

## Determinants of Farmers' Participation in Formal Credit Markets in Rural Rwanda

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**ABSTRACT** Access to credit is a necessary ingredient for policies aiming at transforming rural economies, particularly for a largely subsistence agricultural economy such as Rwanda. Despite the increasing number of formal financial institutions penetrating rural areas in the country, access to credit among the majority of agricultural households remains limited. This study assesses micro-level factors influencing Rwandan farmers' participation in formal credit markets as borrowers, using Rwamagana District as an illustrative case. Survey data of 185 farm households were employed in a binary Logit regression analysis. The results reveal that the likelihood of farmers participating successfully in formal credit markets increases with education, off-farm incomes, and agricultural extension, and decreases with the presence of informal financial systems in the neighbourhood. The study concludes with key rural development policy recommendations.

### I. INTRODUCTION

It is common argument that farm credit enhances productivity and promotes standard of living by breaking vicious cycle of poverty of small scale farmers. The provision of financial services to the poor has a crucial role to play in providing household food security and alleviating poverty. If the credit is adequately accessed and productively used, it positively influences the optimum allocation of resources and enables technology adoption (Vasthoff 1968). It is usually considered as an essential input for increasing agricultural land and labor productivity, boosting food production and income levels, encouraging employment and alleviating rural poverty. Generally, farm credit is provided for relief of distress and for purchasing productivity-enhancing inputs such as seeds, fertilizers, and farm implements.

The importance of credit for rural development is even more pronounced for developing countries with largely subsistence farming systems such as Rwanda. While agriculture contributes significantly to the country's economic growth, the sector continues to be characterized by very low levels of input use. It is practiced on the average farm size less than one hectare per household (IFDC 2007). Compared to other countries, it is estimated that over the last de-

cade, only 12 percent of farming population used improved seed varieties and 5.2 percent of household used approximately 4 Kg of fertilizer per hectare (Government of Rwanda 2009). This figure is far much below the estimated average use of fertilizer in the Sub Saharan Africa (SSA) which stands at 9 to 11 Kg per hectare (Government of Rwanda 2009). Similarly, a survey carried out on the use of improved inputs in 2005 showed that only 12 percent of households use improved seeds (Government of Rwanda 2009).

Therefore, it is challenging for smallholder farmers to grow out of poverty without being provided with adequate and affordable financial services (Papias and Ganesan 2010). Credit accomplishes this developmental task by enabling risk-averse smallholder farmers to overcome their liquidity problem and to make farm investments, particularly in improved farm technology and inputs that could lead to increased agricultural production (Fuentes 1996). Thus farm credit is very essential if economic growth is to be achieved in a developing country like Rwanda.

In spite of the vital role played by agriculture in employing and providing livelihood to over 88.6 percent of the population, financial resources allocated to this sector are limited. Two government-supported banks, the Rwanda De-

velopment Bank (BRD) and the Rwanda Union of People's Bank (UBPR), offer financial services to agricultural customers, but the volume of rural lending by these banks amounted to less than 2 percent of bank loans in 2003 (Papias and Ganesan 2009). It is documented that more than 80 per cent of formal financial institutions are centralized in the city of Kigali and urban centers of provinces and districts with few branches in the rural areas (Papias and Ganesan 2010).

Rwanda's "Vision 2020" spells out the importance of agriculture as the main driver in transforming the country into an industrialized state. In order to improve the situation of access to credit by smallholder farmers and low income earners, rural micro-financial institutions such Savings and Credit Cooperative Societies (SACCOs) have been promoted (Papias and Ganesan 2009). The government has also promoted some specific programmes to encourage access to credit by the marginalized populations, including the women guarantee fund, agricultural export and agro-business guarantee, guarantee fund and credit line for the retrenched civil servant project and the rural investment facility project (NBR 2008).

Despite these efforts, Habyalimana (2007) documents that access to formal credit remains steadily low even as the national economy is considerably growing. Formal financial services are not available in places where the poor can easily access them at affordable costs (DFID 2010). Informal finance continues to play a major role for the majority of the Rwandan population. About 39 percent of adults save in informal financial and the access to credit in the kind of informal market ranges from 32 to 56 percent whereas access to formal credit ranges from 2 to 7 percent (Nkonya et al. 2009).

A study by Papias and Ganesan (2010) revealed that the majority of rural households face three forms of credit constraints, including self-imposed constraints, quantity rationing and risk rationing by formal financial institutions. Smallholder farmers often self-select out of the formal financial systems due to the congruence of factors that are intrinsic to their farms and households (Baydas et al. 1994; Binswanger et al. 1989; Diagne 1999; Diagne et al. 2000; Fuentes 1996; Hashemi et al. 1997; Kiiza and Pederson 2001; Oboh and Kushwaha 2009).

