Unequal capitalization of rural credit in brazilian states and regions

Capitalização desigual do crédito rural nos estados e regiões brasileiras

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ABSTRACT
The research sought to evaluate how the resources are appropriated and how the number of contracts of the National Program for Strengthening Family Agriculture (Pronaf) were distributed in the Brazilian regions and states between the years 2000 and 2018. To reach the research objectives, which also sought to evaluate the homogeneity/heterogeneity of the appropriation of Pronaf resources in Brazilian regions and states, data from the Central Bank of Brazil were used. The values were updated for the year 2018. The rural credit appropriation index (ICAR) was constructed, which is the weighted average of the relative annual values of the Pronaf credit modalities: funding and investment for crop and animal production. The weights used for the weighting were generated using factor analysis. The results of the research showed that the appropriation of Pronaf's resources was quite unequal in the evaluated period, being the richest regions and states the ones that captured the highest average values of the credit modalities taken in aggregated way.

Keywords: family farming, rural credit, rural development, public policy.

RESUMO
A pesquisa procurou avaliar como os recursos são apropriados e como o número de contratos do Programa Nacional de Fortalecimento da Agricultura Familiar (Pronaf) foi distribuído nas regiões e estados brasileiros entre os anos de 2000 e 2018. Para alcançar os objetivos da pesquisa, que também buscou avaliar a homogeneidade/heterogeneidade da apropriação dos recursos do Pronaf nas regiões e estados brasileiros, foram utilizados dados do Banco Central do Brasil. Os valores foram atualizados para o ano de 2018. Foi construído o índice de apropriação de crédito rural (ICAR), que é a média ponderada dos valores relativos anuais das modalidades de crédito do Pronaf: financiamento e investimento para produção agrícola e animal. Os pesos usados para a ponderação foram gerados por meio de análise de fatores. Os resultados da pesquisa mostraram que a apropriação dos recursos do Pronaf foi bastante desigual no período avaliado, sendo as regiões e estados mais ricos os que capturaram os valores médios mais altos das modalidades de crédito tomadas de forma agregada.

Palavras-chave: agricultura familiar, crédito rural, desenvolvimento rural, política pública.

1 INTRODUCTION

Since humans domesticated the first plant and animal species, approximately 8000 BC. (DIAMOND, 2002), agriculture is present in society, as a provider of food for the population, hence its great importance. Over the centuries, many changes have taken place, aiming to make agricultural activity more technically and economically viable. Among the advances, farmers' access to rural credit programs and technical assistance stands out. Thus, rural credit must be, in essence, differentiated from credit made available for other economic activities.

After some unsuccessfully attempts to promote subsidized credit for family farmers, the National Program for the Strengthening of Family Farming (Pronaf) was created in 1996. This was undoubtedly a great achievement for Brazilian family farmers.

This public policy is part of a national strategy to recognize family agriculture and the rural environment. One of the target for the creation of Pronaf was the attempt to reduce inequalities between regions and Brazilian states in access to resources, which would translate into the reduction of inequalities in the formation of wealth from the agricultural sector (MONTEIRO; LEMOS, 2019).

Given the above, this study is justified by the need to explore and quantify the differences in the measurement of Pronaf contracts in Brazilian states, since Brazil is an unequal country in development, especially rural development. And this is striking in Brazilian states and regions (LEMOS, 2020).

How have pronaf credits for funding and investment been appropriated by brazilian regions and states since its creation?

In this context this study attempts to answer the following question: How have been appropriated Pronaf credits for funding and investment by Brazilian regions and states in agricultural and livestock activities between the years 2000 and 2018?

To answer this question, the general objective is to evaluate the distribution of the values of funding and investment contracts, in the agricultural and livestock modalities, in the Brazilian regions and states in the period from 2000 to 2018. Specifically, the research seeks: a - to compare, in relative form, the participation of regions and states in the raising of Pronaf resources in the modalities of funding and investments in crop and livestock production activities between the years 2000 and 2018; b - to assess, in a weighted way, the average participation of each state in the appropriation of Pronaf resources in the period under investigation.

