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Credit Access and Smallholder Rice Farmers' Productivity in Agricultural Co-operatives Based Irrigation Schemes in Tanzania

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ABSTRACT

Access to credit is crucial for enhancing productivity among smallholder rice farmers in Tanzania's irrigation schemes. Despite its importance, various barriers prevent these farmers from securing the necessary financial services. This study investigates the factors influencing credit access and its effect on productivity among smallholder rice farmers in irrigation schemes managed by agricultural co-operatives in Tanzania. The study adopted a cross-sectional research design, collecting data from 382 smallholder rice farmers in three Agricultural Marketing Co-operative Societies (AMCOS) during the 2021 cropping season. Data were gathered through a structured questionnaire and key informant interviews. The analysis employed the Statistical Package for Social Sciences (SPSS), utilizing descriptive statistics and binary logistic regression. The findings reveal that only 34.3% (131) of the 382 respondents had access to credit, and this access positively influenced productivity among smallholder rice farmers. The model results indicated that the duration of membership in a cooperative society, land size, access to training, farming experience, and adequate extension services were significant determinants of agricultural credit access. While only 34.5% of respondents had access to credit, this access positively influenced productivity. The key determinants of agricultural credit access include cooperative membership duration, land size, training access, farming experience, and extension services. To improve rural farmers' access to credit, the Local Government Authority and stakeholders in the credit industry should design interventions that enhance credit access among smallholder farmers. Additionally, promoting capacity building, financial literacy programs, and ensuring that policy interventions focus on supporting rural financial institutions are recommended strategies for improving credit access, boosting agricultural productivity, and enhancing the livelihoods of smallholder rice farmers in Tanzania.

Keywords: Co-operatives, Credit access, Productivity, Smallholder

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1. Introduction

Rice (Oryza sativa L.) is a vital staple food for over half of the global population (CGIAR, 2016). It is regarded as one of the strategic crops and plays a significant role in ensuring food security and employment in both developing and developed economies (Gadal et al., 2019). Therefore, rice production is crucial for achieving the Global Sustainable Development Goal (SDG) number 2 on zero hunger. Countries worldwide need this crop to eradicate hunger and ensure food security by providing food and humanitarian relief and establishing sustainable food production by 2030 (UNDP, 2021). Several global studies have emphasized the necessity of effective agricultural financing as a strategy for sustainable agricultural development (NAP, 2013; Kashif et al., 2016; Turvey & Xiong, 2017; NRDS, 2019; Nordjo & Adjasi, 2020; Waje, 2020). In developing nations like Tanzania, the significance of agricultural credit for agricultural output has been widely highlighted (MAFAP, 2013; Isaga, 2018; Mapunda et al., 2018; Exaudi & Mwaitete, 2022). The Tanzanian government has established various credit structures and facilities, including banks, microfinance organizations, and farmers' groups, to finance multiple sectors, including agriculture. With access to better inputs and technologies, farmers can maximize the benefits of irrigation schemes.

Access to credit is a major component of financial inclusion (Turvey & Xiong, 2017). However, low access to credit among smallholder farmers, who make up the majority of the agricultural sector's drivers, is a significant constraint (Waje, 2020). Access to a well-functioning financial system can empower individuals both economically and socially, allowing smallholders to integrate more successfully into their national economies, contribute actively to development, and protect themselves against economic shocks. Several empirical studies have shown a positive relationship between agricultural credit and agricultural development (Diallo et al., 2020; Nordjo & Adjasi, 2020; Obagbemi et al., 2022; Ouattara et al., 2020). These studies consider agricultural credit essential for modernizing agriculture, as it enhances the flow of inputs and increases the efficiency of agricultural production. It is well established that smallholder farmers with access to credit are likely to utilize optimal inputs, improved varieties, and new technologies, thereby increasing their agricultural productivity (Anang et al., 2016; Kashif et al., 2016; Waje, 2020; NAP, 2013). The positive impacts of agricultural credit on production and productivity are evident in the improved living conditions of smallholder farmers (Mago & Hofisi, 2016).

