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Experimental Validation of Factors Related to Agricultural Credit Based on Metrics from the Perspective of Borrowers

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Abstract: *Credit is an important tool to enable farmers to increase agricultural production and productivity, and contribute to poverty alleviation in order to keep populations growing in developing countries. Although the volume of agricultural credit presents a growing trend in nominal terms in Mozambique in recent years, studies have shown that organizations and academics have not adopted appropriate strategies to estimate a composite indicator to overcome restrictions on credit financing in order to improve the quality of their products and services. Determinants of access to agricultural credit, such as amortization period, interest rate, lack of guarantee, distance from loan sources and the amount granted can be analysed to find out if they are relevant indicators in directing the Loans to borrowers. This analysis can be quantitatively supported by metrics.* ***Objective****: To present an experimental validation of the loan accessibility metrics and repayment capacity in the perspective of borrowers.* ***Methodology****: Data were collected from 20 farmers in order to compose different configurations and methods analytical tests patterns were used to determine the properties of the data applied in the selected metrics of the current literature and adapted by the Goal-Question-Metric (GQM) method. To estimate the data, descriptive statistical analysis and Spearman's non-parametric correlation coefficient (ρ) were used to support the interpretation.* ***Results and conclusions****: the observed values of lending accessibility and repayment capacity were analyzed and showed a weak and statistically significant positive correlation (Corr.1=0.35). Therefore, the experiment carried out provides evidence that such metrics can be used as relevant indicators for lending credit to borrowers in Boane district.*

Keywords*: Loans and repayment, farmers, metrics, Goal Question Metric, indicators.*

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I. Introduction

The new forms of development and cooperation that emerged in the financial system end up restricting access to agricultural credit to low-income populations as results of the globalization process, also impacted throughout the process of micro Loans in cooperation for development and social integration [11]. With this, the number of problems faced with high transaction costs, insufficient collateral issues to support their loans, unstable income, lower literacy, efficiency and high monitoring costs also increased [13].

In the process of accessibility of the loan, the level of schooling, marital status, size of arable land, agricultural income and size of the household of farmers are determining factors in the access to credit [14] and, to make this possible, data describing reality of the process need to be obtained and duly analysed. One of the main critical limitations in credit acquisition is the depreciation period, interest rate, amount granted and the distance from loan sources [8], and due to this existence increases the cost of establishing communication between the different Actors involved, and may make it inadequate. In addition, it restricts the possibility of performing informal communication, which traditionally establishes itself among people and with this allows to share experiences and information in order to obtain financial inclusion (BdeM[1]) [2]. This exchange of experiences is of great importance for borrowers to collaborate and leverage the services and products, thus achieving the established objectives [6].

In this context, metrics have shown to be the key factor in directing credit financing to borrowers facilitating the opportunity to improve agricultural production [12]. Experimental studies conducted at various sites report problems caused by the lack of capacity in repayment [1] and accessibility of the loan [8].

In this article we present from the selection and definition of metrics to analysis of the results obtained, aiming to study the combination of accessibility metrics of the formal and informal lending to borrowers. The idea is to measure them, establish (co) relations with the ability to reimburse farmers, then extract an indicator. The values observed in the experiment performed were applied to the normality tests of Shapiro and Wilk [21], and Kolmogorov-Smirnov (Corder and Foreman [4]). These metrics are related to the socioeconomic

[1] Bank of Mozambique. Annual report. Volume 24. Annual Report No. 26

characteristics of the interviewees [11] [14], aiming to support credit managers in decision-making based on indicators, contributing to the research and practice of improving the state of the art. The results were evaluated based on the data provided by the selected farmers for the experiment and by the respective metric.

The remainder of the work is organized as follows: Section 2 describes the investigation related to our study followed by a description of both the context and the research methods used; Section 3 defines the loan accessibility metrics and the repayment capacity to be evaluated and illustrates how to capture them; Section 4 presents how the experimental study was planned and performed to evaluate the metrics and; Section 5 presents the conclusions, and finally discusses the opportunities for future work and bibliographical references.

