therefore, intervene and avail credit services to the farmers coupled with prior financial literacy. This can be achieved by establishing village banks and encouraging financial institutions to give farmers loans at low-interest rates.

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