

DETERMINANTS OF ACCESS TO AGRICULTURAL CREDIT AMONG SMALLHOLDER RICE AND MAIZE FARMERS IN THE EASTERN AND WESTERN PROVINCES OF RWANDA

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ABSTRACT

Agricultural credit is believed to play a catalytic role in enhancing agricultural productivity; however, its access is limited for smallholder farmers in Rwanda. To investigate this phenomenon, this study sought to identify and assess the determinants of access to agricultural credit among rice and maize smallholder farmers in Rwanda. The study was conducted in the eastern and western provinces of Rwanda using a cross-sectional survey design. Sample districts, sectors, and cells were obtained using stratified random sampling techniques. Convenient and purposive samplings were used to sample households and farmers, respectively. Data were collected using structured interviews and questionnaires, and were analyzed using a binary logistic regression model. Model results indicated that both individual and institutional factors determine access to agricultural credit among smallholder maize and rice farmers in eastern and western provinces of Rwanda. The individual factors included: saving of money in commercial banks (Adjusted Odds Ratio (AOR) = 2.389), owning a size of land that is 0-0.1 ha (AOR = 0.127), and knowledge of the repayment terms of agricultural loans (AOR = 0.203), while the institutional factors included: having privately-owned finance institutions in the area (AOR = 0.287), offer of both long and short-term loans (AOR = 0.290), interest rate between 11-15% (AOR = 0.178), the process for obtaining agricultural credit not being too long (AOR = 2.026). Institutional factors were more important than the individual farmer characteristics in determining access to credit. Policy interventions aimed at bolstering agricultural credit access among the smallholder farmers should address institutional challenges such as information asymmetry and the lack of credit guarantees that hinder agricultural credit access.

Key words: smallholder farmers, agricultural productivity, agricultural credit, access, determinants

INTRODUCTION

Forecasts by the World Bank indicate that food demand will increase by 70% by the year 2050 (World Bank, 2019a; World Bank, 2020); however, production is stagnating, especially in developing countries. To address this issue, there is a need to increase the productivity of global food staples, specifically wheat, maize and rice (World Bank, 2019b). Maize and rice are two of the most important global cereals regarding production and consumption, with maize demonstrating the highest production volume and rice being one of the most widely consumed grains (Shahbandeh, 2018; FAO, 2019; Shahbandeh, 2021). The Government of Rwanda has emphasized the need for agricultural productivity increment as spelt out in the Rwanda strategic plan for agricultural transformation (Paul *et al.*, 2017; World Bank, 2018). That followed the reality that the current demand for maize and rice is not being met by the current production despite the

productivity of these two crops rising over the years (Kelly and Mbizule, 2014; FAO, 2020a; FAO, 2020b; NISR, 2020; Santpoort, 2020).

The gap in rice and maize productivity is currently being narrowed through financial empowerment of smallholder farmers, given that 59% of the land mass (1.39 million ha) of Rwanda is arable and is currently used by mostly smallholder farmers (IFAD, 2019; United Nations, 2019; NISR, 2020). Specifically, the focus on the financial inclusion of smallholder rice and maize farmers is informed by evidence that access to agricultural credit enables farmers to: undertake efficient land preparation, irrigation and plant protection, the purchase of farm inputs, adoption of agriculture technologies and on-farm technical efficiency (Adjognon *et al.*, 2017; Chandio *et al.*, 2018; Araya and Sung-Kyu, 2019; Chandio *et al.*, 2019; Rehman *et al.*, 2019). Thus, without access to agricultural credit, optimal agricultural productivity cannot be realized within the country (Peprah *et al.*, 2020).

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The Government of Rwanda has geared its efforts and strategies towards promoting smallholder farmer financial inclusion (World Bank, 2018; FAO, 2019; FAOSTAT, 2019; World Bank, 2019b; World Bank, 2020). The inclusion of smallholder farmers focuses on increasing their access to agricultural credit from any financial institution. For example, in the recent past, Rwanda has increased its annual budget allocation to agriculture (FAO, 2019). Budget allocation to agriculture in Rwanda increased from 5% to more than 7% during the financial year 2020/2021, to increase the use of improved inputs and improve irrigation facility development and crop production (RoR, 2020). Further, the Government has initiated several economic sector policies that promote private sector investments and ease agricultural credit disbursement (IFAD, 2019; PwC Rwanda, 2019). The above initiatives are for promoting farmers' access to agriculture credit avenues and ease of access to it, since credit has a potential impact on agricultural productivity (Lawal *et al.*, 2019; Mita *et al.*, 2019; Zakaria *et al.*, 2019). Credit access promotion for farmers in Africa has been bolstered even more since the advent of the corona virus disease that is expected to devastate farmer incomes (Ufondu *et al.*, 2021).

The efforts notwithstanding, smallholder farmers in Rwanda have for the past decade generally grappled with the challenge of accessing agricultural credit/finance (D'Souza, 2020), even though the Government has increased investment in agriculture. For example, less than half of the farmers who needed agricultural credit were reported to have received it in the last five years (AFR, 2016; 2017; RoR, 2018). Rice and maize farmers in the eastern and western provinces may be the most affected given that the two provinces that are known for principal production of the two cereals, have persistently registered reduced production, most likely due to low access to credit since agricultural credit access certainly guarantees high productivity (Teka *et al.*, 2019; Temitope *et al.*, 2019). Few studies have attempted to understand what determines access among that population of farmers in Rwanda, especially the eastern and western provinces.

