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Determinants of microfinance credit uptake and the amount of credit by smallholder dairy cattle farmers in Maara sub-county, Tharaka Nithi County, Kenya

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Abstract

Microfinance institutions play a crucial role in enhancing the production and productivity of smallholder farmers by providing them with the necessary financial resources. However, the adoption and utilization of microfinance credit in the Maara sub-county fall short of their potential benefits. Despite various credit service providers, not all smallholder dairy cattle farmers in this region have been able to capitalize on these services. Several factors contribute to the low uptake of microfinance credit among smallholder dairy farmers, including inadequate financial literacy, absence of collateral, high transaction costs, and insufficient infrastructure. Acknowledging that these factors are dynamic and can vary across different regions is and essential. Therefore, a comprehensive understanding of the dynamics influencing microfinance credit adoption and utilization in the Maara sub-county is lacking. This study examined microfinance credit uptake from two angles: the factors affecting its adoption and the determinants of credit size once accessed. Recognizing the interdependence of these choices, the study employed the Heckman selection model. Results indicated that factors such as years of schooling, household size, organization membership, access to extension services, and collateral availability significantly ($p < 0.01$) influenced microfinance credit uptake. Furthermore, schooling years, household size, and daily milk production per cow emerged as the most impactful credit size determinants ($p < 0.05$). The study suggests that promoting organization membership among smallholder dairy cattle farmers could enhance access to microfinance credit facilities, thereby ensuring sustainable milk production. By addressing the identified factors, the Maara sub-county could unlock the potential of microfinance credit to benefit its agricultural sector.

Keywords: Microfinance institutions; Smallholder farmers; Credit uptake; Dairy cattle farmers; Dairy; Heckman selection model

1. Introduction

Access to microfinance credit remains a challenge in developing countries, as smallholder farmers often require small loans that are administratively complex and typically lack the necessary collateral. Agriculture plays a crucial role in these economies by contributing to employment, income generation, GDP growth, foreign exchange earnings, and food security. Thus, investing in the agricultural sector is vital to increasing production and promoting rural development [1]. Various studies have emphasized the impact of credit access on rural development, farm productivity, and economic efficiency. [27] highlighted that access to credit significantly influences rural development and farm productivity. Agricultural credit plays a role in modernizing agriculture, improving input flow, and enhancing production efficiency. Similarly, [17] noted that credit access accelerates agricultural modernization and contributes to economic development by facilitating optimal input use. [26] further highlighted that credit access enhances production efficiency among small-scale farmers, reducing rural poverty and food insecurity.

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The concept of smallholder farmers is vital to this study. These farmers are crucial contributors to agricultural and economic development in developing countries. The determinants of farm size are multifaceted, with off-farm wages being a key factor. In areas with ample opportunities for off-farm employment, farms tend to be larger, utilizing labour-saving technologies. Conversely, where such opportunities are limited, farms are smaller and more labor-intensive. Access to credit is a pivotal concern for smallholder farmers, particularly in the context of agriculture-driven economies. For instance, in the Maara sub-county, where agriculture is the primary economic activity, access to credit is a top priority for smallholder farmers [14]. The literature also reflects the scarcity of comprehensive analyses on factors affecting access to microfinance credit in the Maara sub-county. Studies like [27], [28], [8], [12], and [25] have explored these factors to varying extents, but few studies have accounted for selectivity bias in borrower sampling.

The present study aims to build upon previous studies by addressing the issue of selectivity bias in credit access analysis. The study approaches the issue of access to microfinance credit from two perspectives: the discrete choice of credit access and the continuous choice of credit size. Given the interrelated nature of these choices, the Heckman selection model is employed to account for potential sample selectivity bias in the regression analysis of loan size [11].