However, the effects of such factors on farm households' participation in formal credit markets within the socio-economic context of Rwanda have not been explored in the literature.

Against this background, this paper seeks to identify the host of various household-level factors affecting access to credit in Rwanda. The purpose of this study is to document key determinants of credit use. These insights can be used to inform rural development policymakers and other stakeholders in Rwanda. To that end, this study uses Rwamagana district, a highly productive agro-ecological region in the country, as an illustrative case.

This paper is sub-divided into four sections. The methodological section up next explains the theoretical and empirical strategy adopted by the study. It is followed by a section reporting and discussing the results of the empirical model. A concluding section highlights the key findings and draws concluding remarks.

## II. METHODOLOGY

### 2.1. The Conceptual Underpinning

#### 2.1.1. *Farmer Characteristics and Credit Market Participation*

Studies have documented the important role played by human capital in agricultural credit markets access. With environmental changes in different aspects of farm business (such as climate and competitiveness conditions), increasing returns in agricultural production (for example, through adoption of new technologies) is often defined by farmers' abilities and skills (Arene 1992; Njoku and Odii 1991). Gender is an important dimension in which farmers' ability to access rural finance is understood. Authors such as Baydas et al. (1994) have argued that women are discriminated against in formal financial markets. According to Buvinic et al. (1979), factors related to woman's lack of control over the economic resources and the nature of their economic activity are two categories of major factors that restrict women's access to formal credit compared to men. Empirical evidence such as Mohamed (2003) in Zanzibar supports the assertions.

Age of household head also relates to some factors that may differentiate farmers' ability to

access financial markets. On the one hand, older people have more experience with the economic activities being financed, which increases their lenders' trust and confidence (Feder et al. 1988). On the other hand, younger farmers, not having constituted enough wealth yet, may rely more on credit markets to adopt new technologies (Nguyen 2003). Therefore, in rural credit markets, whereas older farmers might be relatively more creditworthy but less demander (due to the congruence of factors increasing their risk aversion), younger farmers relying on credit for their survival are often disadvantaged. For example, in Pakistan, Shah et al. (2008) found that the participation to credit was influenced by age of the household head.

According to Feder et al. (1988), education constitutes an asset which determines credit access through on-farm efficiency. As a household gets more formal education, its increasing operations and financial management skills will secure access to finance (Musebe et al. 1993). For example, a participatory rural appraisal conducted in Kenya by Musyimi (2010) documented that the majority of farmers had no access to credit due to lack of knowledge on how to access and manage credit. In China (Tang et al. 2010), Pakistan (Shah et al. 2008), Uganda (Kiiza and Pederson 2001), and Zanzibar (Mohamed 2003), the likelihood of participating in credit market is often found to increase with the level of education of the farmer.

The size of household often indicates labor endowment for household economic endeavors. The more the labor force available to a certain household, the higher its ability to overcome credit risk (Schereiner and Nagarajan 1997). Empirical evidence on the effect of household size is documented in studies such as Tang et al. (2010) in China and Shah et al. (2008) in Pakistan, and Sisay (2008) in Ethiopia.

Income earning has also been identified as an important determinant of credit market participation. However the expected effect is not always unidirectional. On the one side, off-farm incomes may build confidence to borrower and it can be a major source of finance to ensure repayment (Sharma and Zeller 1997). According to Diagne (1999), the increase in income raises access to credit. On the other side, higher off-farm incomes may reduce household's borrowing needs because such households may be

able to meet their investment needs, without having to resort to borrowing. For example, Kiiza and Pederson (2001) in Uganda, Oboh and Kushwaha (2009) in Nigeria, and Tang et al. (2010) in China showed that households earning more off-farm incomes had a higher likelihood of borrowing from formal sources.

### ***2.1.2. Farm Characteristics and Credit Market Participation***

As asserted by Binswanger and Rosenzweig (1986), agricultural land has been the most important collateral for formal credit in rural areas. They also argue that farmers with more land are more likely to seek credit, as long as land exploitation requires more capital. This has been the basis of the understanding the positive effect of landholding in agricultural finance. Empirical studies such as Oboh and Kushwaha (2009) in Nigeria, and Tang et al. (2010) in China show that farm size has significant effect on credit demand.

### ***2.1.3. Institutional Characteristics***

Various studies have documented the importance of local institutions for farmers' access to financial markets. Participation in formal credit markets is often found to be related to the levels of penetration of financial institutions in the rural areas. For example, studies such as Kiiza and Pederson (2001) in Uganda, Oboh and Kushwaha (2009) in Nigeria, and Shah et al. (2008) in Pakistan suggest that proximity to the financial institution is a significant factor influencing the rural households' participation in the credit programmes. There have been also studies such as Sisay (2008) in Ethiopia documenting the role of access to agricultural extension services.