For instance, Ali *et al.* (2014) focused on credit constraints, productivity and non-rural farm participation. Muhongayire (2012) focused on the determinants of farmers' participation on formal credit markets while Musabanganji *et al.* (2015) and Mpirwa *et al.* (2018) focused on the institutional factors influencing the decision to take financial credits among smallholder coffee farmers. Mugenzi (2014) focused on access to and utilization of microcredits by farmers, while Musabanganji *et al.* (2015) focused on determinants of access to agricultural credits for smallholder farmers in the Southern Province of Rwanda.

The focus of most studies has been on agricultural credit access by farmers in general with

little attention being given specific crop producers such as maize and rice farmers. The objective of this study was to assess the determinants of access to agricultural credit among smallholder farmers in the eastern and western provinces of Rwanda. The findings of this study provide useful insights that will help in improving agricultural credit access to not only maize and rice farmers but also other sectors of the economy of Rwanda.

MATERIALS AND METHODS

Study Design, Setting and Sampling Procedures

The study used analytical cross-sectional survey to study rice and maize smallholder farmers in the two provinces (eastern and western). The study further utilized stratified and simple random sampling techniques to sample the study districts. The study was conducted in eastern and western provinces of Rwanda, of which the eastern province, the largest of the provinces, has the largest population of smallholder farmers. The province is constituted by districts including Rwamagana, Kayonza, Gatsibo, Bugesera, Kirehe, Nyagatare, Ngoma, with Rwamagana being the provincial capital. The western province is on the other hand comprised of districts including; Rubavu, Karongi, Rusizi, Nyabihu, Nyamasheke, Ngororero and Rutsiro, with the provincial capital being Kibuye. Rwanda has an estimated total 6,000,000 smallholder farmers, of which about 3,000,000 reside in the eastern and western provinces (Martin *et al.*, 2018). The smallholder rice and maize farmers in the eastern and western provinces of Rwanda were the target population of this study.

First, the study stratified the regions into two: eastern and western strata, followed by simple random sampling to select districts in each stratum. The simple random sampling technique using the lottery procedure was used to select the districts because of its ability to avoid sampling bias. The resultant districts sampled were Nyagatare, Rwamagana, Bugesera and Gatsibo in the eastern province, while in the western province, they were; Karongi, Ngororero, Nyamaseke and Rusizi districts. Each of the sampled districts was then stratified with half the number of sectors in the sampled district therein randomly sampled, followed by further stratification of sectors in order to randomly sample half the number of cells in each. Since there was no systematic arrangement of farm households in each of the cells, it was not feasible to use probabilistic methods to sample them. Hence, convenience sampling was used to sample households.

Sample Size Calculation

A sample of 422 smallholder farmers was obtained, based on a finite population size of 3,000,000 smallholder farmers, at a proportion (P) of 50% using the formula of Krejcie and Morgan (1970) as follows:

$$n = \frac{NZ^2P(1-P)}{(N-1)e^2 + Z^2P(1-P)} \quad (1);$$

where N is the finite population size based on assumption that the eastern and western provinces have an estimated 3,000,000 smallholder farmers (NISR, 2020), n is the required sample size, P is the proportion, 1 is the complement of the proportion, Z^2 is the square of the standard normal probability value. To come up with the sample size, the substitution of the parameters was done as follows:

$$\frac{3,000,000(1.96)^2(0.5 \times 0.5)}{(3,000,000-1)(0.05)^2 + (1.96)^2(0.5 \times 0.5)} \quad (2);$$

$n = 384$ smallholder farmers. In addition to a non-response rate of 10%, the final sample was $384 + (384 \times 0.1) = 422$ smallholder farmers. The number of smallholder farmers that was required from the eastern and western provinces was calculated using the formula of proportionating as shown below:

$$n_0 = \frac{N_1}{N_2} \times n \quad (3);$$

where n_0 is number of smallholder farmers required from a particular province, N_1 - number of smallholder farmers available in the eastern province, N_2 is total number of smallholder farmers available in both provinces, n is sample size (422).

The number of smallholder farmers who were required in the eastern province was calculated as:

$$n_0 = \frac{1,700,000 \times 422}{3,000,000}$$

where n_0 is number of smallholder farmers required from the eastern province. With the number of smallholder farmers available in the eastern province, N_1 , being 1,700,000 (NISR, 2020), the total number of smallholder farmers available in both provinces, N_2 , being 3,000,000, and the sample size, n , being 422, n_0 was calculated to be 239.

The number of smallholder farmers who were required from the western province was calculated as:

$$n_0 = \frac{1,300,000 \times 422}{3,000,000}$$

where n_0 is number of smallholder farmers required from the eastern province. With the number of smallholder farmers available in the western province, N_1 , being 1,300,000 (NISR, 2020), the total number of smallholder farmers available in both provinces, N_2 , being 3,000,000, and the sample size, n , being 422, n_0 was calculated to be 183.