2. Materials and methods

2.1. Study Area

The study was conducted in Maara Sub-County Tharaka Nithi County, one of five sub-counties in the region. Tharaka Nithi County shares borders with Embu, Meru, Kirinyaga, Nyeri, and Kitui Counties. Maara Sub County has five wards; Mitheru, Ganga, Muthambi, Chogoria, and Mwimbi. Benefiting from ample rainfall, it lies in the County's upper regions. The area has a total land of 468.2 sq km with a population of 114,894 residents. Notable crops include coffee, tea, maize, beans, and cowpeas, and dairy farming is on the rise. The area was selected due to the presence of many active microfinance institutions and the dominance of dairy farming as the primary source of livelihood due to its relatively favourable climate conditions.

2.2. Sampling Procedure and Data Collection

The study employed a cluster sampling procedure to gather data. The five wards, namely Muthambi, Ganga, Chogoria, Mwimbi, and Mitheru, were selected as the clusters for the sampling process. In this study, the sample size of smallholder dairy farmers was selected from a total population of 1,500 farmers. The study calculated the sample size using Kothari's formula, which takes into account the level of significance (5%) and the desired level of precision. As a result, a sample size of 315 farmers was chosen for the study. This sample size represents a subset of the entire population and is used to draw conclusions and make inferences about the entire population of smallholder dairy farmers.

2.3. Empirical model specification

The empirical analysis relies on Heckman's two-stage procedure, which addresses the issue of sample selection bias. This bias can arise when obtaining an entirely random sample from the target population is challenging, significantly when the outcome of interest does not wholly influence the selection process. Consequently, this selection bias can introduce coefficients with a bias in regressions of various outcomes, leading to varying estimates [11]. The Heckman selection model is commonly utilized to tackle these econometric challenges. This two-step approach corrects for non-randomly selected samples. Initially, a probit model estimates the selection process. Subsequently, the self-selection issue is addressed by incorporating the "inverse Mills ratio," derived from the probit model. This inverse Mills ratio is then included as an additional explanatory variable in the ordinary least square (OLS) model of interest.

Based on the Heckman selection model, the equation below represents how various factors influence a household's decision to take credit:

$$Z_i^* = Y'L_i + u_i \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots \; 1$$

where Z_i^* a dichotomous variable, which remains unobservable, is perceived through the smallholder farmer's decision regarding whether to use credit.

Thus, $Z_i = 1$ if $Z_i^* > 0$ and $Z_i = 0$ if $Z_i^* < 0$, L_i is a vector of independent variables that affect Z_i^*.

Credit uptake is closely related to the credit amount taken by households, assumed to be influenced by farms, farmers, milk yield, and institutional characteristics. This can be expressed in the outcome equation below;

$$Y_i = b_i' X_i + V_i \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots \textit{ 2}$$

where X_i is the vector of covariates determining the credit amount. Y_i is observed only when $Z_i = 1$. Modified from the equation by [11], the expected credit amount may be expressed as follows:

$$E(Y_i|Z_i = 1) = E(Y_i|Z_i^* > 0) = E(Y_i|V_i > -Y'L_i) = b_i' X + E(V_i|u_i > Y'L_i) = b_i' X_i + \rho \sigma_v u_i(\alpha_u) \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots \textit{ 3}$$

where inverse Mill's ratio is given by the equation below:

$$u_i(\alpha_u) = \frac{\varphi(\alpha_u)}{1 - \varphi(\alpha_u)} = \frac{\varphi(-\alpha_u)}{\varphi(\alpha_u)} = \frac{\varphi(Y'L_i|\alpha_u)}{\varphi(Y'L_i|\alpha_u)} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots \textit{ 4}$$

The Heckman model involves two steps. First, a probit model is estimated, and the inverse Mill's ratio is computed from its linear prediction. In the second step, Y is regressed on X and the inverse Mill's ratio, but only for cases where the selection equation equals one, indicating households with credit access. A strongly influential result from the Wald test on the inverse Mill's ratio suggests the presence of selection bias.