The Government of Tanzania has made efforts to increase smallholder rice farmers' access to credit in irrigation schemes by addressing the challenges hindering their competitiveness. The primary focus has been on improving productivity through enhanced access to credit and extension services by strengthening the linkage between financial institutions and farmers, as well as establishing microfinance institutions such as Savings and Credit Co-operative Societies (SACCOS) and Village Community Banks (VICOBA), where smallholder farmers can obtain credit (NAP, 2013; NRDS, 2019; ASDS, 2015). Additionally, strategies to facilitate farmers in forming groups and associations to strengthen their bargaining power and access to credit have been implemented. Despite these efforts, smallholder rice farmers still have limited access to credit, which is crucial for

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increasing agricultural production and productivity. Numerous studies have assessed smallholder farmers' access to credit in Sub-Saharan Africa and other parts of the world, consistently showing that these farmers have limited access to financial resources (Kehinde, 2022; Jiang et al., 2024; Chauke et al., 2013; Kiplimo et al., 2015; Bonnke et al., 2022; Odhiambo & Upadhyaya, 2020; Sanka & Nkilijiwa, 2021; Waje, 2020; Taremwa et al., 2022; Tesiso et al., 2023; Ullah et al., 2020). Previous studies indicate that only a small proportion of smallholder farmers accessed agricultural credit (Taremwa et al., 2022). Moreover, the sources of credit for these farmers included commercial banks, microfinance institutions, traders, input dealers, relatives, and cooperative institutions, with most farmers borrowing from cooperative institutions and input providers (Obagbemi et al., 2022; Sanka & Nkilijiwa, 2021; Ullah et al., 2020). Various studies conducted in South Africa, Congo, Kenya, Pakistan, Ethiopia, and Nigeria examined factors affecting smallholder farmers' access to credit (Chauke et al., 2013; Kiplimo et al., 2015; Bonnke et al., 2022; Odhiambo & Upadhyaya, 2020; Waje, 2020; Ullah et al., 2020). These studies applied Probit and Logistic regression models, revealing that age, education level, land size, credit need, extension contact, cooperative membership, high farm income, better access to information, large physical asset ownership, and connections with local leaders significantly influenced farmers' access to credit. Other studies have assessed the relationship between agricultural credit and smallholder farmers' productivity (Awotide et al., 2015; Diallo et al., 2020b; Girabi et al., 2013; Houensou et al., 2021; Mapunda et al., 2018; Mpeku & Urassa, 2022; Nordjo & Adjasi, 2020). Research by Diallo et al. (2020b), Girabi et al. (2013), and Nordjo & Adjasi (2020) in Tanzania, Ghana, Nigeria, and Senegal indicated that farmers with access to credit achieved higher yields through investment in farm inputs compared to those without access, providing strong empirical evidence to promote agricultural credit in production.

While some empirical studies exploring smallholder farmers' access to agricultural credit have been conducted in developing countries, results vary significantly from one country to another and across different geographical settings, even within the same country. Consequently, there is a lack of empirical literature in Tanzania, and limited information is available in the study area. For example, studies by Isaga (2018) and Mpeku & Urassa (2022) focused on smallholder farmers' access to credit from commercial banks, without considering other sources of credit. Additionally, a study by Mmasa (2017) exclusively examined women farmers' access to informal credit in the Singida and Chamwino Districts of Tanzania. Meanwhile, Mwonge & Naho (2021) assessed the determinants of credit demand among smallholder farmers in Morogoro municipality. Most studies have concentrated on agricultural credit access for farmers in general, with little attention paid to specific crop producers, such as rice farmers. This highlights a gap in the literature regarding factors influencing smallholder rice farmers' access to credit in irrigation schemes. This study aimed to identify key determinants of credit access for smallholder farmers and their relationship with productivity within irrigation schemes in the Mvomero and Mbarali districts.

2. Materials and Methods

2.1 Study Area

The research on which this paper is based was conducted in the Mbarali and Mvomero Districts, located in the Mbeya and Morogoro

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regions, respectively. These study areas are among the major rice-growing regions, with both districts situated in suitable agro-ecological zones for rice production (URT, 2019). Mbarali District is positioned at latitude 8°51'60" South and longitude 33°51'0" East. It is one of the seven districts in the Mbeya Region, bordered to the north and east by the Iringa Region, to the south by the Mbeya Rural District, and to the west by the Chunya District. Mvomero District is located at latitude 6°26'0" South and longitude 37°32'0" East, bordered by Handeni District (Tanga Region) to the north, Bagamoyo District (Coast Region) to the east, Kilosa District (Morogoro Region) to the west, and Morogoro Urban District (Morogoro Region) to the south.

