

The Effect of Agricultural Credit on Commercialization Level of Smallholder Rice Farmers in Mvomero District, Tanzania

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Abstract

This study examines the impact of agricultural credit on the level of commercialization among smallholder rice farmers in Mvomero District, Tanzania. Agricultural credit is a crucial factor in enhancing productivity and commercialization, enabling farmers to invest in better inputs, technology, and practices. This research employs both descriptive and inferential statistical analysis techniques. Propensity Score Matching (PSM) was used to analyze the effect of access to credit on the level of commercialization. Additionally, factors influencing the commercialization of smallholder rice farmers were determined using Multinomial Logistic Regression. The findings indicate that farmers with access to credit are 24% more likely to commercialize compared to those without credit. This is achieved through adopting improved farming techniques, increasing their scale of production, and engaging more extensively in market-oriented activities. Moreover, the level of commercialization is positively influenced by access to credit out of other factors such as sex, farm size, farming experience, education level, and farmer's age. The study concludes that while agricultural credit positively affects commercialization levels, there is a need for more tailored financial products and supportive policies to enhance credit accessibility for smallholder farmers in Mvomero District. These findings have important implications for policymakers, financial institutions, and development agencies aiming to promote agricultural commercialization and rural development.

Keywords: Agricultural credit, Smallholder farmers, commercialization

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1. Introduction

Agricultural commercialization has become a critical focus in Sub-Saharan Africa (SSA), as countries seek to transit from subsistence farming to sustainable commercial agriculture. Despite these efforts, the level of commercialization in the agricultural sector remains low, resulting in insufficient income generation (Osabohein *et al.*, 2020). For instance, the 2019/20 National Agricultural Sample Census reported a commercialization rate of only 19% for cereal crops, leaving 81% of the produce outside the market. Sustainable commercial agriculture necessitates significant financial investments to acquire essential inputs such as land, machinery, fertilizers, pesticides, and seeds (Ngog *et al.*, 2023).

Tanzania, like many SSA countries, relies heavily on agriculture for economic growth and livelihoods (Mpeku and Urassa, 2022). The sector contributes 26.1% to the country's GDP (BOT, 2022), employs over 65% of the population, and supports the livelihoods of 75.5% of the impoverished population (World Bank, 2022). However, challenges such as climate change, including droughts and floods, significantly constrain agricultural productivity. The limited income generated from farming makes it difficult for farmers to mitigate climate risks, highlighting the need for financial support. Despite this, access to agricultural credit remains a significant constraint, with only 3.8% of farmers reporting access to credit during the 2019/2021 agricultural period (URT, 2021).

Commercialization in agriculture is a complex process involving two key decisions by farmers: participation in agricultural markets and the extent of their market involvement, measured by the proportion of total output sold (Mpombo *et al.*, 2022). In the rice subsector, low yields hinder small-scale farmers' ability to engage effectively in market-oriented production. For example, rice yields average 2.3 tons per hectare in Tanzania, significantly below the global average of 4.6 tons per hectare (Mauki *et al.*, 2023). Smallholder farmers, who cultivate farm sizes ranging from 0.9 to 3 hectares, account for approximately 90% of the rice produced (URT, 2019). These farmers face numerous challenges, including limited access to yield-enhancing technologies such as fertilizers

and improved seeds, primarily due to low farm income.

Agricultural credit offers a potential solution by providing farmers with the liquidity needed to invest in productivity-enhancing technologies and other high-yield practices, thereby increasing their chances of participating in rice commercialization (Balana *et al.*, 2022). Recognizing the significance of rice, the Tanzanian government has implemented the National Rice Development Strategy (NRDS), now in its second phase, aimed at transforming the rice subsector by enhancing yields to 4 tons per hectare and strengthening market linkages mainly through providing credit to farmers.

Agricultural credit is defined as the provision of funds or inputs by an organization or individual to farmers, under the agreement that the funds will be repaid with interest after being used for agricultural activities (Reuben *et al.*, 2020). Credit can be provided in the form of cash or agricultural inputs and has been shown to increase yields and commercialization (Sekyi *et al.*, 2020). Higher levels of commercialization can empower farmers to negotiate better prices, increasing their income and reducing rural poverty. However, limited access to credit constrains farmers' productivity and market participation, exacerbating poverty in rural areas.

To address these challenges, Tanzania's government has taken measures to improve agricultural financing. For example, the Bank of Tanzania (BOT) increased annual agricultural credit provision by 42.1% in the 2021/22 financial year and introduced reduced statutory reserve requirements for banks offering agricultural credit at interest rates below 10% per annum (BOT, 2022). Although existing research in Tanzania has explored factors influencing credit access, the adoption of yield-enhancing technologies, and the impact of credit on productivity, limited attention has been given to the effect of credit on commercialization among smallholder rice farmers. This study aims to fill this gap by examining the impact of credit disbursed by CRDB and NMB banks on rice commercialization in Mvomero District.

The study focuses on three objectives: (1) determining the level of commercialization among rice farmers, (2) identifying socio-economic factors influencing commercialization, and (3) assessing the effect of credit on rice commercialization among smallholder farmers. The findings will provide valuable insights for policymakers to develop strategies that improve farmers' access to credit, strengthen market linkages, and enhance rural welfare while addressing income poverty.