Objective of the research

The broad objective of the research document is to establish (co) relationships and demonstrate how repayment capacity affects the accessibility of the loan of farmers in the Boane district by means of metrics, in order to extract an indicator. Specifically, this study has as its primary objective:

1. Identify the constraints involved in the financing of agricultural credit and repayment capacity.
2. Study and investigate the relationships between lending accessibility and capacity in repayment
3. Estimate the composite indicator between lending accessibility and repayment capacity.

Departure question

The study therefore seeks to provide answers to the following questions for formulating the hypotheses:

i. What are the determinants of access to agricultural loans from formal and informal sources among farmers?
ii. How does the reimbursement capacity affect the accessibility of the loan of farmers in Boane district?
iii. What is the distance from the place of the farmers (arable land) in relation to the sources of loan?

II. Theorical Framework

In this section, we describe the background literature related to how to extract credit determinants and assess critical limitations of borrowing from formal and informal sources using metrics, examining factors that inhibit access to mainly by small producers. We also discuss the current research on reimbursement capacity to categorize the challenges of restrictions on agricultural credit financing.

1. Determinants of Access to Agricultural Lending Among Smallholder Farmers

Abiodun, et al. [8], propose an approach to investigating the determinants of access to formal and informal agricultural loans among farmers in the local government area of Obubra, Nigeria. This approach establishes measurements as an integral part of the process and proposes the analysis of the results supported by the binomial test. The objective of the research was to describe the socioeconomic characteristics of the interviewees, analyzed the factors that determine the access of farmers to formal and informal agricultural loans and identified the restrictions of farmers in the acquisition of Loan.

The results of the binomial test show that seven of the nine determinant variables analyzed were significant factors influencing the accessibility of farmers to sources of formal loans (agricultural experience, education, guarantees, size of arable land, agricultural income, household size and participation of the Cooperative Society), while five variables only significantly influenced the accessibility of farmers to sources of informal loans (gender, Marital status, bondsmen, size of arable land, and household size) in the study area. More than that, farmers identified some constraints such as depreciation period, interest rate, lack of guarantee, distance from loan sources and the amount granted as critical restrictions on access to loans [17].

The study recommends that financial institutions should relax their guarantee conditions for obtaining loans. Farmers should be encouraged to join groups of cooperatives to enable them to harmonies their resources together in order to benefit from formal loan sources.

2. Repayment Capacity and Borrowing Rates from Micro-Finance Borrowers

Related searches Adu, Owualah and Babajide [17] with the theme of this work is applied in a case study, aiming to understand the impact of the lending rate on the repayment capacity of borrowers to micro finance banks is; How does the lending rate affect the repayment capacity of borrowers. The objective of the research was to investigate the lending rate and repayment capacity of micro-finance banks to borrowers in the state of Oyo in the Southwest, Nigeria, through the use of descriptive and inferential statistics. One hypothesis was formulated and analyzed through Cox regression. This is done to test the effect of the lending rate on the ability to reimburse customers from micro finance banks and, the successful repayment of the loan is linked to three objectives: loan size, repayment standard and loan fee.

The results of the Cox test show that the fit size of the loan, loan rate and reimbursement standard contributed significantly to the failure of the refund. This shows that a unit increase in the loan size, loan rate and repayment standard significantly increases the risk ratio for reimbursement of benefits. Thus, the fit size of

the loan granted to the customer's micro Finance Bank the loan rate, and the type of repayment schedule for the loan have a significant strong positive influence on the customer's ability to pay the benefits to the loan repayment period.

The survey should consider the renegotiation process of the loan term to avoid the immediate loss of the loan. Eze eIbekwe [5], deeply rooted in the study of the above research proposes a model to categorize the challenges of repayment of the loan where the size of the loan, the age of the beneficiaries, the size of the household, the number of years of Formal instruction and career were identified as key factors of repayment of the loan and is in line with the economically active age of customers considered for loan by was micro finance banks in Oyo in the state of Nigeria.