Data Analysis

Since agricultural credit access was a dichotomous or a binary variable, with the option of "access to agricultural credit" or "no access to agricultural credit",

the binomial logit model was applied. That was premised on the fact that the association between an explanatory variable and a binary dependent variable, the logit model is the recommended method (Hosmer and Limeshow, 2000; Long and Freese, 2006; Greene, 2008). The denotations were 0 when a farmer had no access to agricultural credit and 1 when they had access to agricultural credit. Beck and Demirgüç-Kunt (2008) conceptualize credit access as the requisition and subsequent acquisition and use of loan by a smallholder farmer from a formal institutional source. The credit received is subsequently invested in agribusiness in the previous agricultural season. It is the same criterion by Beck and Demirgüç-Kunt (2008) that was used to determine whether a given smallholder farmer had had access to credit or not.

Following the descriptive analysis of independent and dependent variables, bivariate analysis was done to identify any individual or institutional characteristics with a statistically significant relationship with the dependent variable. The study used the binomial distribution with a logit link function for analysis. Since there was no adjustment at the bivariate level, the findings reported only the crude odds ratios (COR), at a 95% confidence interval, with significance set at an alpha level of 5% (0.05). The multivariate analysis included all the variables that were statistically significant at bivariate analysis with adjustment for confounders. The adjusted odds ratios (AOR) at a 95% confidence interval, with significance set at an alpha level of 5% was used to report the findings. The binomial distribution model with a logit link function used in this study is specified below. If there are k independent observations ranging from y_1, \dots, y_k , with the i -th observation treated as an obtainment of a random variable Y_i , then the assumption is that Y_i has a binomial distribution given that:

$$Y_i \sim B(n_j, \pi_i) \quad (4);$$

where n_j is the binomial indicator and π_i is the probability, and $n_j = 1$ for all i . This defines the stochastic structure of the model. The logit of probability π_i is considered to be a linear function of the predictors given by:

$$\text{Logit}(\pi_i) = X^i \beta \quad (5);$$

where X_i is a vector of the covariates and hence a definition of the model systematic structure. Thus, with all factor's constant, β , represents the change in the logit of the probability associated with a unit change in the j -th predictor. Exponentiation of equation 2 provides the odds for the i^{th} unit given by:

$$\frac{\pi_i}{1 - \pi_i} = \exp(X^i \beta) \quad (6).$$

The vector of predictors X included the following variables as shown in Table 1.

Table 1: Vectors and their variables in the model

Vector	Variable
	Individual characteristics
X_1	Age (years)
X_2	Sex (1 = male, 0 = female)
X_3	Received formal education (1 = no, 0 = yes)
X_4	Level of education (1 = primary (lower), 2 = primary (upper), 3 = secondary (O- level), 4 = secondary (A- level), 5 = post-secondary education, 6 = university education)
X_5	Years of farming experience (1 = one year, 2 = two years, 3 = three years, 4 = four years, 5 = five years, 6 = above five years)
X_6	Land ownership (1 = yes, 0 = no)
X_7	Land tenurial system (1 = lease hold, 2 = rental, 3 = crop sharing)
X_8	Engaged in off-farm business (1 = yes, 0 = no)
X_9	Size of land owned during in last 12 months (1 = 0-0.1, 2 = 0.1-0.19, 3 = 0.2-0.49, 4 = 0.5-0.99, 5 = 1.0-1.99, and 6 = 2-5 ha)
X_{10}	Type of crops periodically cultivated (1 = cash crops, 2 = food crops, 3 = both)
X_{11}	Where farmer saves money (1 = in a SACCO, 2 = in a commercial bank, 3 = in a village savings scheme, 4 = in the house, 5 = both a SACCO village savings scheme, 6 = COOPEC, 7 = BK, BPR, SACCO)
X_{12}	Member of any farmers' organization/cooperative (1 = yes, 0 = no)
X_{13}	Savings account in any financial institution (1 = yes, 0 = no)
X_{14}	Aware of how to obtain agricultural credit (1 = yes, 0 = no)
	Institutional characteristics
X_{15}	Presence of financial institutions (1 = yes, 0 = no)
X_{16}	Category of institutions (1 = formal only, 2 = semi-formal, 3 = informal only, 4 = both formal and informal)
X_{17}	Government owned finance institutions in the area (1 = yes, 0 = no)
X_{18}	Number of government owned ones (1 = one, 2 = two, 3 = three)
X_{19}	Privately owned finance institutions in the area (1 = yes, 0 = no)
X_{20}	Number of privately owned ones (1 = one, 2 = two, 3 = three, 4 = four, 5 = five)
X_{21}	All financial institutions offer agricultural credit (0 = no, 1 = yes)
X_{22}	Type of loans offered (1 = long term loans only, 2 = short-term loans only, 3 = both long term and short-term loans, 4 = short term loans and over draft)
X_{23}	Financial institutions require collateral (0 = no, 1 = yes)
X_{24}	Form of collateral required (1 = land titles, 2 = agricultural machinery, 3 = houses, 4 = land titles and agricultural machinery, 5 = car log books, 6 = both land titles and agricultural machinery, 7 = both agricultural machinery and houses, 8 = agricultural machinery, houses and land titles)
X_{25}	Interest rate charged (1 = 1-5%, 2 = 6-10%, 3 = 11-15%, 4 = 16-20%, 5 = more than 20%, 6 = not sure)
X_{26}	Credit/loan payment periods usually (1 = less than 1 year, 2 = 1 year, 3 = two years, 4 = three years, 5 = more than three years, 6 = I do not know)
X_{27}	Distance to nearest financing institution (1 = less than 30 minutes, 2 = 30 minutes to 1 hour, 3 = more than 1 hour)
X_{28}	Process for obtaining an agricultural credit is too long (1 = agree, 2 = disagree, 3 = don't know)
X_{29}	Repayment terms (1 = in full only, 2 = installment only, 3 = don't know, 4 = both 1 and 4).
X_1 to X_{29} - vector of predictors (vectors), SACCO - Savings and Credit Cooperative Organization, COOPEC - The Umurenge SACCOs Project, BK - Bank of Kigali, BPR - Banque Populaire du Rwanda	

