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; Chandro et al., 2018; Araya and Sung-Kyu, 2019; Chandro 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 Rutshuru, 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, Nyamasheke 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:
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:

\[
\frac{3,000,000(1.96)^2(0.5 \times 0.5)}{(3,000,000-1)(0.05)^2 + (1.96)^2(0.5 \times 0.5)}
\]

\( n = 384 \) 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:

\[
n_0 = \frac{N_1 \times n}{N_2}
\]

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 \( y_1, \ldots, y_k \), with the \( i \)-th observation treated as an attainment of a random variable \( Y_i \), then the assumption is that \( Y_i \) has a binomial distribution given that:

\[
Y_i \sim B(n_i, \pi_i)
\]

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

\[
\text{Logit}(\pi_i) = X_i^T \beta
\]

where \( \pi_i \) is a vector of the covariates and hence a definition of the model systematic structure. Thus, with all factor’s constant, \( \beta \) 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 \( j \)-th unit given by:

\[
\frac{1 - \pi_i}{\pi_i} = \exp(X_i^T \beta)
\]

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 |
|--------|----------|
| $X_1$  | 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 = COOPEC, 6 = BK, BPR) |
| $X_{12}$ | 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) |
| $X_{15}$ | 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 and 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) |

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. (n = 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 (24.6)          |
| Primary (upper)                   | 201 (47.6)          |
| Secondary (O-level)               | 24 (5.7)            |
| Secondary (A-level)               | 19 (4.5)            |
| Post-secondary education          | 2 (0.5)             |
| University education              | 4 (0.9)             |
| 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 (4.7)            |
| Rental                            | 74 (17.6)           |
| Other                             | 15 (3.6)            |
| Crop sharing                      | 1 (0.2)             |
| Engaged in off-farm business      |                     |
| No                                | 340 (80.6)          |
| Yes                               | 82 (19.4)           |
| Size of land owned during in 12 months |              |
| 0-0.1 ha                          | 50 (12.8)           |
| 0.1-0.19 ha                       | 73 (17.8)           |
| 0.2-0.49 ha                       | 110 (26.1)          |
| 0.5-0.99 ha                       | 109 (25.8)          |
| 1-1.99 ha                         | 44 (10.4)           |
| 2-5 ha                            | 6 (1.4)             |
| Kind of crops periodically cultivated |                  |
| Cash crops                        | 17 (4.0)            |
| Food crops                        | 127 (30.0)          |
| 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 (0.5)             |
| 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 (n = 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       | Maize                       | 25 (10.0%)             |
|                                                      | Rice                        | 37 (21.5%)             |
| Principal crop grown                                 | Total                       | 62 (14.7%)             |