The paper is divided into four sections, beginning with this introduction. Section two presents a theoretical discussion about family farming and Pronaf, its history, and its importance. In the third section the materials and methods will be presented, as well as a description of the model used to create the index. In the fourth section, the main results of the estimates are presented and discussed, and, finally, in the last section, the final considerations are made.

2 FAMILY FARMING AND PRONAF

Since the 16th century, Brazil has played the role of producer to supply the foreign market, keeping in the background the domestic demand for products and food. Subsistence agriculture existed, but it was to supply the needs of large landholdings aimed at the international market (OLIVEIRA, 2012).

With the attention focused on large crops, there were no incentives for individual workers, so it can be said that it was from the colonial period that inequalities on the agrarian question in the country began (SOUSA, 2008).

However, in the year 1930, when the period of industrialization took place in the country, production turned to the domestic market, replacing imports. It was in the 1960s, at a time of modernization, that Brazil invested in technology to develop agriculture, the so-called Green Revolution.

The "Green Revolution" was a production model based on the modernization of agriculture, such as the improvement of seed genetics, the use of chemicals in soils, the use of machinery and the use of agrochemicals. A large part of the resources necessary for such investments to take place came through the rural credit offer subsidized by governments. They were intended to benefit the large crops turned to the foreign market. This phase excluded family production, under the allegation of not being competitive from an economic point of view, leaving it on the sidelines of this phase of agricultural policy. It was only in the 1990s that agricultural policies aimed at the inclusion of family farmers in policies of access to subsidized rural credit in a more ostensible way emerged (SOUSA, 2008).

Discussions about the relevance of the activities developed in Family Farm Units (FFU) started to experience greater insertion in social, political, and academic circles not so long ago. The FFU are important in agricultural production, among other reasons, for presenting characteristics that differentiate them from non-family units (NFU), namely: they are at the same

time: production units; consumption units; and units that foster attachment by farmers to the environment in which their ancestors lived and that, normally, they would like to remain, if they can afford to do so (CHAYANOV, 1966; DE JANVRY, 1989; SACHS, 1997; LEMOS, 2020).

The term family farming only came to have more prominence in Brazil after its institutionalization in 1995. In that year, the Extraordinary Ministry for Land Policy incorporated the proposal of expressive segments of the Brazilian society that involved the FFU. The Pronaf was created in 1996 (BRASIL, 1996; AZEVEDO, 2011; NAVARRO; PEDROSO, 2014).

Due to its importance at a national and regional level, Pronaf's credits came to better assist family farmers and land reform settlers, in an attempt to contribute to better production, income, and the occupation of family labor.

Pronaf is characterized by being directed towards the financing, in an assisted way, of activities practiced by Brazilian family farmers, through the disbursement, with subsidized interest rates, for agricultural and non-agricultural activities practiced in rural areas by family farmers. According to the Presidential Decree 1.946, of 06/28/1996, which created Pronaf, its objective is to promote the sustainable development of the rural segment (BRASIL, 1996).

Operationally, Pronaf is divided into three modalities: 1 - Pronaf rural credit, which finances agricultural production; 2 - Pronaf infrastructure, which finances investments in improving the infrastructure of rural establishments; 3 - Pronaf training and professionalization, which empowers farmers by providing new knowledge regarding production processes and farm management (GRISA *et al.*, 2014).

According to the former Ministry of Agrarian Development, the program has special credit lines that deserve to be highlighted, such as Pronaf food, which encourages the production of the five foods that make up the country's basic food basket - rice, beans, cassava, corn, and wheat; Pronaf Semi-arid, which is geared towards semi-arid areas. There is also the Forestry Pronaf, which encourages the planting of forest species; the Agroecology Pronaf that finances investments in agroecological production systems; the Family Livestock Pronaf that offers credit for the purchase of animals such as cattle, goats, and sheep; and the Machinery and Equipment Pronaf. And finally, the Pronaf Tourism that finances rural tourism projects, such as the provision of restaurants and rural inns to receive tourists (AZEVEDO, 2011).