RESULTS

Smallholder Farmers' Socio-Demographic Characteristics

In Table 2, majority of the sampled farmers were male (58.8%). On average, the respondents' age ranged between 18 and 64 years, with almost a third (31%) of the respondents being youth aged between 29 and 39 years. Most respondents reported that they had received some form of formal education (i.e., 84.1%) had been smallholder farmers for more than five years (89.1%). Nearly three quarters of the respondents owned the piece of land they cultivated on at the time (73.9%), with more than a quarter (28.1%) owning between 0.2 and 0.49 ha. Slightly more than two thirds of those who didn't own the pieces of land cultivated were renting them (67.3%). About four-fifths of the respondents were not engaged in off-farm business (80.6%). Close to two-thirds of the respondents were cultivating both maize and rice (65.9%). The majorities were saving their money in a SACCO (62.1%), were members of farmers' organizations/cooperative (76.1%), had a savings account in a financial institution (80.8%), and were aware of the process of obtaining agricultural credit in Rwanda (55.6%).

Access to Agricultural Credit

Findings in Table 3 showed that more than two thirds of the farmers interviewed had requested for agricultural credit in the last agricultural season, but only 43.7% received the money they had applied for.

Thus, only about 15% of the smallholder farmers had accessed agricultural credit in the previous agricultural season. The cross tabulations further revealed that of the maize smallholder farmers, 10% had accessed agricultural credit, compared to almost 21.5% of the rice farmers. As such, rice farmers accessed credit more as compared to maize farmers.

Determinants of Access to Agricultural Credit

Bivariate analysis

The inferential findings of the study show that three individual characteristics had statistically significant relationships with access to agricultural financial. They include; size of land owned during in the last 12 months for which ownership of between 0.0-0.1 ha was associated with the least odds of accessing credit (COR = 0.083; 0.009-0.759; $P = 0.028$). The findings show that smallholder farmers who saved their money in village savings scheme were 4 times as likely to have access to agricultural credit (COR = 4.483; 1.822-11.032; $P = 0.001$).

Table 2: Descriptive analysis of the farmers' demographic characteristics

Categories	Freq. (<i>n</i> = 422)	(%)
Sex		
Female	174	41.2
Male	248	58.8
Age		
18-28 years	41	9.7
29-39 years	131	31.0
40-50 years	125	29.6
More than 50 years	125	29.6
Received any form of formal education		
No	67	15.9
Yes	355	84.1
Level of education		
Primary (lower)	105	29.6
Primary (upper)	201	56.6
Secondary (O-level)	24	6.8
Secondary (A-level)	19	5.4
Post-secondary education	2	0.6
University education	4	1.1
Years of farming experience		
One year	7	1.7
Two years	2	0.5
Three years	10	2.4
Four years	4	0.9
Five years	23	5.5
Above five years	376	89.1
Own the piece of land cultivated on		
No	110	26.1
Yes	312	73.9
Agreement under which land is being used, if not owned		
Lease hold	20	18.2
Rental	74	67.3
Other	15	13.6
Crop sharing	1	0.9
Engaged in off-farm business		
No	340	80.6
Yes	82	19.4
Size of land owned during in last 12 months		
0-0.1 ha	50	12.8
0.1-0.19 ha	73	18.6
0.2-0.49 ha	110	28.1
0.5-0.99 ha	109	27.8
1-1.99 ha	44	11.2
2-5 ha	6	1.5
Kind of crops periodically cultivated		
Cash crops	17	4.0
Food crops	127	30.1
Both	278	65.9
Where the farmer saves money		
In a SACCO	262	62.1
In a commercial bank	36	8.5
In a village savings scheme	42	10.0
In the house	51	12.1
Both a SACCO village savings scheme	22	5.2
COOPEC	7	1.7
BK, BPR, SACCO	2	5.0
Member of any farmers' organization/cooperative		
No	101	23.9
Yes	321	76.1
Have a savings account in any financial institution		
No	81	19.2
Yes	341	80.8
Aware of process of obtaining agricultural credit in Rwanda		
No	187	44.4
Yes	234	55.6

Acronyms same as defined in Table 1

Institutional Characteristics and Access to Credit

Smallholder farmers who reported that they had no privately-owned financial institutions in their areas were the least likely to have accessed agricultural credit (COR = 0.259; CI = 0.145-0.463; $P = 0.000$) compared to those who had private financial institutions in their areas. Smallholder farmers who reported that the type of loans offered by financial institution was both short-term loans were least likely to have access to agricultural credit (COR = 0.291; CI = 0.113-0.748; $P = 0.010$) compared to those who reported that interest rate charged the loans were long term loans and overdrafts. Smallholder farmers who reported that the interest rate charged by financial institutions was between 11 and 15% were least likely to have accessed agricultural credit (COR = 0.172; CI = 0.038-0.775; $P = 0.022$). Smallholder farmers who reported that the process for obtaining agricultural credit was not too long were twice likely to have accessed agricultural credit (COR = 2.434; CI = 1.114-5.318; $P = 0.026$). Smallholder farmers who reported that they did not know the repayment terms of agricultural loans were least likely to have accessed agricultural credit (COR = 0.118; CI = 0.015-0.911; $P = 0.040$).