2.2 Sampling and Sample Size

The study adopted a cross-sectional research design and a mixed-methods approach for data collection. Data were gathered from 382 smallholder rice farmers in irrigation schemes managed by Agricultural Marketing Cooperative Societies (AMCOS). The sampling frame comprised smallholder rice farmers in Mbarali and Mvomero districts. Purposive sampling was utilized to select the two districts (Mvomero and Mbarali) and three irrigation schemes based on their prominence in rice farming and participation in the rice value chain. A simple random sampling procedure was employed to select respondents from the list of smallholder farmers obtained from the AMCOS offices. The sample size was estimated using Yamane (2001), assuming a 95% confidence level and a margin of error of 5%, as specified below:

$$n = \frac{N}{1 + N(e^2)} \dots\dots\dots\dots\dots\dots\dots (1)$$

Where:

n = sample size

N = population size = 4749

e = level of precision (sampling error) = 5% or 0.05

2.3 Data Collection

Data collection methods included surveys, Key Informant Interviews (KII), and Focus Group Discussions (FGDs). Both quantitative and qualitative data were collected using a structured questionnaire with open and closed-ended questions. Four FGDs were conducted, each consisting of eight participants. Data were collected in February 2022, with farmers asked to provide information on the previous cropping season (2020/2021). The data collection tools included a structured questionnaire and a key informant interview guide. Key informants comprised village agricultural extension officers, district cooperative officers,

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irrigation scheme supervisors, and AMCOS officials.

2.4 Data Analysis

Data analysis was performed using SPSS software. Descriptive statistical analysis, such as means, frequencies, and percentages, was calculated to describe the socio-demographic characteristics of respondents and their farming profiles. Content analysis was employed to systematically organize, rearrange, and manage qualitative data obtained through FGDs, allowing for meaningful insights and patterns to emerge. Chi-square and independent sample t-tests were used to analyze the characteristics of smallholder rice farmers based on whether they had access to credit or not, for categorical and continuous variables, respectively. The binary logistic regression model was utilized to assess factors influencing access to credit among smallholder rice producers. This technique is commonly used in social sciences to predict the presence or absence of an outcome based on a set of predictor variables.

Wooldridge (2009) indicated that the logistic regression coefficient can be used to estimate odds ratios for each of the independent variables in the model. The term "logit" refers to the natural logarithm of the odds (log odds), which indicates the probability of falling into one of two categories regarding some variable of interest (Wooldridge, 2009). According to Harrell (2001), binary logit has only two categories in the response variable: event A and non-event A. Harrell (2001) also asserts that the model demonstrates how a set of predictor (explanatory) variables (X's) relate to a dichotomous response variable Y (ln (Pi/1 – Pi)). The dichotomous response variable Y can take the value of 0 or 1, where Y=1 denotes the occurrence of the event of interest, while Y=0 indicates otherwise. Dummy variables, also known as indicators or bound variables, characterize dichotomous responses. In this study, since only two options were available, "access to credit" or "no access to credit" - a binary model was established, defining Y=1 for situations where the farmer accessed credit and Y=0 for instances where the farmer did not access credit from either formal or informal sources. The cumulative logistic probability model is mathematically specified as follows:

$$\text{logit}(P_i) = \ln\left(\frac{P_i}{1-P_i}\right) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots\ldots + \beta_k X_k \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (2)$$

Where:

Pi is the probability that the dependent variable is 1 (i.e., the event occurs);

$\ln\left(\frac{P_i}{1-P_i}\right)$ is the log-odds of the event occurring;

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β_0, β_1,…..,β_k are the coefficients estimated from the data;

X_1,X_2,……,X_{13} are the independent variables. The key variables that were subjected to the regression model are specified in Table 1.