## **2.2. Econometric Model Specification**

Following studies such as Kiiza and Pederson (2001), Mohamed (2003), Shah et al. (2008) and Sisay (2008), this study adopted a binary regression model to analyze socio-economic and institutional factors influencing participation in credit markets in rural Rwanda. The dichotomous dependent variable can be written as:

$$y_i = \begin{cases} 1 & \text{if } y_i^* > 0 \\ 0 & \text{otherwise} \end{cases}$$

Where  $y_i^*$  is a latent variable expressing the quantity of loan contracted by farmer  $i$  from formal financial markets. This quantity is a function of his household and farm characteristics ( $X_i$ ), as expressed in the following equation:

$$y_i^* = \beta_0 + \sum_{j=1}^k \beta_j X_{ij} + \mu_i \quad (1)$$

A logit model depends on the assumption of the logistic distribution of the error term in equation (1). In the dichotomous analysis outcome variable, Hosmer and Lemeshew (1989) pointed out that the logistic distribution (logit) has an advantage over the other models because of its extreme flexibility and ease of use from mathematical point of view and results in a meaningful interpretation. Following Pindyck and Rubinfeld (1981), the cumulative logistic probability function is specified as:

$$P_i = F(Z_i) = F\left(\alpha + \sum_{i=1}^n \beta_i X_i\right) = \frac{1}{1 + e^{-Z_i}} \quad (2)$$

where,  $P_i$  is the probability that a farmer participated in formal credit market given his household and farm characteristics  $X_i$ , and  $\alpha$  and  $\beta$  are the parameters to be estimated. To understand the interpretation of the coefficients, the logit model could be written in terms of the odds and log of odds. The odds ratio implies the ratio of the probability ( $P_i$ ) that an individual would choose an alternative to the probability ( $1 - P_i$ ) that the person would not choose it. After simple mathematical manipulation of equation (2), it can be shown that  $(1 - P_i) = \frac{1}{1 + e^{Z_i}}$

or,  $\left(\frac{P_i}{1 - P_i}\right) = \frac{1 + e^{Z_i}}{1 + e^{-Z_i}} = e^{Z_i}$  which is the odds ratio.

Taking the natural logarithms of the odds ratio results into the Logit model as indicated below (Hosmer and Lemeshew, 1989):

$$Z_i = \ln\left(\frac{P_i}{1 - P_i}\right) = \alpha + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_n X_n \quad (3)$$

Accounting for the error made by researcher in the estimation of probabilities, equation (3) becomes:

$$Z_i = \ln\left(\frac{P_i}{1 - P_i}\right) = \alpha + \sum_{i=1}^n \beta_i X_i + \mu_i \quad (4)$$

The coefficient of the logit model, therefore, presents the change in the log of the odds asso-

ciated with a change in the explanatory variables.

### 2.3. Sampling Procedure and Data Collection

The study used a multistage sampling procedure to select farm households for this study. The Eastern Province was selected purposely out of the total 4 provinces of Rwanda based on its high agro-ecological potential. From its seven districts, Rwamagana district was purposely selected based on its diverse economic patterns in terms of the penetration of financial institutions. These include branches of formal banks such as National Bank of Rwanda, BRD, and SACCOs such as *Umurenge* SACCO and *Umwalimu* SACCO. Its administrative location is highlighted in Figure 1. The unit of analysis was a farm. Cochran (1963)'s sampling formula

$$(n = Z^2(1-p)/e^2)$$

where  $n$  is the sample size,  $Z$  is the desired confidence level,  $p$  is an estimated proportion of an attribute that is present in the population, and  $e$  is the absolute size of the error in estimating  $p$  that researcher is willing to permit) was used.

A  $p$  of 0.86 was used in the formula based on the fact that only 14 percent of adult population was banked (we assume that the national average can be applied to that study area) (DFID 2010). With  $e=0.05$ , the formula suggested a sample of 185 farmers. Sampling frames were obtained from extension workers operating in the six administrative sectors making up the district (Fumbwe, Karengye, Muhazi, Muyumbu, Mwulire and Rubona). A simple random selection technique with probability proportional to size was used to obtain interviewed household in each of the administrative sector. A structured questionnaire was prepared to collect quantitative data for the study using face-to-face interviews. Trained field enumerators conducted a pilot testing of the survey instrument which allowed the researcher to adjust the forms and flows of questions. Afterwards, field enumerators proceeded with face-face interviews. Only the household heads were allowed to participate in the interviews.