Table 6 presents the multivariate findings of the determinants of access to agricultural credit among smallholder farmers. All seven variables tested were shown to be significant influencers in the bivariate analysis, and remained significant after adjustment for confounders. Farmers who saved money in commercial banks were twice as likely to access agricultural finance (AOR = 2.389; CI = 1.745-7.976; $P = 0.022$) compared to those who saved their money in other types of financial institutions including savings and credit cooperatives (SACCOs) and rotating savings and credit associations (ROSCAs). Smallholder farmers who owned land that was between 0 and 0.1 ha in size had 87% less chances of accessing agricultural credit (AOR = 0.127, [CI = 0.022 - 0.748], $P = 0.023$) compared to those who had larger land sizes. Smallholder farmer who reported that they had no privately owned finance institutions in their areas had 71% less chances of accessing agricultural credit (AOR = 0.287; CI = 0.165-0.499; $P = 0.000$) compared to those who had private financial institutions.

Table 3: Assessment of access to agricultural credit

Variable	Categories	Frequency (<i>n</i> = 422)	(%)
Requested for agricultural credit in the last agricultural season	No	291	69.0
	Yes	131	31.0
Received the money applied for	No	69	52.7
	Yes	62*	47.3
Disaggregation of access to agricultural credit by principal crop grown	Maize	25 (10.0%)	225 (90.0%)
	Rice	37 (21.5%)	135 (78.5%)
	Total	62 (14.7%)	360 (85.3%)
			250 (100.0%)
			172 (100.0%)
			422 (100.0%)

* - number of smallholder farmers who accessed agricultural credit in the previous season

Table 4: Unadjusted relationships between individual characteristics and access to agricultural credit

Variable	Access to agricultural credit		COR (CI at 95%)	P value
	Accessed credit (n = 62) %	Had no access to credit (n = 358) %		
Respondent's gender				
Female	13.8	86.2	0.884 (0.509-1.536)	0.662
Male	15.3	84.7	1.000	
Current age				
18-28 years	7.3	92.7	0.316 (0.090-1.107)	0.072
29-39 years	14.5	85.5	0.679 (0.353-1.306)	0.246
40-50 years	14.5	85.5	0.545 (0.272-1.093)	0.087
More than 50 years	20.0	80.0	1.000	
Receive any form of formal education				
No	11.9	88.1	0.756 (0.342-1.671)	0.489
Yes	15.2	84.8	1.000	
Level of education attained				
Primary (lower)	12.4	87.6	0.693 (0.262-1.835)	0.460
Primary (upper)	16.9	83.1	1.029 (0.242-4.371)	0.059
Secondary (O-level)	12.5	87.5	1.468 (0.343-6.293)	0.969
Secondary (A-level)	10.5	89.5	0.791 (0.221-2.828)	0.605
Post-secondary education	0.0	100.0	6.851 (0.791-13.748)	0.718
University education	0.0	100.0	1.000	
Duration as smallholder farmer				
One year	14.3	85.7	0.914 (0.108-7.731)	0.934
Two years	50.0	50.0	5.483 (0.338-88.900)	0.231
Three years	0.0	100.0	8.683 (0.621-14.343)	0.999
Four years	25.0	75.0	1.828 (0.187-17.875)	0.604
Five years	4.3	95.7	0.249 (0.033-1.885)	0.178
Above five years	15.4	84.6		
Own the piece of land cultivated on				
No	13.6	86.4	0.890 (0.476-1.666)	0.716
Yes	15.1	84.9	1.000	
Agreement under which land is being used, if not owned				
Lease hold	15.0	85.0	0.597 (0.242-1.474)	0.263
Rental	9.5	90.5	1.029 (0.242-4.371)	0.969
Other	33.3	66.7	3.664 (0.255-52.661)	0.340
Crop sharing	0.0	100.0	1.000	
Engaged in off-farm business				
No	13.8	86.2	0.716 (0.378-1.357)	0.306
Yes	18.3	81.7	1.000	
Size of land owned during in last 12 months				
0-0.1 ha	4.0	96.0	0.083 (0.009-0.759)	0.028*
0.1-0.19 ha	13.7	86.3	0.317 (0.051-1.967)	0.218
0.2-0.49 ha	16.4	83.6	0.391 (0.067-2.299)	0.299
0.5-0.99 ha	20.2	79.8	0.506 (0.087-2.942)	0.448
1-1.99 ha	11.4	88.6	0.256 (0.037-1.777)	0.168
2-5 ha	33.3	66.7	1.000	
Kind of crops periodically cultivated				
Cash crops	17.6	82.4	1.141 (0.394-3.303)	0.808
Food crops	12.6	87.4	0.815 (0.477-1.390)	0.452
Both	15.5	84.5	1.000	
Where the farmer saves money				
In a SACCO	13.4	86.6	2.207 (0.530-9.196)	0.277
In a commercial bank	27.8	72.2	4.111 (2.441-10.109)	0.030*
In a village savings scheme	11.9	88.1	4.483 (1.822-11.032)	0.001*
In the house	5.9	94.1	1.051 (0.283-3.909)	0.653
Both a SACCO village savings scheme	40.9	59.1	1.410 (0.315-6.310)	0.407
COOPEC	0.0	100.0	1.239 (0.747-2.056)	0.823
BK, BPR, SACCO	0.0	100.0	1.000	
Member of any farmers' organization/cooperative				
No	16.8	83.2	1.201 (0.720-2.002)	0.483
Yes	14.0	86.0	1.000	
Have a savings account in any financial institution where to deposit or withdraw money at convenience				
No	11.1	88.9	0.715 (0.368-1.388)	0.322
Yes	15.6	84.4	1.000	
Aware of what it takes or the process that one has to go through in order to obtain an agricultural credit in Rwanda				
No	11.2	88.8	0.641 (0.393-1.046)	0.075
Yes	17.5	82.5	1.000	