III. Loan Accessibility Metrics and Repayment Capacity

To measure the accessibility of the loan involved in formal and informal sources, both critical constraint variables are used, which have influenced only significantly the loan to farmers about the distance from the sources of Loan. It was decided to analyze only the variables of critical constraint as restrictions of access to loans, since the others (size of arable land, size of household, sex, marital status, and education) are dependent on this. One question was characterized to study the object in question: (i) "What are the determinants of access to the agricultural loan from formal and informal sources among farmers "?

Thus, to answer the question we used the technique to capture the metrics evaluated by determinants of access to agricultural loans from formal and informal sources (TAEA) among farmers, by providing critical restrictions on access to loans.

A. Loan accessibility metrics

According to Abiodun, et al. [8], the calibration for access to the loan for each farmer must be obtained from the historical basis of the micro-finance institution. This is because the experience of using and repayment the credit may vary from one farmer to another. Thus, the calculation model was applied to analyze factors that influence access to credit, which can receive grades ranging from 1 to 4, the value 1 indicating that this item is simple and of low complexity; The value 2 indicating moderate, medium influence; The value 3 moderate influence, complex; and the value 4 strong influence, N – complex. The determinant factor of the loan-DEF is obtained through Eq. 1.

$$DEF = NxTFator \quad (1)$$

Where: DEF – factor of determinants loans, TFator-is the sum between the weight and the attributed score of each determinant of the loan,-is the total number of farmers; and the technical estimate to capture the accessibility metric of the agricultural loan per farmer is calculated in Eq. 2.

$$TAEA_{(agric)} = \text{LOS} + \text{LR} + \text{RPP} + \text{LOG} \quad (2)$$

Where: - $TAEA_{(agric)}$ - Is the estimation of the technique to capture the metric accessibility of the agricultural loan per farmer, LOS-refers to the amount granted of the loan (amount-MTN), LR is lending rate (percentage-%), RPP is the repayment period (months), LOG – Represents the loan guarantee (amount-MTN).

The estimated accessibility of the agricultural loan defined in the question is described below for the purpose of extracting equation Eq. 3.

$$AEmp_{(agric)} = \frac{\left(TAEA_{(agric)} xDEF\right)}{\left(N^2 - N\right)} \quad (3)$$

Where: $AEmp_{(agric)}$ - is estimated accessibility of the agricultural loan by farmer from formal and informal sources, $TAEA_{(agric)}$ - Is the estimation of the technique to capture the metric accessibility of the agricultural loan by farmer, DEF – factor of determinants loans, and N- is the total number of farmers.

Table 1 describes the determinants of access to the agricultural loan [1] [11] [14], to reflect a reality already observed in several micro-finance institutions, when it comes to the analysis of lending to farmers.

TABLE I. DETERMINING FACTORS FOR ACCESS TO LOANS

Determinants of access to formal and informal agricultural loans	agricultural experience, education, guarantees, size of arable land, agricultural income, household size, participation of cooperative society, gender, marital status
Determinants of restrictions on access to agricultural loans	amortization period, interest rate, lack of guarantee, distance from loan sources and the amount granted.

B. Identify capacity metrics in repayment from on perspective of borrowers

The process of repayment capacity depends largely on the inherent characteristics of borrowers and their businesses that make it unlikely that the loan will be refunded as loan size, repayment period, loan rate, distance Space between the local smallholder farmers (arable land) in relation to loan sources [1] [8] [10] [15] and a systematic risk of external factors, economic, political and business environment in which the borrower operates [13]. The smaller distance from borrowers in relation to loan sources predispose the advantage of being supervised easily and often than those living in distant positions. Consequently, the advantage of the position is expected to increase the repayment performance of the loan.