2. Theoretical reviews

2.1 Demand credit theory and credit rationing theory

This study is guided by demand credit theory and credit rationing theory. In demand credit theory, a borrower want to maximize utility in borrowing credit. Every unit of credit has its own opportunity cost that is interest rate, and therefore the decision to obtain any amount of credit is a rational choice that made by a borrower (Khoi *et al.*, 2013). Farmer decide amount of credit to apply to a lender for a purpose such as purchasing yield enhancing input that will be used in rice production process to increase yield, hence enable farmer to participate in the market.

However, on the credit provider side, they do not depend only on interest rate. Thus, CRDB or NMB will need information about the borrowers so as to reduce risk of default. However, in a market asymmetry condition credit providers do not have sufficient information about default risk on a borrower and cannot increase the equilibrium interest rate on the credit market. Here is where the credit rationing theory came that was profound by Stiglitz and Weiss in 1981. Lenders tend to rationalize credit to borrowers; thus, the credit market doesn't simply follow supply and demand theory. Lenders decide on the amount of the credit to give borrowers based on their perception on the borrower's creditworthiness. The amount of the credit that provided can be the same as applied amount, less than applied amount or it can be zero thus lender decide not to give borrower a credit at all.

2.2 Diffusion of Innovation

The diffusion of innovation theory, originally developed in the agricultural sector, seeks to explain how farmers adopt new technologies at varying rates. Rogers (2003) defines innovation as "an idea, practice, or object perceived as new by an individual or other unit of adoption." This theory posits that the adoption of new ideas or practices within a social unit depends on several interconnected dimensions, including the characteristics of the innovation, the communication channels used, the social system, and the passage of time (Wittich, 2015). The adoption of advanced agricultural technologies, such as improved seeds and fertilizers, enhances yields, thereby increasing the surplus available for purposes beyond household consumption. This surplus can then be allocated to the market, boosting commercialization (Alamerie, 2016). Accordingly, this study hypothesizes that

smallholder farmers are more likely to shift from subsistence to market-oriented agriculture with access to credit. Credit facilitates the adoption of improved farm technologies, ultimately leading to higher yields and profit maximization

3. Empirical reviews

3.1 Factors influencing rice commercialization

Numerous studies have examined the factors influencing rice commercialization among smallholder farmers. Kyaw *et al.* (2018) highlighted key determinants in Myanmar, including the age and education level of the household head, household size, total rice production, rice prices, household income, livestock ownership, farmer organization membership, road access, market distance, extension services, and access to market information. Similarly, Osmani and Hossain (2015) investigated commercialization decisions among smallholder rice farmers in Bangladesh, finding that farm size, household labor availability, livestock income, and overall farm income significantly influenced commercialization.

In Tanzania, Achandi and Mujawamariya (2016) explored market participation by smallholder rice farmers, identifying cropped area, yield, market distance, and the type of rice variety cultivated as significant determinants. Likewise, Mpombo (2018), using data from the 2014/15 national panel survey, found that factors such as harvest quantity, wealth status, age of the household head, family size, and access to extension services significantly affected rice market participation among smallholders.

In Nigeria, Mafimisebi and Ikurowo (2018) applied a probit model to analyze market participation among local rice farmers, revealing that rice output, group membership, access to market information, land ownership, and land allocated to other crops were significant determinants. Donkor *et al.* (2021), in a study of Ghanaian rice farmers using a double hurdle model and data from 199 respondents, found that farm size, rice output prices, market information, and credit access positively influenced market participation. Conversely, extended payment periods and ownership of bicycles reduced the likelihood of market participation. Their study also noted that only a small percentage of farmers sold rice directly to processors, and they recommended enhancing access to credit and market information to improve participation.

Additionally, Yameogo *et al.* (2018) examined market participation among lowland rice farmers in Dono, identifying gender of the household head, membership in farmer groups, and total rice output as significant factors influencing the decision to engage in markets.

3.2 Credit effect on rice commercialization

The influence of credit on rice commercialization has been a subject of interest in various studies. For instance, Sekyi *et al.* (2020) examined the relationship between farmers' access to credit and agricultural commercialization, finding that access to credit significantly promotes higher levels of commercialization. The study recommended implementing policies aimed at improving farmers' access to credit as a means to encourage market-oriented production.

Similarly, Alhassan *et al.* (2020) in Ghana reported that credit positively impacts agricultural productivity, which, in turn, enhances market participation. They advised the Ghanaian government to establish practical measures for providing credit to farmers. In Pakistan, Hussain and Thapa (2012) investigated the effects of agricultural credit on commercialization among smallholder rice farmers with farms up to 2 hectares. Their findings indicated that credit access facilitated a shift from traditional farming systems to commercial agricultural practices.

Lopera *et al.* (2023) employed a double-hurdle approach in Bolivia to assess the factors influencing rice market participation. The study revealed that access to credit, larger farm sizes, and membership in farmers' associations significantly increased the likelihood of market participation. However, it also noted that higher endowments and assets, animal farming, and off-farm income opportunities reduced market participation tendencies.

In Kenya, Apind (2015) demonstrated that access to credit had a positive influence on rice commercialization, with farmers who accessed credit being more likely to sell their produce than those without credit access. Similarly, Lopera *et al.* (2023) confirmed that households receiving credit were more likely to engage in market

activities than those without credit.

3.3 Conceptual Framework

The conceptual framework of this study (Figure 1) illustrates the anticipated transition of smallholder rice farmers from subsistence-oriented production to higher levels of commercialization. This transition is driven by access to credit, which facilitates the adoption of advanced farming technologies, enhances rice productivity, and addresses critical socio-economic factors.