In addition to the importance of family farming at the national and regional level, the Northeast region, in particular, having more than 50% of rural establishments focused on family

farming, it should be noted that the existence of public policies aimed at the rural area has a positive impact (CASTRO, 2012).

Thus, Pronaf is an important public policy instrument for the development of rural areas, counting on the presence of the State investing in free technique assistance, rural extension, and the promotion of new knowledge to increase resilience in the face of technique, social, and environmental vulnerabilities.

The strengthening of family farming requires the interaction of macroeconomic policies that improve the conditions of a group of producers and not just a few. Policies that present strategies to reduce poverty, both urban and rural, generating jobs and strengthening regional economies and the internal market; policies aimed at "emancipation", in terms of the competitiveness of its beneficiaries to enter the market; and to have a minimum criticism mass of family farmers that can trigger the take-off for local development (BUAINAIN *et al*., 2003).

To carry out this mission, the program's operational structure was originally divided into four action axes, namely: 1) negotiation and articulation of public policies; 2) installation and improvement of infrastructure and services in the municipalities; 3) financing family farming production (funding and investment); and 4) training and professionalization of family farmers and technicians.

3 METHODOLOGY

This section is divided into two subsections. First, the sources of secondary data used in the research will be presented, as well as the used variables. The second sub-section presents the methodology used for the construction of the index of rural credit appropriation (IRCA), which aggregates the costing and investment credit modalities for agricultural activities as well as the costing and investment credit modalities for livestock activities.

3.1 DATABASE

Rural credit data for Brazilian regions and states were sourced from the Central Bank of Brazil for the period 2000 / 2018. The data extracted for state i (i = 1, 2, ..., 27) in year t (t = 1, 2, ...) are: a) total value of financing in agricultural costing (VC_{Ait}); b) total value of financing for agricultural investment (VIA_{it}); c) total value of financing for agricultural activities (VTA_{it}); d) total value of costing for livestock (VCL_{it}); e) total value of investment for livestock (VIL_{it});:

(f) total value of financing for livestock activities(VTL_{it}); (g) number of agricultural costing contracts (NCA_{it}); (h) number of contracts for agricultural financing (NFA_{it}); (i) number of contracts for livestock costing (NCL_{it}); (j) total number of contracts for livestock financing (NIL_{it}).

3.2 CONSTRUCTION OF THE IRCA

The research constructs the Index of rural credit appropriation (IRCA) by state between the years 2000 to 2018. To do so, it uses the variables shown in Table 1:

Table 1 - Variables used to construct the IRCA

Variable	Identification	Definition
Y_{it}	Relative Agricultural Costing	(VCA_{it}) / (VTA_{it})
Y_{2t}	Relative Agricultural Investment	(VIA_{it}) / VTA_{it}
Y_{3t}	Relative Livestock Costing	(VCL_{it}) / (VTL_{it})
Y_{4t}	Relative Livestock Investment	(VIL_{it}) / VTL_{it}

Source: Draft by the authors to elaborate the research.

The Rural Credit Appropriation Index by Brazilian states between the years 2000 and 2018 has the mathematical expression shown in equation (1):

$$IRCA_{jt} = \Sigma w_{jt}.Y_{jt} \tag{1}$$

The weights (w_{jt}) vary between zero and one, excluding the extreme values, and add up to one ($\Sigma w_{it} = 1$). They are used for the estimation of the IRCA for each Brazilian state. The weights were estimated using the factor analysis (FA) method with the principal component decomposition (PCD) technique. Defined in this way the IRCA ranges from zero (0) to one hundred (100), and can be understood as a percentage. in fact the IRCA is, a weighted average of the relative participation of the states and regions in the Pronaf credit modalities discussed in this paper. The differential with conventional weighted averages is that the weights associated with each variable emerge from the correlation between the modalities of rural credit observed over the period investigated. So, the closer to zero (0) the estimated IRCA is for a given state, the smaller is its relative participation in the appropriation of the four credit modalities in the

investigated period. Conversely, the closer to 100 the estimated IRCA is for a given state, the higher its relative participation in the four modalities evaluated.