Thus, two questions were raised in order to better characterize the objective to be achieved: (i) how does the reimbursement capacity affect the accessibility of small farmers ' loans in Boane district? and (ii) "How far is the location of small farmers (arable land) in relation to loan sources? "

Subsequently, the statistical formula adapted from the work of Onyeagoacha et al. [17] and slightly modified to adapt to this study to capture all measurable variables is shown in Eq. 4,

$$RPC = LOS + LR + RPP \quad (4)$$

Where: RPC is repayment capacity, LOS-refers to the size of the loan (amount-MTN), LR is loan rate (percentage-%), RPP is the repayment period (months).

The formulation for the second question consists of measuring the geographic (spatial) dispersion respecting the relations of precedents and resources the O´Leary and Cummings [16] described in Equation Eq. 5, since financial inclusion should lead financial services to farmers rather than low-income borrowers search for micro finance services to take advantage of services and products (BdeM, [2]).

$$SDI = \sum_{i-j}^{k} \frac{(KM_{ij} \times N_i \times N_j)}{(N^2 - N)/2} \quad (5)$$

where: SDI – is the index of the spatial distance, KM_{ij} - refers to the deadline is the distance between sites i and j in kilometers, N_i and N_j - represent the number of people on the site, k - Is the total number of locations that it modifies in relation to the farmer's decision, N - Is the total number of farmers.

The estimation of the repayment capacity defined as an object to answer the research question is described below for the purpose of extracting equation Eq. 6.

$$RPC_{(agric)} = \frac{\left(RPC \times SDI\right)}{\left(N^2 - N\right)} \quad (6)$$

where: $RPC_{(agric)}$ - is estimated reimbursement capacity per farmer, RPC - is repayment capacity, SDI – refers to the spatial distance index, and N - is the total number of farmers.

IV. Experimental validation of the Metrics

We follow the suggestions provided by Perry et al. [19] and Wohlin et al. [23] on how to perform controlled experiments with minor adaptations.

A. Definition

Based on the Goal Question Metric paradigm proposed by the template of Basili et al. [3], the objective of the experiment is presented as follows:

Analyze metrics collected from the literature to assess the (co) relationship between lending accessibility and repayment capacity in the perspective of borrowers.

For the purpose of validation.

Referring to the ability to be used as relevant indicators in directing credit financing to borrowers

From the point of view of the credit manager.

In the context of farmers in Boane District, Maputo Province and micro finance institutions, include credit unions, micro banks, savings and loan organizations, group purchasing society and exchange houses, considered by BdeM As micro-credit operators acting as credit manager responsible for the artifacts to be distributed in the experimental study.

B. Planning

1) **Context Selection**: the experiment was carried out in a mixed environment: agribusiness cooperatives (farmers) and micro finance institutions (credit managers).
2) **Participation Selection:** a group of farmers in Boane district.

3) **Variable Selection:** the independent variables were the estimation of loan accessibility and repayment capacity. And the dependent variables were the resolution of the metrics generated by the participants.
4) **Pilot Project:** a pilot study was conducted with a view to evaluating the instrumentation of the experimental study. For this, only local credit managers were used. The managers used the same instruments of the study. The data obtained by the pilot study were not used to complement the experimental study to avoid the bias of information. The study participants, in addition to attending at least high school, are inserted in the production context.

Twenty farmers participated in the experimental study, five secondary education and seven primary education. As a small sample level was considered, variations with the participants ' agricultural experience were reduced. For the study in question, the following hypotheses were proposed:

5) **Formulation of hypotheses**: hypotheses proposed for the experimental study

- **Null hypotheses ($H_{(0)}$):** there is no significant correlation between the metric $AEmp_{(agric)}$ and $RPC_{(agric)}$ the metric sent by the farmers participating in the study;
- **Alternative hypotheses ($H_{(1)}$):** there is a significant correlation between the metric $AEmp_{(agric)}$ and $RPC_{(agric)}$ the metric sent by the participating farmers in the study.