Access to formal credit supports farmers in managing their agricultural operations effectively by ensuring the availability of inputs and enabling the adoption of modern technologies. This, in turn, improves productivity and market participation. The study focuses on formal financial institutions due to their ability to provide substantial and accessible capital, benefiting a broader range of smallholder farmers.

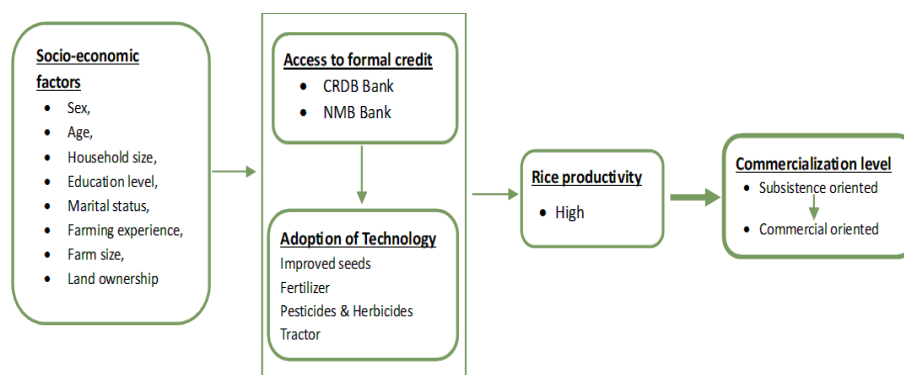


Figure 1: Conceptual framework demonstrating the effect of agricultural credit on smallholder rice farmer commercialization level

4. Methodology

4.1 Description of the study area

The study was carried out in Mvomero district, which is part of the Morogoro region in Tanzania. The coordinates of the district are approximately latitude of 06°26' South, Longitude of 37°32' East (URT, 2017). According to the population and housing census in 2022, the area had an estimated population of approximately 421,741 individuals with a total surface area of 6631 square kilometers, equating to a population density of about 63.60 individuals per square kilometer (URT, 2022).

Moreover, Mvomero district was purposively selected for the study because it is located within a favorable agro-ecological zone for rice production. The district is recognized as one of the leading rice-producing areas, with a significant presence of actors involved in the rice value chain (URT, 2017). In addition, the district majority population is constituted by rice smallholder farmers, and the district has formal financial institutions available. The formal financial institutions in the Mvomero district include banks, that are: CRDB, and NMB. CRDB has two branches one located in Turiani and the other in Mzumbe, the same applies to NMB, one branch located in Turiani and the other in Wami-Dakawa.

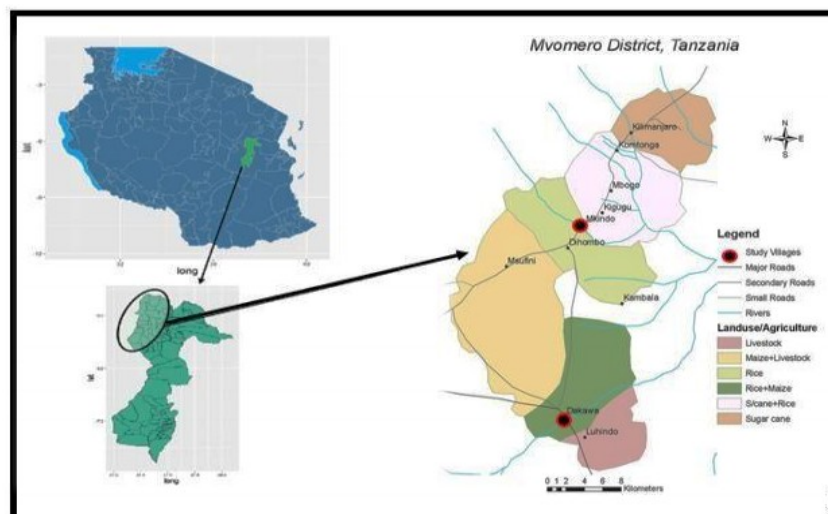


Figure 2: Map illustrating the Study Area

4.2 Research design

The study used a cross-sectional research design. This design involved collecting data at a single point in time as well as allowing the examination of multiple variables simultaneously, such as age, income, gender, etc. The choice of this design was based on its suitability for meeting the study objectives with limited resources and time. Cross-sectional studies are cost-effective and efficient, making them ideal for gathering data quickly and at a low cost (Trochim, 2006).

4.3 Sampling technique and sample size

In total, 190 smallholder rice farming households from Mvomero district participated in the study, selected from two villages, Dakawa and Mkindo. Among these, 95 credit beneficiaries were purposefully chosen from borrower registers obtained from formal financial institutions NMB, Turiani, and CRDB, Morogoro MC, for the financial year 2020/21. Additionally, we randomly selected 95 credit non-beneficiaries from the village farmers' registers corresponding to the production year.

Table 1: Sample size

Villages	Sample size	Beneficiaries	Non-beneficiaries
Dakawa	126	63	63
Mkindo	64	32	32
Total	190	95	95

4.4 Data collection

The primary data were gathered from respondents using a semi-structured questionnaire that included both open and closed-ended questions. These questions primarily aimed to collect data from both rice smallholder farmers who benefited and did not benefit from agricultural credit during the production year 2020/21. Additionally, Key Informant Interviews (KIIs) data were collected using the KII guide. Two KIIs were conducted, one from each village, involving loan officers from respective formal financial institutions. To ensure the validity of the collected data, the research tools underwent a pre-test in the study area before actual data collection. This pre-testing aimed to ensure that the tools were familiar and clear to respondents. Notably, the final study analysis did not include the data collected during the pre-test.