Acronyms as defined in Table 1. COR - Crude Odds Ratio, CI – confidence interval, *significant P values at 5% (< 0.050)

Smallholder farmers who reported that the type of loans offered by financial institution were both long and short-term loans had 89% less odds of accessing agricultural credit (AOR = 0.290; CI = 0.112-0.750; *P* = 0.011) compared with those with access to short term loans and overdrafts. Those who reported that the interest rate charged by their institutions was 11-15% had 82% less chances of accessing agricultural credit (AOR = 0.178; CI = 0.039-0.807; *P* = 0.025). Smallholder farmers who reported that the process

for obtaining agricultural credit was not too long were twice as likely to have accessed agricultural credit (AOR = 2.026; CI = 1.073-3.824; *P* = 0.029) compared to those who reported otherwise. Smallholder farmers who reported that they did not know the repayment terms of agricultural loans had 80% less odds of having access to agricultural credit (AOR = 0.203; CI = 0.045-0.922; *P* = 0.039) compared with those who knew that it was both full and installment (partial payment).

Table 5: Unadjusted relationships between institutional characteristics and access to agricultural credit

Variable	Access to agricultural credit		COR (CI at 95%)	P value
	Accessed credit (n = 64) %	Had no access to credit (n = 358) %		
Have financial institutions which provide agricultural credit in the area				
No	12.5	87.5	0.818 (0.277-2.418)	0.716
Yes	14.9	85.1	1.000	
Category of institutions				
Formal only	13.3	86.7	0.760 (0.522-1.107)	0.152
Semi-formal	0.0	100.0	1.004 (0.811-1.244)	0.968
Informal only	0.0	100.0	1.103 (0.826-1.473)	0.505
Both formal and informal	25.6	74.4	1.000	
Have government owned financial institutions in the area				
No	13.6	86.4	0.864 (0.498-1.501)	0.605
Yes	15.4	84.6	1.000	
Number of government owned				
One	15.1	84.9	0.950 (0.258-3.491)	0.938
Two	10.9	89.1	0.653 (0.146-2.916)	0.577
Three	15.8	84.2	1.000	
Have privately owned financial institutions in the area				
No	7.7	92.3	0.259 (0.145-0.463)	0.000*
Yes	24.4	75.6	1.000	
All financial institutions in the area offer agricultural credit to farmers who need it				
No	12.8	87.2	0.795 (0.436-1.448)	0.453
Yes	15.6	84.4	1.000	
Type of loans offered				
Long term loans only	31.3	68.8	0.687 (0.260-1.820)	0.451
Short-term loans only	19.6	80.4	0.432 (0.214-0.872)	0.019*
Both long term and short-term loans	13.2	86.8	0.291 (0.113-0.748)	0.010*
Short term loans and over drafts	45.5	54.5	1.000	
Financial institutions require collateral				
No	7 (14.9%)	85.1	1.018 (0.434-2.388)	0.967
Yes	55 (14.7%)	85.3	1.000	
Form of collateral required				
Land titles	12.0	88.0	2.698 (0.403-18.046)	0.907
Agricultural machinery	0.0	100.0	1.122 (0.163-7.713)	0.235
Houses	16.7	83.3	1.499 (0.687-3.271)	0.309
Land titles and agricultural machinery,		100.0	1.812 (0.679-4.833)	0.235
Both land titles and agric. machinery	36.4	63.6	1.901 (0.256-14.102)	0.530
Both agric. machinery and houses	62.5	37.5	1.174 (0.601-2.293)	0.639
Agric. machinery, houses and land titles	100.0	0.0	1.000	
Interest rate charged				
1-5%				
6-10%	27.2	72.8	1.974 (0.960-4.058)	0.065
11-15%	10.1	89.9	0.570 (0.271-1.201)	0.140
16-20%	3.3	96.7	0.172 (0.038-0.775)	0.022*
More than 20%	7.1	92.9	0.389 (0.048-3.191)	0.380
Not sure	40.0	60.0	3.375 (0.854-13.336)	0.083
	16.5	83.5	1.000	
Process for obtaining an agricultural credit is too long				
Agree	10.5	89.5	0.752 (0.362-1.562)	0.444
Disagree	27.5	72.5	2.434 (1.114-5.318)	0.026*
Don't know	13.5	86.5	1.000	
Repayment terms				
In full only	18.2	81.8	0.222 (0.029-1.684)	0.146
Installment only	14.5	85.5	0.170 (0.023-1.263)	0.083
Don't know	10.6	89.4	0.118 (0.015-0.911)	0.040*
Both 1 and 4	50.0	50.0	1.000	

. COR - Crude Odds Ratio, CI – confidence interval, *significant P values at 5% (< 0.050)