Table 1: Summary of Variables that were used in the Binary Logistic Model

Symbol	Variable	Description	Expected hypothesis on access to credit
logit(P_i)	Access to credit	Dummy (1=accessed credit, 0=otherwise)	
x_1	Sex	Dummy (1=male, 0=female)	-/+
x_2	Marital Status	Dummy (1=married, 0=otherwise)	+/-
x_3	Education level	Dummy (0=No formal education 1=Formal education)	+
x_4	Household size	Continuous (Number of household members)	+
x_5	Years in AMCOS	Continuous (In years)	+
x_6	Land size	Continuous (In hectares)	+
x_7	Membership in economic groups	Dummy (0=no 1=Yes)	+
x_8	Experience in rice farming	Continuous (In years)	+
x_9	Access to training	Dummy (1=accessed training, 0=otherwise)	+
x_{10}	Frequency of extension contact	Categorical (0=rarely, 1=on event, 2=frequently)	+
x_{11}	Access to adequate information	Dummy (1=accessed adequate information, 0=otherwise)	+
x_{12}	Economic activity	Dummy (0=rice farming only, 1=other economic activities)	-
x_{13}	Owning a smartphone	Dummy (1=owned smartphone, 0=otherwise)	+/-

3. Findings and Discussion

3.1. Socio-Demographic Characteristics of Respondents

The findings regarding the socio-demographic characteristics of smallholder rice farmers, as shown in Table 2, indicate that the majority (73.6%) of farmers had at least a primary school education. This level of education is expected to significantly influence access to credit in rice farming, as educated farmers are more adept at understanding information from various credit sources. These findings align with

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Ndakije *et al*. (2020), which reported that 82% of rice farmers had formal education.

The study further revealed that the majority (70.7%) of respondents were male, while 29.3% were female, indicating male dominance in rice production in the study area. Tadesse *et al*. (2017) noted a similar trend in rice-growing regions of Ethiopia. Furthermore, most respondents (90.3%) were married, while only 9.7% were single (Table 2). It is widely recognized that marriage fosters a sense of responsibility in individuals (Njau, 2023). Given that most respondents were married and had family commitments, they are likely to be dedicated change agents in both farming practices and credit utilization.

Additionally, 11.5% of farmers reported that rice farming was their sole economic activity. This suggests that these farmers dedicate most of their time to rice farming but rely on a single source of income. However, depending on one income source can be risky and may hinder their competitiveness.

Table 2: Socio-Demographic Characteristics Among Farmers in the Study Area (n=382)

Variable	**Classes**	**AMCOS**			**Pooled Statistics**
		Kapunga	**Madibira**	**UWAWAKUDA**	**n=382**
		%	**%**	**%**	
Sex	Male	74.2	72.6	62.8	70.7
	Female	25.8	27.4	37.2	29.3
Marital Status	Single	11.3	10.3	7.1	9.7
	Married	88.7	89.7	92.9	90.3
Education Level	Informal Education	1.6	3.8	5.8	3.9
	Primary	69.4	71.4	82.6	73.6
	Secondary	4.8	19.2	7.0	14.1
	Tertiary	24.2	5.6	4.7	8.4
Economic Activities	Farming (Other Crops)	40.3	42.7	22.1	37.7
	Livestock	0.0	1.3	2.3	1.3
	Business	0.0	12.8	23.3	13.1
	Farming, Livestock, and Business	46.8	34.6	33.7	36.4
	Rice Farming Only	12.9	8.5	18.6	11.5
Household Size	Mean	5	5	5	5
	Max	9	14	15	15
	Min	2	1	1	1
Experience in Rice Farming	Mean	21.24	17.77	16.35	18.02
	Max	50	41	50	50
	Min	3	2	3	2
Years in AMCOS	Mean	11.85	15.21	12.43	14.04
	Max	22	33	19	33
	Min	2	2	3	2

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The study also found that the average household size was five members. Larger household sizes can provide inexpensive labor on farms, potentially enhancing productivity. However, they can also exert pressure on household income, which is necessary for purchasing inputs to improve productivity, thereby negatively impacting overall productivity. This finding is consistent with Kulyakwave *et al*. (2019), who reported an average household size of five members in rice farming. The average years of experience in AMCOS was 14.04, with the highest mean years in Madibira (15.21) and the lowest in Kapunga (11.85). This suggests that Madibira has more experience with rice farmers and is likely better equipped to address members' urgent issues related to access to credit compared to Kapunga and UWAWAKUDA.