4.5 Data Analysis Technique

The objective I, was to determine the commercialization levels among rice farmers in the study area. The commercialization index by Von Braun (1995) was used in the analysis. The following formula was used to determine commercialization index;

$$CCi = \frac{\sum_{i=1}^n S_y}{\sum_{i=1}^n Q_y} * 100\%; Q_y \geq S_y; \leq CCI \leq 100 \quad (1)$$

Where; CCI = Crop (Rice) Commercialization Index of i^{th} households, S_y is the total value of all rice sold and Q_y is the total value of all the rice produced, where y ranges from 1, 2... y_n .

Then farmers were categorized into three groups as described by Asuming-Brempong *et al.* (2013).

Farmers with the commercialization index of $\leq 30\%$ were categorized as the low commercialized farmers; 30–75% were the medium commercialized farmers, and $>75\%$ were the high commercialized farmers.

For objective II, which aimed to determine factors that influence rice commercialization levels among smallholder farmers, the study employed Multinomial logistic regression. Multinomial logistic regression is an extension of the binomial logistic regression to allow for a dependent variable with more than two categories. Following Green (2003), the multinomial logistic model for a multiple-choice problem takes the form:

$$Pr(y=j) = \frac{\gamma \beta_j X_i}{\gamma \beta_0 X_i + \beta_1 X_i + \dots + \gamma \beta_j X_i} \quad (2)$$

Given; Prob ($Y=1$) where $j = 1, 2, 3$. The dependent variable takes three categories of the low commercialized group, the medium commercialization group, and the high commercialized group. The equation is estimated as follow

$$Pr(y = j) = \beta_0 + \beta_1 (\text{sex}) + \beta_2 (\text{Age}) + \beta_3 (\text{Farm experience}) + \beta_4 (\text{education}) \\ + \beta_5 (\text{Marital status}) + \beta_6 (\text{farm size}) + \beta_7 (\text{income}) + \beta_8 (\text{household size}) \\ + \beta_9 (\text{land ownership}) + \mu \quad (3)$$

Objective III, the Propensity Score Matching (PSM) method was employed to examine the effect of agricultural credit on rice commercialization. PSM is used to evaluate intervention in the absence of the baseline data using single cross-sectional data. For this study, the PSM basic idea is to match the observations of credit beneficiaries and non-credit beneficiaries based on their predicted propensity for credit access.

Let Z_i denote categorical variable such that, $Z_i = 1$ for the farmer that benefited credit from CRDB and NMB, and $Z_i = 0$ if otherwise. Similarly, let Y_{1i} and Y_{2i} denote rice commercialization for credit beneficiaries and non-credit beneficiaries, respectively. Then $\Delta = Y_{1i} - Y_{2i}$ is the impact of credit on i^{th} farmers, usually called treatment effect. The primary treatment effect of interest that can be estimated is Average Treatment Effect on the Treated (ATT), which is the average difference in the rice commercialization between the matched (credit non-beneficiaries) and treated group (credit beneficiaries') (Hailua *et al.*,2015). Following the PSM assumption of conditional independence (CIA) and common support, the ATT can then be estimated as:

$$ATT = E[E\{Y_{1i}|Z_i = 1, p(X)\} - E\{Y_{2i}|Z_i = 0, p(X)\}] \quad (4)$$

Where; Y_{1i} being the commercialization index for a famer who was subjected to treatment $Z_i = 1$, Y_{2i} being the commercialization index for the untreated farmer $Z_i = 0$, the ATT indicates the average difference in the rice smallholder farmers' commercialization between the credit beneficiaries and non-credit beneficiaries.

After obtaining the propensity score, we need to search for counterfactuals that match with each credit beneficiary depending on its propensity to score. The propensity score is a derived measure indicating the likelihood of a subject being assigned to the treatment group based solely on that subject covariate's information. The matching methods that were used to pick the comparison group are nearest neighbor matching (NNM) and kernel matching (KM). According to Awotide *et al.* (2015), the difference between NNM and KM is that NNM pairs each treated unit with the nearest propensity score from the non-treated group, whereas KM calculates a weighted average outcome from the comparison group for each treated unit by subtracting it from each outcome observation in the treatment group.

Table 2: Description of variables used in propensity scores estimation

Variables	Description
Commercialization Index	<i>Outcome variable</i> Commercialization percentage (%)
Access to credit	<i>Treatment variable</i> 1 if beneficiary, 0 = non-beneficiary
<i>Independent variables</i>	
Sex	1 = male, 0 = female (<i>dummy</i>)
Age	Household head's age in the number of years
Farm Experience	Years of farming rice, in numbers
Education	Years of schooling, in numbers
Marital status	1 = married and 0 if otherwise (<i>dummy</i>)
Farm Size	Rice farming acre (<i>acres</i>)
Income	The amount earned per year (<i>Tshs</i>)
Household Size	Total number of people living in the household
Land Ownership	1 = Owns land and, 0 if farmer has rented (<i>dummy</i>)

5. Results and Discussion

5.1 Farmers' Socio-economic Characteristics

Descriptive statistics were used to analyze the economic characteristics of smallholder farmers in the study area. Of the 190 farmers interviewed, 53 percent were female and 47 percent were male. As seen in Table 3, the ages of the farmers ranged from 24 to 73, the median age was 46, and the majority of the workers were in the working age group. The average family size was five people; the smallest family consisted of one person and the largest family consisted of nine people.