DISCUSSION

The findings of this study showed that both individual and institutional characteristics in Rwanda determined smallholder farmer access to agricultural credit. This finding is in line with the minimalist theory which supposes that access to agricultural credit on the part of a farmer is influenced by the possession of some particular characteristics (Ledgerwood, 1999). The finding that individual characteristics of smallholder farmers influenced access to agricultural credit is consistent with existing studies (Sebatta *et al.*, 2014; Amurthy *et al.*, 2018; Chandio *et al.*, 2018; Saqib *et al.*, 2018; Temesgen *et al.*, 2018; Linh *et al.*, 2019). Additionally, our finding that owning savings account in a commercial bank increases farmer access to credit

(i.e., farmers with an account are twice as likely to access credit) is consistent with the findings of Karlan *et al.* (2014) and Sebatta *et al.* (2014). A savings account in a commercial bank increased the likelihood of acquiring credit since it minimized information asymmetry between the farmer and bank. Possessing a bank account in a commercial bank was also of great benefit since the bank management can easily monitor the account activities and transactions. A bank account creates a sense of reassurance on the part of the bank management on the potential of loan repayment by the account holder. On the part of the smallholder farmer, having a savings account in a commercial bank increased their chances of knowing the requirements/processes

Table 6: Determinants of access to agricultural credit among smallholder farmers in the eastern and western provinces of Rwanda

Variable	COR (CI at 95%)	P value	AOR (CI at 95%)	P value
Where farmer saves money (individual)				
In a SACCO	2.207 (0.530-9.196)	0.277	1.508 (1.048-5.855)	0.027*
In a commercial bank	4.111 (2.441-10.109)	0.030	2.389 (1.745-7.976)	0.022*
In a village savings scheme	4.483 (1.822-11.032)	0.001	2.258 (1.573-6.953)	0.032*
In the house	1.051 (0.283-3.909)	0.653	1.314 (0.646-2.673)	0.059
Both a SACCO village savings scheme	1.410 (0.315-6.310)	0.407	0.796 (0.591-1.071)	0.121
COOPEC, BK, BPR, SACCO	1.000		1.000	
Size of land (individual)				
0.99 ha	0.083 (0.009-0.759)	0.028	0.127 (0.022-0.748)	0.023*
0.1-0.19 ha	0.317 (0.051-1.967)	0.218	0.463 (0.127-1.687)	0.243
0.2-0.49 ha	0.391 (0.067-2.299)	0.299	0.545 (0.160-1.856)	0.332
0.5-0.99 ha	0.506 (0.087-2.942)	0.448	0.653 (0.195-2.191)	0.490
1-1.99 ha	0.256 (0.037-1.777)	0.168	0.357 (0.087-1.461)	0.152
2-5 ha	1.000		1.000	
Have privately owned agricultural credit institutions in area (institutional)				
No	0.259 (0.145-0.463)	0.000*	0.287 (0.165-0.499)	0.000*
Yes			1.000	
Type of loans offered (institutional)				
Long term loans only	0.687 (0.260-1.820)	0.451	0.686 (0.255-1.848)	0.456
Short-term loans only	0.432 (0.214-0.872)	0.019*	0.431 (0.210-0.885)	0.022*
Both long term loan and short-term loans	0.291 (0.113-0.748)	0.010*	0.290 (0.112-0.750)	0.011*
Short-term loans and overdrafts only	1.000		1.000	
Interest rate charged (institutional)				
1-5%	1.974 (0.960-4.058)	0.065	1.693 (0.799-3.587)	0.169
6-10%	0.570 (0.271-1.201)	0.140	0.531 (0.249-1.133)	0.101
11-15%	0.172 (0.038-0.775)	0.022*	0.178 (0.039-0.807)	0.025*
16-20%	0.389 (0.048-3.191)	0.380	0.401 (0.049-3.307)	0.396
More than 20%	3.375 (0.854-13.336)	0.083	4.812 (0.630-36.738)	0.130
Not sure	1.000		1.000	
Long process for obtaining agricultural credit (institutional)				
Agree	0.752 (0.362-1.562)	0.444	0.770 (0.406-1.461)	0.425
Disagree	2.434 (1.114-5.318)	0.026*	2.026 (1.073-3.824)	0.029*
Don't know	1.000		1.000	
Repayment terms (institutional)				
In full only	0.222 (0.029-1.684)	0.146	0.884 (0.238-3.279)	0.854
Installment only	0.170 (0.023-1.263)	0.083	0.831 (0.283-2.438)	0.735
Don't know	0.118 (0.015-0.911)	0.040*	0.203 (0.045-0.922)	0.039*
Both full and installment	1.000		1.000	

Acronyms as in Table 1. COR - Crude Odds Ratio, CI - confidence interval, AOR - Adjusted Odds Ratio, *significant P values at 5% (< 0.050)

of accessing an agricultural loan from the bank, as there is a reduction of asymmetric information (Mitra *et al.*, 2018). This also explains the findings that smallholder farmers who reported that they did not know the repayment terms of agricultural loans were less likely to have accessed agricultural credit (AOR = 0.203; CI = 0.045 -0.922; P = 0.039).