3.2 Farmers' Access to Credit

The findings in Table 3 illustrate the distribution of smallholder rice farmers' access to credit. Approximately 34.3% of respondents reported having access to credit, while the majority (65.7%) did not. These results indicate that a significant portion of smallholder rice farmers in the studied irrigation schemes lacks access to credit.

Table 3: Smallholder rice farmers' access to credit (n=382)

Response	Frequency	Percentage (%)
Yes	131	34.3
No	251	65.7
Total	**382**	**100**

The fact that only 34.3% of farmers reported having access to credit raises concerns about their ability to secure the necessary funds to expand operations, purchase inputs, or invest in improved farming technologies. Additionally, the 65.7% of farmers lacking access to loans could directly impact their agricultural output. Without financial assistance, farmers may struggle to acquire and install irrigation systems, fertilizers, or improved seeds, potentially leading to lower yields and income levels. These findings align with research by Taremwa *et al.* (2022), Tesiso *et al.* (2023), and Waje (2020), which indicated that the majority of farmers in Ethiopia and Rwanda also lacked access to credit.

3.3 Amount of Credit Obtained

Table 4 provides an overview of the amount of credit obtained by the 131 smallholder rice farmers with access to credit. Of these farmers, a majority (64.1%) received amounts of no more than 1,500,000 TZS.

Table 4: Amount of Credit Obtained (n=131)

Range	Frequency	Percentage (%)
<=1,500,000	84	64.1
1,500,001-5,000,000	39	29.8
5,000,001-8,500,000	4	3.1
8,500,001+	4	3.1
Total	**131**	**100**

This indicates that while some farmers can secure credit, the amounts tend to be modest, limiting their ability to make significant investments in farming activities such as purchasing new equipment or expanding their land area.

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Farmers receiving credit amounts between 1,500,001 and 5,000,000 TZS represented a smaller percentage of recipients (29.8%). Those obtaining larger credit amounts have better opportunities to increase their output compared to those receiving smaller amounts. Only 6.2% of farmers (3.1% in the highest two categories) secured credit exceeding 5,000,000 TZS, suggesting that a relatively small portion of farmers can access significant credit that could dramatically change their farming practices.

Interestingly, 29.9% of farmers stated they had sufficient personal funds and thus did not require loans. While this reflects financial independence for some, it underscores that those without private funds are more adversely affected by barriers to credit access. A smaller proportion (8.8%) cited a lack of information as their reason for not accessing loans, indicating that some farmers may not be fully aware of available credit options or the application process.

3.4 Smallholder Rice Farmers' Characteristics

The characteristics of smallholder rice farmers, including sex, education level, household size, economic activities, years of membership in AMCOS, experience in rice farming, membership in other organizations, adequacy of extension services, smartphone ownership, access to adequate information, and access to training, were hypothesized to influence credit access in the study area, as shown in Table 5. Cross-tabulation was employed to analyze and compare these variables, allowing for examination across multiple factors. A t-test was used for continuous variables, while a Pearson chi-square test was conducted for categorical variables to assess significant differences in means and frequencies.

The cross-tabulation results indicate that factors such as access to training, adequacy of extension services, and access to adequate information significantly influence smallholder rice farmers' access to credit. The findings reveal that a higher percentage of farmers with credit access (29%) had received training compared to those without access (16.7%), which is significant at p=0.005 (Table 5). This suggests that training is crucial for enabling farmers to access credit, highlighting the importance of expanding training programs to improve credit access. Conversely, farmers with credit access reported receiving adequate extension services (34.4%) more frequently than those without credit access (46.6%). Although the p-value is slightly above the typical significance threshold at p=0.066, the trend suggests that sufficient extension services may aid in enhancing credit access by providing essential technical support and information. Therefore, improving the reach and quality of extension services could be beneficial for increasing credit accessibility. A slightly higher percentage of farmers with adequate information had access to credit (35.1%) compared to those without access (45.4%), with a statistically significant difference at p=0.053, as shown in Table 5.