The farmers' average years of formal education was seven, which corresponds with the compulsory primary education level in Tanzania. This shows that most farmers have literacy and numeracy skills, which can enable them to access credit and advance in the economy, especially that 50% of the farmers have valuable assets that can be used to produce goods

The average distance from farmers' homes to the nearest formal financial institution was approximately 33 kilometers, with the shortest distance being 12 kilometers (from Mkindo to NMB Turiani) and the longest at 58 kilometers (from the furthest farmer to CRDB Morogoro MC). This reflects limited access to formal financial services in the area.

Furthermore, 63% of the farmers own land for rice cultivation, while 37% rent their land. The most experienced farmer had 49 years of rice farming experience, and the least experienced had two years, resulting in an average

of 15 years of experience. A notable income disparity exists among the farmers, with the highest annual household income reaching TZS 5,000,000 and the lowest around TZS 60,000. This income gap is partly attributed to some farmers supplementing their income through off-farm activities, including small businesses.

Table 3: Rice smallholder farmers' socio-economical characteristics

Variables	Mean	Standard deviation	Minimum	Maximum
Age	45.53	12.99	24.00	73.00
Household size	4.75	1.94	1.00	9.00
Education level	6.63	4.10	0.00	16.00
Farming experience	15.00	3.47	2.00	49.00
Land ownership (%)	0.63	0.48	0.00	1.00
Collateral (%)	0.50	0.50	0.00	1.00
Farm size	2.89	1.02	0.13	50.00
Income (Tzs)	2,073,168	1,307,119	60,000	5,000,000
Proximity (km)	33.00	13.25	12.00	58.00

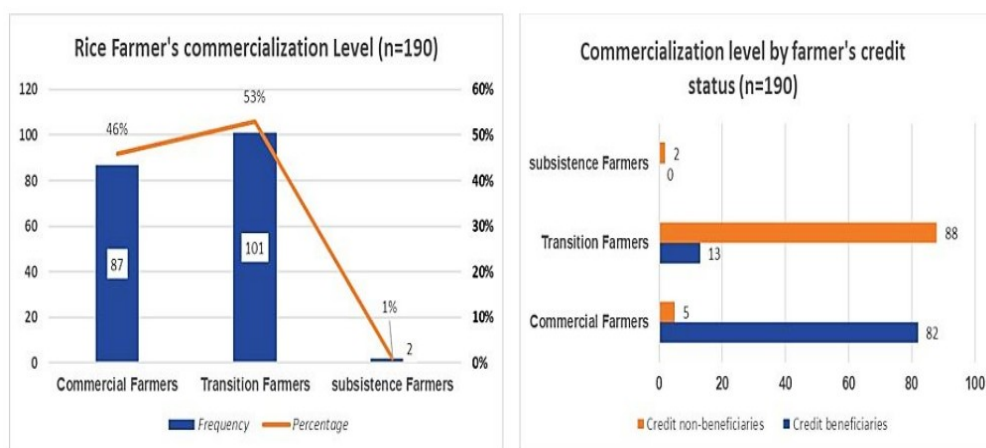


Figure 3: Rice Farmers Commercialization levels (Left) and Commercialization levels with respect to Credit accessibility (Right)

5.2 Farmers' Rice Commercialization

In figure 3, Rice was more commercialized among the farmers who benefited from credit, out of 95 credits beneficiaries' farmers, 82 of them were able to sell an average of 84% of their rice production, while out of 95 non-beneficiary farmers, 88 of them were able to sell an average of 58% of their rice production. This implies that a farmer who has access to credit can commercialize more compared to one with no access, this was also observed from the study by Mmari and Kapaya, (2022) in their study of financial services access and agriculture commercialization of smallholder rice growers in Kilombero District, which found that the financial service access has a positive relationship to agricultural commercialization.

Moreover, in table 4, the results show majority of the interviewed farmers (101) were in the level of transition yet they managed to commercialize by 53%, since out of 101 farmers only 13 managed to obtain credit, hence if the remaining 88 had access to credit even at a small level they had a highly chance to commercialize.

Table 4: Rice Smallholder Farmer's Commercialization Level

Commercialization status	Frequency	Percentage	Credit beneficiaries	Credit non-beneficiaries
Commercial Farmers	87	46%	82	05
Transition Farmers	101	53%	13	88
subsistence Farmers	02	01%	0	02

5.3 Factors influencing rice commercialization levels

The study assesses the determinants of rice farmer commercialization by categorizing farmers into three groups: commercial farmers (CI > 0.75), transitioning farmers (CI = 0.30–0.75), and subsidized farmers (CI < 0.30). The table 5 show results of the multinomial regression explained below;

Access to Credit; significantly influences commercial farmers (B = 5.4061, Sig= 0.000***). This suggests that credit availability plays a critical role in enabling farmers to scale production, invest in inputs, and engage in market-oriented farming. Credit access might facilitate the purchase of fertilizers, high-yield seeds, and machinery, which collectively enhance productivity and market participation. These findings align with studies by Sekyi *et al.* (2020), who emphasize the importance of credit in enhancing agricultural commercialization. Conversely, access to credit does not significantly influence transitioning or subsidized farmers, indicating structural barriers or inefficiencies in credit distribution that prevent these categories from benefiting.