3. Results and discussion

3.1. Descriptive statistics

The results of the study showed significant ($p < 0.05$) differences in six variables between credit adopters and non-adopters (Table 2). They included schooling years, number of dairy cattle, gender of the household head, organization membership, access to extension services, and availability of collateral. The average age of dairy cattle farmers was 49 years old. This indicates that the smallholder dairy cattle farming cluster predominantly comprises aging farmers. The average age did not vary significantly ($p = 0.0119$) between the credit adopters and non-adopters. The findings align with those of [17], who reported that the average age of dairy farmers, credit borrowers, and non-borrowers ranged between 41 and 50 years.

Table 1 Descriptive summary of the farm, farmers, milk yield, and institutional factors of credit adopters and non-adopters

Variables	Adopters		Non-adopters		Pooled		
	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation	p-value
Age	47.15	12.12	50.28	12.08	48.56	11.96	0.1119
Schooling years	12.02	4.08	13.29	4.86	12.38	4.00	0.0010*
Household size	4.87	1.67	4.78	1.49	4.46	1.54	0.2979
Land size	1.80	1.01	2.05	1.13	1.90	1.07	0.0236
Number of cattle	1.90	1.10	2.20	1.14	2.02	1.12	0.0083*
Milk production/cow/day	13.57	9.51	14.29	8.94	8.35	10.01	0.2469
Farming experience	10.08	3.17	10.13	6.23	13.88	9.26	0.4057
Gender of respondent	0.57	0.37	0.75	0.44	0.64	0.48	0.0006*
Access to extension services	0.49	0.50	0.71	0.46	0.58	0.49	0.0000*
Organization membership	0.89	0.31	0.35	0.48	0.66	0.47	0.0000*
Collateral availability	0.75	0.43	0.30	0.17	0.44	0.49	0.0000*

*Significant level at 1%

The study revealed an average schooling of 12 years, mostly focused on secondary education for dairy cattle farmers, indicating a reasonable formal education level (Table 2). However, concerns arise about adopting sustainable dairy practices without modern farming knowledge. Credit adopters averaged 12 schooling years, while non-adopters had 13, with a significant difference (p = 0.0010). The average household size for dairy farmers was four family members, suggesting smallholder households. Reliance on hired labour might lead to reduced profits due to higher labour costs. Comparing household sizes between adopters and non-adopters did not significantly differ. This aligned with [17]'s findings of one to five family members. Mean land sizes for credit adopters (1.80 acres) and non-adopters (1.90 acres) showed no significant difference. Average dairy cattle numbered two, constrained by land fragmentation and costly inputs. Non-adopters had more cattle than adopters, a significant difference (p = 0.0083), echoing [17]. Credit adopters averaged 13 litres of daily milk per cow, slightly less than non-adopters 14, without a significant difference. A significant gender gap (p = 0.0006) emerged, with male-headed households accessing microfinance credit more, contrary to [4]'s findings. Smallholder dairy organization membership significantly differed (p = 0.000) between adopters (89%) and non-adopters (66%), suggesting membership increased credit access chances. [17] and [18] also reported similar trends.

Collateral availability among smallholder dairy cattle farmers significantly differed (p = 0.000) between credit adopters and non-adopters (Table 2). Among credit adopters, 70% used collateral for loans, contrasting with 44% among non-adopters. This indicates collateral's role in enhancing credit access for dairy farmers. Those adopting credit were likelier to use collateral. This aligns with [7], where collateral like cattle secured loans. Similarly, Access to extension services varied significantly (p = 0.000) between credit adopters and non-adopters. Smallholder dairy cattle farmers had 49% average access. Actively seeking these services enhanced productivity, efficiency, and credit demand. Extension messages empower informed decisions. [1] saw similar credit adoption with access. Contrarily, [7]'s study noted that most credit-using dairy farmers lacked extension services.