While a higher proportion of males had access to credit (76.3%) compared to females (23.7%), this difference was not statistically significant. This indicates that although gender differences exist, they are not statistically meaningful. It suggests that while there may be gender-related barriers to credit access, other factors could be more influential.

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Table 5: Summary of smallholder rice farmers' characteristics based on access to credit

Variables	Access to credit		No access to credit		p-value
	Frequency	Percentage	Frequency	Percentage	
Sex					
Male	100	76.3	170	67.3	0.079
Female	31	23.7	81	32.3	
Education level					
Formal education	124	94.7	243	96.8	
Non-formal education	7	5.3	8	3.2	0.303
Economic activities					
Farming	116	88.5	222	88.4	0.976
Other than farming	15	11.5	29	11.6	
Membership in other organizations					
Yes	60	45.8	121	48.2	0.655
No	71	54.2	130	51.8	
Adequacy of extension services					
Inadequate	25	19.1	42	16.7	0.066
Partial	61	46.6	92	36.7	
Adequate	45	34.4	117	46.6	
Owning a smartphone					
Yes	28	21.4	36	14.3	0.081
No	103	78.6	215	85.7	
Adequate information					
Yes	46	35.1	114	45.4	0.053
No	85	64.9	137	54.6	
Access to training					
Yes	38	29	42	16.7	0.005
No	93	71	209	83.3	

A slightly higher percentage of farmers with access to credit owned smartphones (21.4%) compared to those without credit access (14.3%). The marginal significance of smartphone ownership indicates that access to technology may play a role in credit access, potentially facilitating better communication and information access. Promoting smartphone ownership and digital literacy among farmers could enhance their access to financial services. Matto and Njau (2023) emphasized the need for the government and other ICT stakeholders to develop mobile-based educational tools and resources relevant to rural contexts.

The findings in Table 4 reveal that the majority of farmers in both categories were educated (94.7% with access to credit and 96.8% without access), with no significant difference between the two groups. This suggests that education level alone may not

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strongly determine credit access in this context. Most farmers in both groups were primarily engaged in farming (88.5% with access to credit and 88.4% without access). The lack of a significant difference implies that the type of economic activity, specifically farming, does not significantly influence credit access among these farmers, indicating that other factors, such as financial literacy and credit history, may be more important. Membership in other organizations did not significantly differ between those with access to credit (45.8%) and those without (48.2%). This suggests that mere membership in other organizations may not strongly impact credit access. However, the type and activity level of the organization could still be relevant and warrant further exploration.

3.5 Agricultural Productivity and Credit Access

To determine if there was a significant difference in agricultural productivity between the two categories of farmers, a simple linear regression analysis was conducted. Results in Figure 1 indicate a significant difference ($P<0.037$) in aggregate productivity between smallholder rice farmers who accessed credit and those who did not. This implies that as far as farmers get access to credit, their productivity increases slowly but with significant change or increase. Further, the result shows that the productivity increases by an average of 0.000018 (yield per hectare) per unit increase in credit earned by a farmer. The increase in productivity by an average of 0.000018 yield per hectare per unit increase in credit earned by a farmer suggests a positive but modest relationship between credit access and productivity. While the increase is small on a per-hectare basis, it indicates that credit has a measurable impact on yields. Over time and across larger scales of farming, even such incremental gains can accumulate to make a significant difference in overall agricultural output and farmers' livelihoods. However, it may also imply that other factors, such as the effective use of credit, technology adoption, or farm management practices, could be influencing the extent of productivity gains.