* - 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 |
|--------------------------------------------------------------------------|-------------------------------|-----------------|---------|
| Respondent’s gender                                                     |                               |                 |         |
| Female                                                                   | 13.8                          | 86.2            | 0.884   |
| Male                                                                     | 15.3                          | 84.7            | 1.00    | 0.662   |
| Current age                                                             |                               |                 |         |
| 18-28 years                                                             | 7.3                           | 92.7            | 0.316   |
| 29-39 years                                                             | 14.5                          | 85.5            | 0.679   |
| 40-50 years                                                             | 14.5                          | 85.5            | 0.545   |
| More than 50 years                                                      | 20.0                          | 80.0            | 0.718   |
| Receive any form of formal education                                    |                               |                 |         |
| No                                                                      | 11.9                          | 88.1            | 0.756   |
| Yes                                                                     | 15.2                          | 84.8            | 1.00    | 0.489   |
| Level of education attained                                             |                               |                 |         |
| Primary (lower)                                                         | 12.4                          | 87.6            | 0.693   |
| Primary (upper)                                                         | 16.9                          | 83.1            | 1.029   |
| Secondary (O-level)                                                     | 12.5                          | 87.5            | 1.468   |
| Secondary (A-level)                                                     | 10.5                          | 89.5            | 0.791   |
| Post-secondary education                                                | 0.0                           | 100.0           | 6.851   |
| University education                                                    | 0.0                           | 100.0           | 1.00    |
| Duration as smallholder farmer                                          |                               |                 |         |
| One year                                                                | 14.3                          | 85.7            | 0.914   |
| Two years                                                               | 50.0                          | 50.0            | 5.483   |
| Three years                                                             | 0.0                           | 100.0           | 8.683   |
| Four years                                                              | 25.0                          | 75.0            | 1.828   |
| Five years                                                              | 4.3                           | 95.7            | 0.249   |
| Above five years                                                        | 15.4                          | 84.6            | 0.178   |
| Own the piece of land cultivated on                                     |                               |                 |         |
| No                                                                      | 13.6                          | 86.4            | 0.890   |
| Yes                                                                     | 15.1                          | 84.9            | 1.00    |
| Agreement under which land is being used, if not owned                  |                               |                 |         |
| Lease hold                                                              | 15.0                          | 85.0            | 0.597   |
| Rental                                                                  | 9.5                           | 90.5            | 1.029   |
| Other                                                                   | 33.3                          | 66.7            | 3.664   |
| Crop sharing                                                            | 0.0                           | 100.0           | 1.00    |
| Engaged in off-farm business                                            |                               |                 |         |
| No                                                                      | 13.8                          | 86.2            | 0.716   |
| Yes                                                                     | 18.3                          | 81.7            | 1.00    |
| Size of land owned during last 12 months                                 |                               |                 |         |
| 0-0.1 ha                                                                | 4.0                           | 96.0            | 0.083   |
| 0.1-0.19 ha                                                             | 13.7                          | 86.3            | 0.317   |
| 0.2-0.49 ha                                                             | 16.4                          | 83.6            | 0.391   |
| 0.5-0.99 ha                                                             | 20.2                          | 79.8            | 0.506   |
| 1-1.99 ha                                                               | 11.4                          | 88.6            | 0.256   |
| 2.5 ha                                                                  | 33.3                          | 66.7            | 1.00    |
| Kind of crops periodically cultivated                                    |                               |                 |         |
| Cash crops                                                              | 17.6                          | 82.4            | 1.141   |
| Food crops                                                              | 12.6                          | 87.4            | 0.815   |
| Both                                                                    | 15.5                          | 84.5            | 1.00    |
| Where the farmer saves money                                            |                               |                 |         |
| In a Sacco                                                              | 13.4                          | 86.6            | 2.207   |
| In a commercial bank                                                    | 27.8                          | 72.2            | 4.111   |
| In a village savings scheme                                            | 11.9                          | 88.1            | 4.483   |
| In the house                                                            | 5.9                           | 94.1            | 1.051   |
| Both a Sacco village savings scheme                                     | 40.9                          | 59.1            | 1.410   |
| COOPEC                                                                  | 100.0                         | 0.0             | 1.239   |
| BK, BPR, Sacco                                                          | 0.0                           | 100.0           | 1.00    |
| Member of any farmers’ organization/Cooperative                         |                               |                 |         |
| No                                                                      | 16.8                          | 83.2            | 1.201   |
| Yes                                                                     | 14.0                          | 86.0            | 1.00    | 0.483   |
| Have a savings account in any financial institution where to deposit or withdraw money at convenience |     |                 |         |
| No                                                                      | 11.1                          | 88.9            | 0.715   |
| Yes                                                                     | 15.6                          | 84.4            | 1.00    | 0.322   |
| 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   |
| Yes                                                                     | 17.5                          | 82.5            | 1.00    | 0.075   |

*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 = 0.023; 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 | Had no access to 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 | | | | |
| No       | 12.5                          | 87.5                    | 0.818 (0.277-2.418) | 0.716 |
| Yes      | 14.9                          | 85.1                    | 1.00            |        |
| 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                    | 1.00            |        |
| 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                    | 1.00            |        |
| 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                    | 1.00            |        |
| 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                    | 1.00            |        |
| 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                    | 1.00            |        |
| 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                    | 1.00            |        |
| Financial institutions require collateral | | | | |
| No       | 7 (14.9%)                     | 85.1                    | 1.018 (0.434-2.388) | 0.967 |
| Yes      | 55 (14.7%)                    | 85.3                    | 1.00            |        |
| Form of collateral required | | | | |
| Land titles | 12.0                        | 88.0                    | 2.698 (0.403-18.046) | 0.907 |
| Agricultural machinery | 10.0                      | 90.0                    | 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                    | 0.0                     | 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                     | 1.00            |        |
| Interest rate charged | | | | |
| 1-5%     | 1.00                          | 100.0                   | 1.00            |        |
| 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 |
| Process for obtaining an agricultural credit is too long | | | | |
| Agree    | 10.5                          | 89.5                    | 0.750 (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                    | 1.00            |        |
| 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                    | 1.00            |        |

. 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; Amurtiya 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.
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 (Amurtiya 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), Amurtiya 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 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 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.

### 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 |
| 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 |
| 2-3 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 (0.271-1.210) | 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 (1.144-5.318) | 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)
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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