3.2. Determinants of Uptake of Microfinance Credit by Smallholder Dairy Cattle Farmers

From the empirical estimation of the probit regression model, schooling years, household size, organization membership, and collateral availability significantly influenced the uptake of microfinance credit by smallholder dairy cattle farmers (Table 3). Schooling years had a negative and significant (p=0.001) relationship with the uptake of microfinance credit, indicating that smallholder dairy cattle farmers with more years of schooling are less likely to use credit services. The results agree with [8] and [21], who observed a significant inverse correlation between education level and credit accessibility. The results imply that less educated people are the ones who demand access to credit services. This is attributed to limited financial literacy, challenges meeting collateral requirements, and difficulties accessing formal markets. In contrast, educated farmers rely on alternative financial strategies and possess better financial planning skills, reducing their dependence on credit services.

Table 2 Results of the probit and outcome equations of the Heckman Selection Model of access to credit

Independent Variables	Probit Coefficient	p-value	Outcome Coefficient	P-value
Gender	-0.195	0.412	-1470.23	0.277
Schooling years	-0.106	0.001*	598.01	0.001*
Age	-0.009	0.467	-633.61	0.163
Household size	0.413	0.001*	238.41	0.003*
Land size	0.698	0.389	357.82	0.646
Cattle number	0.128	0.266	410.76	0.568
Access to extension services	0.268	0.288	-362.20	0.802
Farming experience	-0.227	0.202	-27.28	0.789
Milk production/cow/day	-0.002	0.984	152.18	0.047**
Organization membership	0.918	0.000*		
Collateral availability	2.608	0.000*		
Mill's lambda			-4404.80	0.002*
Rho	-0.515			

Sigma	8547.44			
Number of observations			315	
Censored observations			181	
Non-censored observations			134	
Wald chi2(9)			26.28	
Prob>chi2			0.0017	

*and ** indicate statistical significance at the 1 and 5% levels.

Household size had a positive and significant (p = 0.001) relationship with the uptake of microfinance credit (Table 3). This indicates that dairy cattle farmers with large household sizes are more likely to use credit services than those with small household sizes. It can be argued that larger households have more people to feed and a more significant labour force for agricultural work. Therefore, such households are likely to take out more loans to reach their production goals to optimize productivity and provide for family requirements. Due to the reduced number of individuals that need to be taken care of smaller farm households tend to borrow less. Lenders may also view smaller farm households as too low-income because a larger household size is frequently linked to better social and economic position. [19] revealed a positive and significant relationship between household size and credit access.

A positively significant (p=0.000) relationship was observed between organization membership and uptake of credit. The results imply that smallholder dairy cattle farmers who belonged to specific organizations were more likely to acquire credit services compared to those who did not belong to any organizations. A possible reason is that dairy cattle farmers in farmer groups can benefit from shared information about dairy cattle production, including feed supplies, cattle breeds, production costs, and market information. Members of these groups enable dairy farmers to discuss and address critical challenges within the dairy industry. Additionally, group membership allows them to collectively negotiate for better pricing and market their dairy products as a unified entity. The results agree with [17] and [6] that membership in a Farmer-Based Organization is crucial in influencing credit access. The results of their study suggest that this phenomenon can be attributed to the associations providing a favourable platform for farmers to seek assistance and support from diverse credit providers. [3] further reinforce this notion, emphasizing that being a member of such associations significantly enhances the credit access status of farmers. This is because credit providers dealing with self-help groups often consider association membership a vital criterion for extending credit opportunities. Therefore, these farmer associations play a significant role in facilitating credit access for agricultural communities.

Collateral availability had a positive and significant (p=0.000) relationship with the uptake of microfinance credit, indicating that smallholder dairy cattle farmers who possessed viable collateral were more likely to secure access to microfinance services. This is attributed to the fact that collateral securities were used to secure loans in financial institutions; hence, farmers with collateral securities could access loans and access higher amounts of loans than their counterparts with no collateral security. The finding highlights the importance of collateral as a crucial factor influencing the lending decision, and it underscores the role of asset-backed security in enabling individuals to obtain microloans. The results agree with [24] and [15], who reported a positive and significant relationship between collateral and access to credit. The study argued that collateral fills the information asymmetry between the lender and borrower alongside contract signing to help borrowers abide by the agreements.