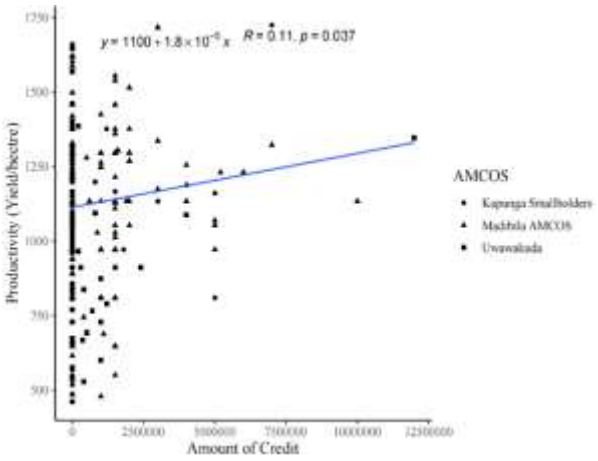

Figure 1. Relationship Between Access to Credit and Productivity

Similarly, key informant (KI) findings revealed that smallholder rice farmers had multiple uses for the credit obtained. One KI expressed: *"The credits we obtained were crucial for purchasing inputs like fertilizers, pesticides, herbicides, and for investing in irrigation systems, which improved water management and increased productivity during dry spells. However, we sometimes have to divert the intended use depending on the situations we encounter."* (KI1, Dakawa Village, March 2022)

Another KI raised a similar concern, stating:

"The loans requested by farmers often arrived late, after most farm activities were completed. Nevertheless, the funds were used to pay laborers for harvesting, transportation, and storage of the produce. In most cases, a portion is allocated to pay for children's school fees and healthcare, but this

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is minimal compared to the amount spent on farming." (KI2, Kapunga Village, February 2022)

It was reported that, despite such diversions, a significant portion of the funds was directed toward rice farming activities, which increased productivity. The findings are consistent with previous studies (Awotide *et al*., 2015; Houensou *et al*., 2021; Nordjo & Adjasi, 2020) that reported farmers who sought credit had higher productivity levels than randomly selected farmers from the sample, suggesting that access to credit positively impacts productivity. These studies further indicated that access to credit is a crucial factor in achieving increased agricultural productivity through investments in farm inputs.

3.6 Factors Influencing Smallholder Rice Farmers' Access to Credit

The findings on the factors influencing smallholder rice farmers' access to credit in the study areas, derived from binary regression analysis, are presented in Table 6. The marginal effects reflect discrete changes of different dummy variables from 0 to 1. The findings indicate that the number of years of membership in AMCOS, land size, access to training, and adequate extension services had significant positive effects on access to credit among smallholder rice farmers. However, years of experience in rice farming had a significant negative effect on their access to credit. The variables of sex, education level, household size, access to adequate information, and economic activities were not significant but showed positive influences on access to credit.

The results in Table 6 further demonstrate that the number of years of membership in AMCOS was statistically significant with a positive influence on access to credit ($p=0.001$). Farmers with longer membership in AMCOS were significantly more likely to access credit. This likely reflects the role of AMCOS in providing better access to financial resources, market information, and networking opportunities, which enhance improve a farmer's creditworthiness. Experience within these cooperatives helps farmers build relationships with financial institutions and establish a track record, making them more reliable candidates for loans. These findings align with those of Sanka & Nkilijiwa (2021), who concluded that membership in a cooperative society increases the likelihood of obtaining farm credit in Tanzania.

Land size was also statistically significant with a positive influence on access to credit ($p=0.002$). The size of a farmer's landholding significantly affects their access to credit, with larger land sizes positively correlated to greater access. Larger landholdings are often perceived as signs of wealth and stability, making farmers with more land more attractive to lenders. Additionally, larger land can serve as collateral, reducing the lender's risk, and is often associated with higher productivity, reassuring lenders of the farmer's ability to repay loans. These findings are consistent with previous studies (Mwonge & Naho, 2021; Sanka & Nkilijiwa, 2021; Taremwa *et al*., 2022; Ullah *et al*., 2020), which also observed a significant positive effect of farm size on farmers' access to credit in Tanzania, Rwanda, and Pakistan.

The findings indicate that access to training was statistically significant with a positive influence on access to credit ($p=0.029$). This suggests that farmers with access to agricultural training are significantly more likely to obtain credit. Training equips farmers with better knowledge and skills, which can enhance productivity and profitability, making them more appealing to

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lenders. Moreover, training improves farmers' understanding of the credit application process, increasing their ability to meet loan requirements and manage loans effectively.'