The study characterized and validated the loan accessibility estimation metric per farmer, repayment capacity and feasibility of using them for directing credit financing to borrowers. Thus, the analysis mechanisms used were:

- **Descriptive statistics analyses** of the metrics collected from the configurations generated by each participant, combined with analyses of the dispersion graphs of the loan accessibility estimation metrics by farmer and Capacity in repayment, and
- **Trade-off analysis** with the objective of prioritizing elements that compose the metrics.

C. Operation

1) **Preparation**: when the experiment was carried out, all participants came from the agricultural sector and had agricultural experience. The materials prepared for the individuals consisted of:

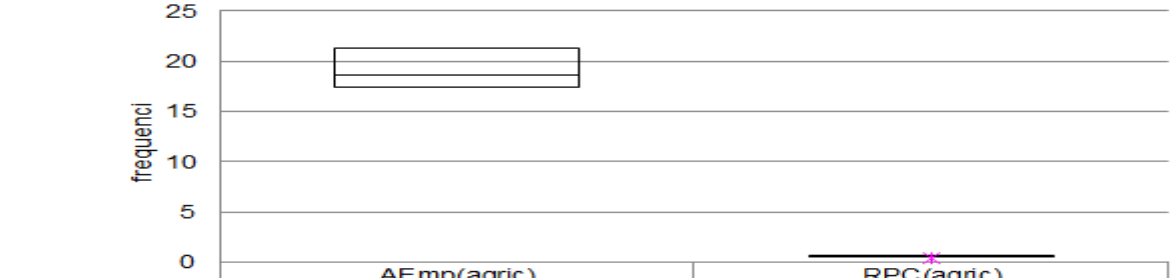
- A copy of the adherence of the experimental study;
- A copy of the characterization of the participants;
- A guide to classification and weights of factors determining restrictions of access to agricultural loans that compose the elements of the metrics; and
- A resolution model containing the configuration of the experimental study by participant.

2) **Execution:** the participants received the material described in section IV-C1. All tasks were performed by each participant individually, with no time limit to resolve them, resulting in a value ranging from-1.0 to 1.0, Spearman's Correlation scale (1904) [21] presented in Figure 2.
3) **Data validation:** the tasks performed by the participants were collected. We consider the subjective evaluation.

D. Analysis and interpretation

We summarize the data collected by calculating the metrics for the 20 resolutions generated by the participants, as well as evaluating the classification of such metrics.

1) **Descriptive statistics**: Figure 1 shows the values observed for metric $AEmp_{(agric)}$ and $RPC_{(agric)}$ represented in a boxplot



	AEmp(agric)	RPC(agric)
Q3-Q2	2,6825	0,08
Q2-Q1	1,29	0
Q1	17,37	0,62
Min Outlier		0,45
Max Outlier		
Zero Offset	0	0

Figure 1. Boxplot for metric $AEmp_{(agric)}$ and $RPC_{(agric)}$ observed values.

2) **Normality test**: we can clearly observe that the loan accessibility metric and the ability to reimburse the distribution of the values (Figure 1) is non-normal.

Nevertheless, normality tests Shapiro and Wilk [21] and Kolmogorov-Smirnov (Corder and Foreman [4]) were performed to make sure of this.

The following hypotheses were proposed for both normality tests with respect to the metric $AEmp_{(agric)}$ and $RPC_{(agric)}$:

- **Null hypothesis ($H_{(0)}$):** the distribution of the values observed for the metric is normal;
- **Alternative hypothesis ($H_{(1)}$):** the distribution of the observed values for the metric in question is not normal.

Normality Tests for metrics: As can be seen in table 2 for a sample size N (20) with mean (μ) 19.476, standard deviation (σ) 3.456 and median (μd) 18.66.

Based on the Shapiro and Wilk tests [21], for a sample size of 20 with 95% of safety (α = 0.05), the significance value (p) is 0.852 (p > 0.05) and the calculated value less than W = 0.974 and W = 0.904 (expected) the alternative hypothesis ($H_{(1)}$) should be rejected. According to Kolmogorov-Smirnov (Corder and Foreman [4]), for a sample size of 20 with 95% of safety (α = 0.05), the significance value (p) is 0.840 (p > 0.05), the null hypothesis ($H_{(1)}$) should be rejected.