Table 5: Factors influencing the Commercialization of a Rice farmer

Production Commercialization Categories						
Variables	Commercial Farmers (CI>0.75) N=87		Transitioning Farmers (CI=0.30-0.75) N=101		Subsidized Farmers (CI<0.30) N=2	
	B	Sig	B	Sig	B	Sig
Access to credit	5.4061	0.000***			-5.0465	0.999
Age	0.1338	0.520			-0.1365	0.342
Household size	0.2009	0.155			-0.3429	0.569
Education level	-0.0165	0.832			-2.9650	0.996
Experience	0.6727	0.280			2.5149	0.597
Marital Status	-0.1308	0.835			15.5623	0.999
Land Ownership	-0.9750	0.166			14.0595	0.998
Collateral	0.8974	0.179			17.3760	0.997
Farm size	-0.0262	0.948			-0.4391	0.811
Income	-1.2708	0.949			2.3807	0.805
Proximity	0.5254	0.317			0.6745	0.769
Cons	-6.6387				-48.5171	
LR	-58.4500					

P<0.01***, P<0.05** and P<0.1*

Age: is not a significant determinant of commercialization across all farmer categories. While older farmers may possess more experience, the results indicate no substantial correlation between age and the likelihood of becoming a commercial farmer (B = 0.1338, Sig = 0.520). This outcome resonates with findings from other studies including Abebe *et al.* (2019) which suggest that the impact of age on commercialization varies based on

access to resources and knowledge.

Household Size: has no significant impact on commercialization levels for any category ($B = 0.2009$, $Sig = 0.155$ for commercial farmers). Larger households may imply higher labor availability, but these results suggest that household labor alone may not sufficiently drive commercialization, especially without complementary inputs or market access.

Education Level: is not a significant determinant of commercialization for commercial farmers ($B = -0.0165$, $Sig = 0.832$). However, the lack of significance across all categories may reflect limited formal education tailored to agricultural entrepreneurship.

Farming Experience: does not significantly influence commercialization ($B = 0.6727$, $Sig = 0.280$ for commercial farmers). While experienced farmers might understand market dynamics, this alone does not guarantee commercial success without supportive external factors like access to inputs and credit.

Marital Status: this variable shows no significant influence on commercialization across categories. Although marital status could affect resource allocation within households, it appears to play a minimal role in driving market engagement.

Land Ownership: surprisingly, land ownership does not significantly determine commercialization ($B = -0.9750$, $Sig = 0.166$ for commercial farmers). This finding might indicate that merely owning land is insufficient without the ability to optimize its productive potential through mechanization, inputs, and market access (Tittonell *et al.*, 2015).

Farm Size: does not significantly impact commercialization ($B = -0.0262$, $Sig = 0.948$). This result contrasts with the common hypothesis that larger farms have greater capacity for market-oriented production (Barrett *et al.*, 2010). However, it might reflect underlying inefficiencies or limited market linkages that constrain larger farm holders.

Income: do not significantly determine commercialization, suggesting that higher earnings may not directly translate into greater market engagement. This highlights the need for targeted interventions to bridge the gap between production and market integration.

Proximity to markets: shows no significant effect across categories ($B = 0.5254$, $Sig = 0.317$ for commercial farmers). While physical accessibility is often associated with higher commercialization, other constraints such as poor infrastructure, lack of transportation, or limited market information might undermine its potential impact (Chamberlin & Jayne, 2013).

These results highlight the significant role of credit access in determining rice farming commercialization. However, other factors like age, education, land ownership, and proximity appear to have minimal influence. These findings suggest a need for targeted policies focusing on improving credit availability and addressing structural barriers that hinder transitioning and subsidized farmers from scaling their market engagement. The limited significance of traditional factors like land ownership and education underscores the importance of integrated approaches, including capacity building, infrastructure development, and value chain support, to foster sustainable agricultural commercialization.

5.4 The effect of access to credit on rice commercialization

The present study evaluates the effect of credit access on the level of commercialization among farmers by comparing the commercialization levels of credit beneficiaries with non-beneficiaries. The analysis employed two matching algorithms, Nearest Neighbor Matching (NNM) and Kernel Matching (KM), using the STATA software package. In these methods, treated units are paired with control units that have the closest propensity scores. Kernel matching was specifically chosen due to its capacity to assign weighted averages from the control group, with greater weight given to observations that are similar in propensity scores to the treated individuals, and less weight to those further away (Mushi and Mishili, 2019). Although several other algorithms exist, these two were selected because they are recognized for their effectiveness in estimating the Average Treatment Effect on the Treated (ATT) (Makate *et al.*, 2017).

The findings from both the NNM and KM methods indicate that rice farmers with access to credit are more likely to engage in commercialization compared to those without access. According to the NNM results, credit beneficiaries have an average commercialization index of 0.81 (81%), while non-beneficiaries have an index of 0.59 (59%), representing a difference of 0.22 (22%) (Table 6). The t-statistic for NNM is 3.75, indicating that the estimated differences in commercialization indices are statistically significant at the 1% level. These results suggest that access to credit has a positive and statistically significant effect on the commercialization level of smallholder rice farmers.