Table 6: Binary Regression Analysis Results on Factors Influencing Smallholder Rice Farmers' Access to Credit

Variable	Marginal effect	Standard Error	Wald	df	p-value
Sex	0.334	0.277	1.449	1	0.229
Marital status	-0.230	0.451	0.261	1	0.609
Education level	0.444	0.622	0.509	1	0.476
Household size	0.003	0.051	0.004	1	0.948
Years in AMCOS	0.1020	0.030	11.444	1	0.001***
Land size	0.579	0.188	9.526	1	0.002***
Membership in economic groups	-0.045	0.236		1	0.847
Experience in rice farming	-0.032	0.020	2.722	1	0.099*
Access to training	0.607	0.278	4.789	1	0.029**
Adequacy of Extension services	0.603	0.260	5.382	2	0.020**
Access to adequate information	0.355	0.251	2.003	1	0.157
Economic activity	0.183	0.382	0.229	1	0.632
Owning a smartphone	-0.414	0.306	1.831	1	0.176

*** ($p<0.01$), ** ($p<0.05$), * ($p<0.10$).

Adequate extension services were also statistically significant with a positive influence on access to credit (p=0.020). This implies that adequate extension services significantly enhance farmers' access to credit. Extension services provide farmers with vital technical assistance, updated agricultural practices, and financial management advice, all of which can improve their farming success and creditworthiness. Such services also help farmers navigate the complexities of applying for credit, thereby increasing their chances of obtaining loans. The findings of this study are consistent with those of Kiplimo *et al*. (2015), who concluded that access to extension services by smallholder farmers significantly positively impacts access to credit in Kenya, and that improvements in extension services in the study area will positively contribute to accessing credit financial services. These findings also align with Waje's (2020) research in Ethiopia, which indicated that extension services had a positive and statistically significant influence on credit access.

The experience in rice farming was statistically significant with a negative influence on access to credit (p=0.099). Greater experience in rice farming shows a weak significant negative influence on credit access. This could indicate that more experienced farmers may be more conservative or risk-averse in seeking credit, possibly due to previous negative experiences with borrowing or a preference for self-financing. This finding aligns with the observations of Ouattara *et al*. (2020) in Côte d'Ivoire, who also noted that farming experience influences smallholder farmers'

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access to microfinance credits. This phenomenon contradicts the findings of Ullah *et al. (2020), who concluded that farmers with less farming experience have greater access to credit, implying that as farmers' experience increases, their access to credit decreases.*

Conclusion and Recommendations

The main objective of this study was to investigate smallholder rice farmers' access to credit and its influence on smallholder farm productivity. The study concludes that the majority of smallholder rice farmers did not access credit. However, for those who did, access to credit was found to increase productivity through investment in farm inputs. The factors influencing credit access among smallholder rice farmers in the study area include membership years in AMCOS, land size, access to training, and adequate extension services. These factors suggest that both social capital (AMCOS membership) and practical resources (land size, training, extension services) play crucial roles in enhancing smallholder rice farmers' access to credit. Conversely, the slightly negative influence of experience in rice farming may reflect a cautious approach to credit use among more seasoned farmers, indicating that different strategies might be needed to engage this group in accessing credit.

In light of these findings, the Local Government Authority and stakeholders in the credit industry should design interventions to increase access to credit among smallholder farmers in the study area. The government should continue to support and strengthen AMCOS by providing technical assistance and capacity-building programs. Enhanced AMCOS can improve farmers' access to credit by offering a collective platform that increases their bargaining power and financial credibility. It is also advisable to encourage smallholder farmers to join AMCOS or organize farmer self-help groups for easier access to agricultural credit. Furthermore, efforts should be taken to increase the availability and quality of agricultural extension services in the study area, especially in remote and underserved areas. It is essential to ensure these services are adequately funded and staffed with knowledgeable personnel who can assist farmers with technical advice and support throughout the farming season. Stakeholders, particularly AMCOS, should invest in expanding training programs accessible to smallholder farmers, covering financial literacy, loan application processes, and modern farming techniques to equip farmers with the skills and technical know-how for managing credit effectively. Such stakeholders should collaborate with financial institutions to offer specialized training aligned with loan products, ensuring that farmers understand the requirements and benefits of accessing credit. The study recommends that financial institutions improve access to credit for smallholder rice farmers and ensure that the credit provided is utilized effectively in rice farming, which is crucial for enhancing productivity.

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