Normality tests for metrics as can be seen in table 2, for a sample size N (20) with mean (μ) 0.645, standard deviation (σ) 0.065 and median (μd) 0.62. Based on the Shapiro and Wilk tests [21], for a sample size of 20 with 95% of safety (α = 0.05), the significance value (p) is 0.0046 (P < 0.05) and the calculated value greater than W = 0.846 and W = 0.90 (expected) the null hypothesis () should be rejected. According to Kolmogorov-Smirnov (Corder and Foreman [4]), for a sample size of 20 with 95% of safety (α = 0.05), the significance value (p) is 0.00001 (P < 0.05), the null hypothesis ($H_{(0)}$) should be rejected.

Thus with the tests, there is evidence to reject the null hypothesis ($H_{(0)}$) by the metric, not considering the distribution of the normal observed values. A non-parametric statistical method should be used to analyze such a metric.

TABLE II. SPEARMAN´S CORRELATION OF METRIC

ID#	$AEmp_{(agric)}$	*ra*	$RPC_{(agric)}$	*rb*	d $\lvert ra-rb \rvert$	d^2
1	17,68	7	0,62	3	4	16
2	18,16	8	0,66	12	-4	16
3	25	19	0,74	19	0	0
4	18,53	9	0,62	3	6	36
5	16,84	4	0,70	14	-10	100
6	13,68	1	0,58	2	-1	1
7	18,53	9	0,62	3	6	36
8	17,37	5	0,62	3	2	4
9	18,79	11	0,62	3	8	64
10	15	3	0,62	3	0	0
11	22,37	16	0,74	19	-3	9
12	14,53	2	0,70	14	-12	144
13	20,84	13	0,45	1	12	144
14	20,84	13	0,66	12	1	1
15	26,53	20	0,70	14	6	36
16	17,37	5	0,62	3	2	4
17	21	15	0,62	3	12	144
18	19,74	12	0,62	3	9	81
19	24	18	0,70	14	4	16
20	22,73	17	0,70	14	3	9

Spearman's ranking correlation: as the distribution of the metric $AEmp_{(agric)}$ is normal and metric $RPC_{(agric)}$ is not normal, the Spearman's non-parametric correlation (1904) [21] (ρ) was applied to support the interpretation of the data. This method allows you to determine whether there is a correlation between two sets of data. The equation (6) presents Spearman's Correlation (1904) [21] (ρ) formula:

$$\rho = 1 - \frac{6}{n(n^2 - 1)} \times \sum_{i=1}^{n} d_i^2 \qquad (6)$$

In such a way that N and the number of samples (N)
Table 2 shows the Spearman Correlation (1904) for Corr. 1.

Thus, according to Figure 2, there is a weak and statistically significant positive correlation ((Corr. 1) = 0.35) between the metric $AEmp_{(agric)}$ and $RPC_{(agric)}$. Based on the proposed correlation, we have evidence to reject the null hypothesis ($H_{(0)}$) of the study, and accept the Alternative hypothesis ($H_{(1)}$) (section IV-B5), which states that loan accessibility metrics are significantly related to the ability to repayment.

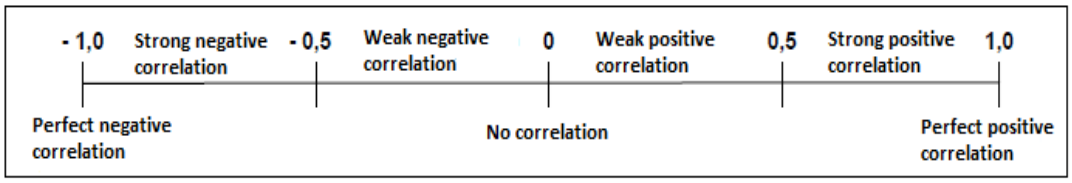


Figure 2. Spearman Correlation Ranking Scale (1904).