Table 6: Effect of credit on commercialization level for rice farmers

Variable (NNM)	Sample	Treated	Controls	Difference	S.E.	T-stat
Commercialization Index	Unmatched	0.82	0.57	0.25	0.015	17.13
	ATT	0.81	0.59	0.22	0.058	3.75
Variable (KM)		Treated (KM)	Controls	Difference ATT	S.E	T-stat
Commercialization Index		95	44	0.242	0.05	4.871

Moreover, the KM indicated that the rice farmers who had benefited from credit have commercialized more by 0.24 (24%) compared to the ones who had not accessed credit (Table 6). The t-statistics is 4.871, this implies that the estimated ATT is statistically significant at 1%. Despite that, the KM resulted in a higher difference than NNM, they both generally indicate that the effect is highly significant, suggesting credit accessibility has a crucial role in enhancing the commercialization efforts of smallholder rice farmers.

This study results align with Mmari and Kapaya (2022) who analyzed the effect of financial services access on the commercialization of smallholder rice growers in Kilombero District, and the study suggested that if formal financial services will be increased, it will significantly improve farmer's commercialization. Other studies on the effect of credit on commercialization that had a similar result to this study include; Rubhara and Mudhara (2019), Sekyi *et al.* (2020), and Thapa and Hussain (2012).

6. Conclusion

From the above discussion, the study estimated the effect of credit accessibility on the level of commercialization among smallholder rice farmers in the Mvomero district, concerning the two villages in the district; Dakawa and Mkindo. A total number of rice smallholder farmers (n=190), were divided into two groups, credit beneficiaries, and non-beneficiaries at a 50:50 ratio. Regarding, commercialization level, the study found that of the sampled rice farmers in the study area, 46% of them commercialized, while 53% of the rice farmers were at a transition level, and only 1% of the farmers were still at the subsistence level. Therefore, the district rice farmers are productive.

Furthermore, the factors that influence a rice smallholder farmer to commercialize were then analyzed through a multinomial logistic model, and the model resulted in the factor that statistically influenced the commercialization of smallholder farmers is credit accessibility, while other factors like sex, farm size, education level, farm experience, and age they all had no influence on commercial agriculture at different levels of significance. Moreover, the Propensity Score Matching results were that credit beneficiaries have a higher probability of commercial agriculture for rice crops by 24% compared to the non-beneficiaries' rice farmers. Therefore, the study concluded that there is a need to stimulate farmers to higher levels of rice output market engagement through productivity increase via credit.

7. Recommendations

From the findings, the study recommends that; policies that encourage the increase of credit accessibility to smallholder farmers should be implemented. Moreover, the Tanzanian government should prioritize the expansion of financial institution that support agriculture, such as the Tanzania Agriculture Development Bank (TADB). By providing affordable credit to a larger number of smallholder farmers, their productivity can be

improved and their market participation increased.

Reference

- Abdullah, Rabbi, F., Ahamad, R., Ali, S., Chandio, A. A., Ahmad, W., Ilyas, A., & Din, I. U. (2019). Determinants of commercialization and its impact on the welfare of smallholder rice farmers by using Heckman's two-stage approach. *Journal of the Saudi Society of Agricultural Sciences*, 18(2), 224–233.
- Abebe, G. K., Tadele, Z., & Mulatu, D. (2019). The role of smallholder agriculture in the sustainable development of rural areas in Ethiopia. *Agricultural Systems*, 171, 126–137.
- Achandi, E.L., & Mujawamariya, G. (2016). Market Participation by Smallholder Rice Farmers in Tanzania: A Double Hurdle Analysis. *Studies in Agricultural Economics*, 118: 112- 115.
- Alhassan, H. (2020). Farm household' flood adaptation practices, resilience and food security in the Upper East region, Ghana. *Heliyon*, 6(6): 1-8.
- Asuming-Brempong, S., Anarfi, J.K., Arthur, S., & Asante, S. (2013). Determinants of Commercialization of Smallholder Tomato and Pineapple Farms in Ghana. *American Journal of Experimental Agriculture*, 3 (3): 606-630.
- Awotide, B. A., Alene, A. D., Abdoulaye, T. & Manyong, V. A. (2015). Impact of Agricultural Technology Adoption on Asset Ownership: The Case of Improved Cassava Varieties in Nigeria. *Food Security*, 7:1239 –1258.
- Balana, B. B., Mekonnen, D., Haile, B., Hagos, F., Yimam, S., & Ringler, C. (2022). Demand and supply constraints of credit in smallholder farming: Evidence from Ethiopia and Tanzania. *World Development*, 159: 1-19.
- Bank Of Tanzania (BOT), (2022). Bank of Tanzania Annual Report 2021/22. Dodoma, Tanzania. 268pp.
- Barrett, C. B., Carter, M. R., & Timmer, C. P. (2010). A century of change in the role of agriculture in the economy of the United States. *Food Policy*, 35(4), 243–249.
- Chamberlin, J., & Jayne, T. S. (2013). The impact of the agricultural credit market on smallholder farmers in sub-Saharan Africa: Evidence from Kenya. *Food Policy*, 40, 49–59.
- Donkor, A., Djajadikerta, H.G., & Mat Roni, S. (2021). Impacts of combined assurance on integrated, sustainability and financial reporting qualities: Evidence from listed companies in South Africa. *International Journal of Auditing*, 25(2): 475-507.
- Getahun, A. (2020). Smallholder Farmers Agricultural Commercialization in Ethiopia: A Review. *Agriculture, Forestry and Fisheries*, 9(3): 67-74.
- Hailua, G., Manjureb, K., & Aymutic, K. M. (2015). Crop commercialization and smallholder farmers' livelihood in the Tigray Region, Ethiopia. *Journal of Development and Agricultural Economics* 7(9): 314 – 322.
- Isinika, A., Mlay, G., Mdoe, N., Boniface, G., Magomba, C., & Kilave, D. (2021). Rice Commercialization Effects in Mngeta, Kilombero District, Tanzania: Identifying the Underlying Factors, APRA Working Paper 63, Brighton: Future Agricultures Consortium.39pp.
- Kyaw, N.N., Ahn, S., & Lee, S.H. (2018). Analysis of the Factors Influencing Market Participation among Smallholder Rice Farmers in Magway Region, Central Dry Zone of Myanmar. *Sustainability* 10(12):
- Makate, C., Wang, R., Makate, M., & Mango, N. (2017). Impact of Draught Tolerant Maize Adoption on Maize Productivity, Sales and Consumption in Rural Zimbabwe. *Agrekon*, 56(1): 67-81