### 2.4. Model Estimation

The econometric model elicited above was used in this study to analyze the potential vari-



**Fig. 1. Administrative map of Rwanda showing the location of Rwamagana district (bolded)**

Source: Drawn by the Authors using ArcGIS software

ables affecting smallholder farmers' participation in credit markets. The dependent variable for the Logit analysis is a binary variable expressing participation or non-participation in formal sources of credit. Since the study focuses on credit market participation (not credit access),

the variable takes the value of 1 only to captures those farmers who had successfully secured loans from formal financial institutions in the past. For those who applied for credit but were not successful (rejected), or those who had never applied for loan, the variable take the value of 0.

The independent variables were selected on the basis of the conceptual underpinning elicited in the section 2 and the likelihood-ratio (LR) test. Only variables that significantly improved the goodness of fit (based on the LR test) were preserved in the model. Those variables are described in Table 1.

Table 2 summarizes the key descriptive statistics of the independent variables used in the econometric model. As the table shows, the majority of interviewed households were headed by men. Most of the farmers were in their late adulthood age. Although the majority of interviewed farmers had attended primary school, some had reached tertiary education. The sizes of interviewed households ranged between 2 to 12 people, with an average of about 6 people. Only around 27 percent of interviewed farmers

**Table 1: Description of variables used in the econometric model**

<i>Variable</i>	<i>Type</i>	<i>Description</i>	<i>Expect sign</i>
<i>Farmer Characteristics</i>			
Female headedness	Dummy	1 = The household is headed by a female; 0= Otherwise	-
Age of the head of household	Continuous	Age of the head of household at the time of the interview measured in years	-/+
Education level of the head of household	Categorical	1= Never went to school, 2= attended primary school, 3= attended high school, 4= went to a tertiary education institution.	+
Size of the household	Continuous	Number of people living in the household (sharing food and shelter)	+
Off-farm income	Dummy	1 = the head of household earns incomes from outside the farm; 0= otherwise	-/+
<i>Farm Characteristics</i>			
Size of the landholding	Continuous	The total size of farmer's landholding in acres	+
Farm records keeping	Dummy	1 = the farmer keeps records of his farming activities; 0=Otherwise	+
<i>Institutional Factors</i>			
Informal microfinance in the neighborhood	Dummy	1 = An informal microfinance (such as tontines) is operational in the neighborhood; 0=Otherwise	
Visit to agricultural extension	Dummy	1 = farmer participates in local agricultural extension activities; 0=Otherwise	+

**Table 2: Descriptive statistics for structural variables**

Variable	Mean	Std. dev	Min	Max
<i>Farmer Characteristics</i>				
Female headedness	0.37	0.17	0	1
Age of the head of household	42.35	10.42	29	68
Education level of the head of household	2.83	0.32	0	4
Size of the household	5.99	2.33	2	12
Off-farm income	0.27	0.14	0	1
<i>Farm Characteristics</i>				
Size of the landholding	3.15	1.04	0.2	7.50
Farm records keeping	0.16	0.3	0	1
<i>Institutional Factors</i>				
Informal microfinance in the neighborhood	0.48	0.23	0	1
Visit to agricultural extension	0.42	0.17	0	1

had off-farm income generating activities. On average, an interviewed farmer held 3 acres of land, and the majority of interviewed farmers were not keeping records of their farming activities. Informal microfinance institutions and agricultural extension activities were prevalent in around 50 percent of cases.

### III. RESULTS AND DISCUSSION

Table 3 reports the maximum likelihood estimates of the logistic regression model. A closer look at the table reveals that most of the variables have expected sign. Diagnostic test were used to verify the reliability of the results. The Breusch-Pagan and Cook-Weisberg test reported a  $\chi^2(1)$  of 0.12, failing to reject the null hypothesis of constant variance, thereby suggesting that there was no heteroscedasticity problem in the model. Analysis of variance inflation factor (VIF) and contingency coefficients revealed that multicollinearity was not a problem for continuous and discrete variables, respectively.