Consistent with findings by Kosgey (2013), Nguyen and Le (2015), and Isaga (2018), the results of this study showed a relationship between land size owned and access to agricultural credit. The study found an inverse relationship between land size and access to credit. Smallholder farmers who owned land that was 0.1 ha were less likely to have access to agricultural credit. This finding is related to some of the core pre-requisites of accessing loans from some financial institutions, notably collateral. Land remains one of the most common forms of collateral asked for (Amurthiya *et al.*, 2018), to the extent that if not available or inadequate, the chances of getting credit remain slim especially eastern and western provinces of Rwanda where farmers owned small pieces (0.1 ha ≈ 0.24 acres). Such scenarios do not make for substantive collateral that can be deemed worthy by a commercial bank, as they can be indicative of a possible fact that a smallholder

farmer with a land size in that range will have meager productivity, and hence less income to service the agricultural credit provided to them which consequently decreases the chances of accessing credit from a financial institution.

Consistent with findings by Ugwumba and Omojola (2013), Duniya and Adinah (2015), Amurthiya *et al.* (2018), and Chandio and Jiang (2018), the findings also showed a relationship between interest rate charged and access to credit. Smallholder farmers who reported that the interest rate charged by financial institutions was between 11-15% were least likely to apply for agricultural credit which agreed with the findings of the previous studies. This finding implies that interest rates beyond 10% are simply a barrier to access to credit. The effect of the interest rate on final access to credit among rice and maize smallholder farmers has to do with the amount of money that a farmer has to pay on the principal fee to clear the loan. The interest paid by the smallholder farmer may be as high as a quarter of the entire profit margin earned by the farmer per season. Thus, the incomes of the majority of the smallholder farmers in the eastern and western provinces, even with access to credit is influenced by the small land sizes. With that being the case,

especially in the eastern and western provinces where the majority of the smallholder farmers cultivate less than a hectare, the interest rate can create hesitance in receiving the agricultural credit sum even when all credit lending conditions are fulfilled. Such an interest rate can be a hurdle to smallholder farmers, more so the farmers in the context of Rwanda, who own less than 1 ha (less than 2 acres).

Smallholder farmers who reported that the process of obtaining agricultural credit was not too long were twice as likely to have accessed agricultural credit (AOR = 2.026; CI = 1.073-3.824; $P = 0.029$). This finding is consistent with that of Samson and Obademi (2018), and it is related to the level of fatigue associated with getting loans and the demographic characteristics of smallholder farmers, particularly education. To some farmers who found the process of getting a loan being short, there happens to be less fatigue in the process, since travel frequency to the finance institution decreases, and becomes more bearable. However, smallholder farmers especially those with modest education backgrounds have recounted such issues as the overwhelming level of bureaucracy and documentation necessary for accessing credit, thus decreasing their access to credit.

Smallholder farmers who reported that the type of loans offered by the financial institutions were both long and short-term were significantly less likely to have access to agricultural credit. Thus, having both long and short-term loans had a positive effect on access to credit. However, when it comes to smallholder farming, more so rice and maize farming, whereby harvesting happens within four months, short term loans are usually preferred, although in most cases, financial institutions root for long term loans, as they earn more interest from them in the long run. Therefore, it so happens that having both loan types on offer, without particular considerations tailored to smallholder rice and maize farmers as people who need short term loans can hamper access to credit.

The study findings indicated that smallholder farmers who reported that they had no privately-owned financial institutions in their areas were less likely to have access to agricultural credit compared to those who had private financial institutions. Private financial institutions in Rwanda usually have finance products that are tailored to meet the needs of specific groups of people such as smallholder farmers hence capturing a large market share. Examples of such products and services include direct financing for farmer self-help groups, cooperatives, pre-and post-harvest financing, at a higher propensity than public banks. Besides, most of the banks partner with the central bank and its auxiliary institutions, to receive guaranteed funds to cover the loans. With such arrangements, the chance of smallholder farmers accessing loans from private institutions thus increases.

CONCLUSION

The study concludes that individual and institutional characteristics both influence access to agricultural credit among maize and rice smallholder farmers in the Eastern and Western Provinces of Rwanda, but that institutional factors have slightly more predictive power on credit access. The individual determinants of agricultural credit access in the study area include; saving money in commercial banks, the size of land owned, and knowledge of the repayment terms of agricultural loans. At the institutional level, four characteristics determine access to credit among maize and rice farmers. They include; having privately-owned financial institutions in the area, offering of long-term and short-term loans, the interest rate, and length of the process for obtaining credit.

In light of these findings there is a need for the Government of Rwanda and stakeholders in the banking industry to come up with interventions that would help increase access to credit among smallholder farmers. Such interventions should aim at increasing access to account services among the smallholder farmers, encourage saving and augment financial literacy among the smallholder farmers. Other measures such as the establishment of an independent agricultural fund, revolving or non-revolving by the Government or its stakeholders which can be accessed by smallholder farmers, without need for collateral would be beneficial. Encouraging the farmers to utilize their farmer cooperatives, or to form farmer self-help groups, and also to look out for institutions that offer direct financing will help farmers' access agricultural credit. Government and private investment in privately-owned financial institutions in areas populated by smallholder farmers would also help improve access to agricultural credit. Agricultural legislation in Rwanda should also streamline measures on interest rates paid by the smallholder farmers which would help improve access to credit. Lastly, Government should put in place measures that call for the provision of both long- and short-term loans by all financial institutions, with emphasis on the possibility of prioritizing smallholder farmer who needs them.

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DECLARATION OF INTERESTS

The authors declare no competing interest in this study.

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