- Mauki, C., Jeckoniah, J., & Massawe, G. D. (2023). Smallholder Rice Farmers' Profitability in Agricultural Marketing Co-operative Societies in Tanzania: A Case Study of Mvomero and Mbarali District, Tanzania. *Heliyon*, 9: 1-9.
- Mmari, F. W., & Kapaya, M. S. (2022). Financial service access and agriculture commercialization of smallholder rice growers in Kilombero District: The moderating role of institution cultural cognition. *International Journal of Research in Business and Social Science*, 11(8): 409-418.
- Mpeku, F. N & Urassa, J. K. (2022). Access to Bank Loans and Smallholder Farmers' Paddy Productivity; A Case of Mvomero District, Tanzania. *International Journal of Science and Business, IJSAB International*, 15(1): 65-78
- Mpombo, L.B. (2018). Determinants of Market Participation Among Smallholder Rice Farmers in Tanzania. Dissertation for Award of MA Degree In Economics at University of Dar Es Salaam, Tanzania, 107pp.
- Mushi, E., & Mishili, F. (2019). Farm Livelihood Impact of APRON STAR 42 WS -Dressed Bean Seeds and its Commercialization Viability in Mbeya and Mbozi District. Dissertation for Award of MSc Degree in Agricultural and Applied Economics at Sokoine University of Agriculture Morogoro, Tanzania, 137pp.
- Osabohien, R., & Adeleye, N., & De Alwis, T. (2020). Agro-financing and food production in Nigeria. *Heliyon*, 6(5): 12-62.
- Osmani, A.G., & Hossain, E. (2015). Market Participation Decision of Smallholder Farmers and its Determinants in Bangladesh. *Economics of Agriculture*, 62(1): 163-179.
- Rubhara, T., & Mudhara, M. (2019). Commercialization and its determinants among smallholder farmers in Zimbabwe. A case of Shamva District, Mashonaland Central Province. *African Journal of Science, Technology, Innovation and Development*, 11(6), 711-718.
- Sekyi, S., Abu, B. M., & Nkegbe, P.K. (2020). Effects of farm credit access on agricultural commercialization in Ghana: Empirical evidence from the Northern Savannah ecological zone. *African Development Review*, 32(2): 150-162.
- Thapa, G. B., & Hussain, A. (2012). Effect of Credit on Agricultural Commercialization and Household Food Security: Insights of Smallholder in Pakistan. The Conference on Sustainable Business in Asia, 92:1-3.
- Tittonell, P., Giller, K. E., Van Wijk, M. T., & Corbeels, M. (2015). When to use and when not to use a "system" approach to study agricultural systems. *Field Crops Research*, 177, 60-69.
- Trochim, W. M. (2006). The Qualitative Debate. Research Methods Knowledge Base. *Creative Education*, 7(4): 1-30.
- United Republic of Tanzania (URT), (2015). Tanzania Agricultural Sector Development Strategy 2015/15 – 2025/26. National Report, Ministry of Agriculture. Dar es Salaam, Tanzania, 359pp
- United Republic of Tanzania (URT), (2017). Mvomero District Investment Profile. Regional Administration and Local Government, Morogoro, Tanzania. 50pp
- United Republic of Tanzania (URT), (2018). The Economic Survey of 2017. Ministry Finance and Planning, Dodoma, Tanzania. 238pp.
- United Republic of Tanzania (URT), (2019). National Rice Development Strategy Phase II (NRDS II) 2019-2030. Ministry of Agriculture. Dar es Salaam, 60pp.
- United Republic of Tanzania (URT). (2022). Tanzania National Bureau of Statistics. The 2022 Population and Housing Census: Administrative Units Population Distribution Report, Tanzania Mainland: Ministry of Finance

and Planning.

United Republic of Tanzania (URT). (2021). *National Sample Census of Agriculture 2019/20. National Report*. Ministry of Agriculture, Dar es Salaam. 931pp.

Westhuizen, V., & Nwafro, C. U. (2020). Prospects for commercialization among smallholder farmers in South Africa: A Case Study. *Rural Social Science*, 35(2): 20pp

World Bank. (2022). *Tanzania Agriculture Public Expenditure Review*. World Bank, Washington DC, USA. 126pp.

Yameogo, T.B., Aymar, Y.B., Bio, M.T., Jean-Louis, F., Dapola, E.C., Yacouba, Y., Georges, S., Fourvouon, S., & Mariam, M.D. (2018). Socio-Economic Factors Influencing Small- Scale Farmers' Market Participation: Case of Rice Producers in Dano. *Sustainability*, 10(12): 43-54.