The coefficient (ρ) for Corr. 1 is calculated as follows:

$$\rho(Corr1) = 1 - \frac{6}{20(20^2 - 1)} \times 861 = 1 - 0.6473 = 0.35$$

E. Validity Assessment

In this section, we discuss the threats to the validity of the experimental study and how such threats have been minimized.

Validity of completion threats: the only concern considered as a risk of affecting the statistical validity of the present study is the size of the sample (N) that can be increased in future repetitions, which is possible to reach the normality of the observed values.

Validity of construction threats: the variables dependent on this study are the accessibility metrics of the loan and the reimbursement capacity, collected based on the resolution and classification of the elements that compose the metrics by the participants in the experimental study. The distance from the place of the farmers (arable land) in relation to sources of loan was constant in less than 2 km, since the micro finance services were concentrated around the agribusiness cooperatives.

Validity of internal threats: we deal with the following questions:

- **Difference between participants:** As was the small sample, the variation in agricultural experiments was reduced. In this case, all participants performed tasks defined by the material prepared in the Operation (section IV-C1) in the same order.
- **Accuracy of participant's responses:** the loan accessibility metric and repayment capacity to estimate a composite indicator in agricultural credit targeting was measured by each participant. As they had average experience with the concepts of agricultural production, it is considered that their answers are valid.
- **Fatigue effects:** on average, the experiment lasted 13 minutes for each participant. Therefore fatigue was not considered relevant.
- **Other important factors**: the interest rate is one of the most important variables when considering access to microcredit; The interest rate of loans, the supply of money and the inflation rate were identified in the study as other important factors, so in addition to monitoring the lending rates, the policies of the Bank of Mozambique (BdeM) need to establish structures To avoid sub-capitalization, fraudulent practices and unjustified interference in the consistent injection of funds into agriculture by the board members of micro-finance institutions.

Validity of external threats: external threats have been identified that can be generalized to the practice of agricultural credit financing.

Participants: the causes identified by the interviewees include delayed approval of the loan, inadequate funding, ineffective monitoring, market problems and natural disasters have a significant effect on the repayment performance of loans from small farmers.

V. Conclusions

In this research, an experimental validation was presented to guide agricultural loans to borrowers in the micro-finance regime. The objectives of the experiment are based on the study of metrics in order to extract a composite indicator and evaluate how socioeconomic aspects, distance from loan sources, and determinant factors in access to credit corroborates to the quality of refund. The calculation of performance indicators is important for donors, professionals and consultants to determine the efficiency, feasibility and reintroduce financial statements to provide useful information on the performance of the institutions of Microcredit. The experiment showed that the accessibility of the loan and capacity in the reimbursement showed a weak and statistically significant positive correlation (Corr. 1 = 0.35), that is, the correlation of the metrics serves as indicators for directing Agricultural credit to farmers in the Boane district.

1. Contributions

The contributions of this study are located in two main dimensions: for theory and market:

- The empirical evaluation of the experimental study of the validation of the metrics showed the importance of understanding the dynamic nature of credit financing to borrowers of rural families.
- The correlation of the loan accessibility metric and repayment capacity has a limit value of (0.35), which evidence that such metrics are correlated to direct agricultural credit financing and support credit managers in making Indicators-based decisions.

2. Limitations

This work has some important limitations to highlight, the experiment is limited in the evaluation based on a case study approach, not considering other approaches that provides social intermediation to establish a knowledge base that allows you to make action corrective. Another limitation is the instrumentation of credit managers in the pilot project that may cause some threat to validation, since the sample consisted of farmers of agribusiness cooperatives, which in a way allows the generalization of results Obtained. As future work, we intend to replicate the experimental study with larger sample sizes so that it is possible to achieve the normality of the observed values in order to obtain real evidence that the metrics can be used as Indicators and investigate the possibility of apply a software application framework as an agribusiness simulator through indicators with the objective of generalizing the results obtained in scale on the Feasibility of the study.

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