On farmer characteristics, the results in Table 3 indicate that the coefficient of the education variable has a positive sign and is significant at 1 percent. This implies that higher levels of farmers' education are significantly associated with higher chances of participating in formal

**Table 3: Estimation results of the Logit regression model**

Variable	Coef.	Marg. effect (dy/dx)	Std. err.	P-value
<i>Farmer Characteristics</i>				
Female headedness	0.05	0.00	0.41	0.89
Age of the head of household	0.01	0.00	0.02	0.39
Education level of the head of household	0.98	0.14	0.35	0.00
Size of the Household	0.04	0.00	0.09	0.60
Off-farm income	0.45	0.04	0.01	0.06
<i>Farm Characteristics</i>				
Size of the landholding	-0.02	-0.00	0.03	0.48
Farm records keeping	0.69	0.10	0.54	0.19
<i>Institutional Factors</i>				
Informal microfinance in the neighborhood	-1.92	-0.29	0.40	0.00
Visit to agricultural extension	0.95	0.14	0.38	0.01
CONSTANT	-3.01		1.11	0.00

Pseudo R<sup>2</sup> 0.2664

LR  $\chi^2(9)$  = 62.87

Prob >  $\chi^2$  = 0.0000

Log likelihood = -86.552163

credit markets as borrower, *ceteris paribus*. The marginal effect indicates that adding one level to a farmers' education increases his chances of borrowing money in formal financial systems by 14.9 percent. This empirical finding supports the assertion that education is the most important factor affecting households' credit activities (Nguyen 2003). This may be due to the fact that educated farmers have a better understanding of banking procedures and rules for acquiring and using formal banking financial product and services. This finding is in line with the findings of similar studies in China (Tang et al. 2010), Pakistan (Shah et al. 2008), Uganda (Kiiza and Pederson 2001), and Zanzibar (Mohamed 2003).

The significantly positive coefficient of the off-farm incomes variable in the model suggests that off-farm income generation increases a farmer's likelihood of contracting a loan from formal sources of finance. Adding off-farm activities to a farm household's income portfolio increases its chance of engaging in credit markets by 4.6 percent. This result suggests that,

given the lack of land tenure security (Musahara 2006) coupled with the unpredictable nature of farm incomes, off-farm activities play an important collateral function in the credit market in Rwanda. This finding vindicates studies conducted elsewhere such as Kiiiza and Pederson (2001) in Uganda, Oboh and Kushwaha (2009) in Nigeria, and Tang et al. (2010) in China. This finding, therefore, implies that poor farmers could be excluded from accessing formal credit perhaps because they lack appropriate collateral.

The results in Table 3 also suggest that institutional factors are the major predictor of participation in credit market. Interestingly, the Logit model results show a negative and significant influence of proximity to informal microfinance institutions on the probability of participating in formal credit markets. The results show that households which had access to informal credit had a lower probability of participating in formal credit than their counterparts. This influence suggests that farmers substitute formal credit sources for informal ones.

Finally, Table 3 reports a positive and significant coefficient of the agricultural extension variable. Consistent with the findings of Sisay (2008) in Ethiopia, this result suggests that farm households which receive technical advice from agriculture extension agents are more likely to use formal credit. A plausible explanation is that, to the extent that extension programs aim at agricultural intensification through adoption of modern technology such as improved seeds, pesticide and fertilizers, farmers working with extension services demand more financial services to support investments in these technologies.

#### IV. CONCLUSION

The purpose of this study was to provide an economic assessment of micro-level factors influencing farm households' participation in credit markets in Rwamagana district, Rwanda. Employing survey data of 185 randomly-selected households in a binary Logit model, the study revealed that the recourse to formal credit among smallholder farmers is significantly explained by factors related to human capital such as education and off-farm employment, coupled with institutional factors such as availability of informal microfinance and agricultural extension services.

#### V. RECOMMENDATIONS

The findings of this study have major policy implications. First, the importance of human capital in the understanding of credit market participation behavior implies that policies that uplift human capital in Rwanda could generate co-benefits in the financial sphere. Notably, the policies that foster education such as the free basic education can significantly contribute to rural poverty alleviation through improved access to financial skills and off-farm employment opportunities. Moreover, as many rural households in Rwanda continue to face land scarcity, credit access promotion through investment in human capital can also alleviate income inequality.

These efforts need to be accompanied by other efforts that develop rural areas through generation of non-farm employment opportunities in rural areas. In this vein, local economic development strategies such as market access promotion, rural infrastructure development, and environmental protection will catalyze a process of pro-poor transformation in financial systems.

However, the negative effect of access informal sources of finance portrays a pronounced need for farmer-orientated financial products and services in rural Rwanda. This underscores the need for linking formal credit providers with well established, traditional financial systems in order to develop mutually beneficial products while overcoming the limitations caused by geographical remoteness. Also, innovative products such as collateral management and warehouse receipt systems can be envisaged in this regard.

The revealed influence of extension services in the credit use model highlights the importance farm-nonfarm linkages. These backward production linkages need to be explicitly accounted for in the design of policies and programs. Hence, the Government of Rwanda could leverage upon such externalities to mainstream financial development in the overall rural development objectives.

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