3.3. Determinants of the credit amount

Schooling years had a positive and significant (p=0.001) relationship with loan size. The positive coefficient indicated that an increase in smallholder dairy cattle farmers' schooling years by one unit increases the loan amount by 598.01 units. Credit providers view farmers with a higher degree of education favorably since they are perceived to have current and relevant knowledge that can significantly help increase agricultural productivity. As a result, highly educated farmers are frequently found actively working in various rural development efforts aimed primarily at agricultural areas. The findings agree with [22] and [16], who found that schooling years positively influenced loan size among rural households, indicating that households with advanced education levels had a higher probability of obtaining more significant credit than families with lower educational attainment.

The results showed that household size had a positive and statistically significant (p=0.003) correlation with credit uptake, indicating that an increase in smallholder dairy cattle farmers' household size by one unit increases the loan borrowed by 238.41 units. One possible explanation is that households with larger family sizes have a dual advantage: they possess a more significant labour force for agricultural activities and have more members to support with food.

Consequently, these households are more inclined to secure additional loans to optimize productivity and fulfill their family's requirements to meet their production targets. Conversely, smaller farm households tend to borrow less due to their limited number of members available for work. Moreover, lenders might view smaller farm households as financially disadvantaged, as larger household sizes often signify higher social and economic status in many rural communities. These findings align with [23] study, which reported a positive and significant correlation between the loan amount and household size.

The coefficient of milk yield per cow per day was positive and significant ($p=0.047$) with credit uptake. The results indicate that one unit of milk production per cow per day increases credit uptake by 152.18 units. One possible explanation is that access to credit enables dairy farmers to invest in better resources and technologies. With the additional funds, farmers can purchase high-quality feed, modern farming equipment, and improved healthcare for their cows. These investments can lead to healthier and more productive cows, increasing milk production. Furthermore, credit uptake may allow farmers to expand their operations and increase their herd size. With a larger herd, there is a potential for increased milk production. Additionally, farmers might have the means to adopt more efficient and advanced farming practices, further contributing to higher milk yields.

The significant inverse Mill's ratio (λ) ($p=0.002$) indicated selective bias in the model. Employing the Heckman two-step estimation effectively rectified this bias, ensuring that the explanatory variables' coefficients offer consistent credit size estimates. The negative sign of the inverse Mill's ratio suggests that the estimated coefficients would have been downwardly biased without correcting for selection bias.

4. Conclusion

Results showed that schooling years, household size, organization membership, and collateral availability influence microfinance credit uptake among the smallholder dairy cattle farmers in the Maara sub-county. Furthermore, household size, organization membership, and collateral availability positively influenced credit uptake, while schooling years negatively influenced credit uptake. On the other hand, schooling years, household, and milk yield per cow per day positively influenced the amount of credit the smallholder dairy cattle farmers could receive. The study revealed that schooling years and household size significantly impact the likelihood of accessing microfinance credit and the amount of credit obtained by smallholder dairy cattle farmers from microfinance institutions. These findings emphasize the importance of individual household characteristics in determining access to microfinance credit in the Maara sub-county, Tharaka Nithi County.

4.1. Recommendation

There is a need to promote the formation of farmer organizations and cooperatives that can significantly benefit dairy farmers. These groups facilitate sharing information and resources among farmers, improving their access to credit and increasing their collective bargaining power with microfinance institutions. This is in line with the study results that organization membership was highly and significantly influencing the uptake of microfinance credit in the study area. This will improve financial access and empower smallholder dairy farmers to make informed decisions, leading to the overall growth and sustainability of the dairy sector in the region. Farmers can optimize their practices and strengthen their economic prospects with better credit access and knowledge exchange.

Compliance with ethical standards

Disclosure of conflict of interest

The authors do not disclose any conflict of interest.

Statement of informed consent

The study ensured that all participants provided written informed consent, and relevant documents were obtained accordingly. In cases where verbal consent was obtained, the reasons for opting for verbal consent were thoroughly documented and can be made available upon request.

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