To make the decision on how to build the IACR and search for the magnitude of the weights, there were two paths to follow, through deterministic or random procedures. Among the deterministic processes, linear programming methods can be used, while, in relation to stochastic processes, regression analysis methods or factor analysis are applied. In this paper, predicting the randomness of the variables and their high correlation with each other. Furthermore, the sum of individual effects is not equal to the total effect, precisely because of correlations. Thus, we opted for the factor analysis method and the technique of decomposition into principal components, rejecting the option of using the linear programming method that depends on the non-correlation between the variables to be performed (MAROCO, 2003; HAIR *et al.*, 2005; FÁVERO *et al.*, 2009; FEITOSA *et al.*, 2020).

The multivariate analysis is used to study models involving more than two variables in which all of them are random, interrelated, so that their different effects cannot be interpreted separately and that there is no clear definition of cause and effect between them (FÁVERO *et al.*, 2009).

After the data preparation stage, it was necessary to run some tests to validate the use of Factor Analysis, namely: normality and linearity and analysis of the correlation matrix with significant values. The estimation of factor scores, from which the weights are derived, as well as the necessary tests to assess the adequacy of the use of the technique. All estimation processes were performed using the software *Statistical Package for the Social Sciences* (SPSS) version 26.

3.2.1 Summary of the factor analysis procedure that applies to the study

The technical foundations of FA lie in the correlation betweenthe variables that are used. For the technique to be feasible the correlation matrix between the variables mustn't be anidentity (BROOKS, 2003; THORNTON *et al*., 2008; HAHN *et al*., 2009; FÁVERO *et al*., 2009; GUILLAUMONT; SIMONET, 2011; LIRA *et al*., 2016).

Factor analysis is designed to investigate whether a number "n" of variables of interest Y_1, Y_2, ..., Y_n, are linearly related to a smaller number "k" (k < n) of unobservable factors: F_1, F_2, ..., F_k.

Factor analysis (FA) can be broken down into the following steps: a) analysis of the correlation matrix and suitability of using the method; b) extraction of the initial factors and determination of the number of factors; c) factor rotation when more than one factor is extracted; d) interpretation of the factors that include the possibility of generating weights from the estimated factorial scores (MAROCO, 2003; HAIR *et al*., 2005; FÁVERO, 2009).

For the FA to be done properly it is necessary to perform the following steps: analyze the correlation matrix, confirming that it is not an identity; verify the Kaiser-Meyer-Olkin statistic (KMO) that must be greater than to 0.5; perform Bartlett's test of sphericity, to confirm that the correlation matrix is not an identity. In this is made by estimating the Chi Square statistics with its degree of freedom. To reject the hypothesis that the correlation matrix is a non identity matrix the p-value must be under 10%. To perform the adequacy of FA it is necessary to evaluate the percentage of explanation of the accumulated variation of the estimated components. The method used to extract the factors was the decomposition into principal components, which has as a characteristic the search for a linear combination of the observed variables to maximize the total variance explained (LEMOS, 2001; BROOKS, 2003; MAROCO, 2003; HAIR *et al*., 2005; THORNTON *et al*., 2008; HAHN *et al*., 2009; FÁVERO *et al*., 2009; GUILLAUMONT; SIMONET, 2011; LIRA *et al*., 2016).

When one wants to apply FA the variables used in the study are transformed into normal standardized variables, that is, they have a mean equal to zero and a variance equal to one. Through this procedure, it is possible to neutralize the units of measurement in the variables. After extracting and determining the number of factors it is possible to estimate the coefficients of factorial scores, and it is from there that the unobserved variables are generated. These unobserved variables gather, through the correlations between them, the information from the original variables. Based on the extracted components and the factorial score coefficients, the weights are generated and used in equation (1) (LEMOS, 2001; BROOKS, 2003; THORNTON *et al*., 2008; HAHN *et al*., 2009; FÁVERO *et al*., 2009; GUILLAUMONT; SIMONET, 2011; LIRA *et al*., 2016).

In equation (1), the Index of Rural Credit Appropriation (IRCA), obtained utilizing relative indicators, must have the essential characteristics when building an index, such as simplicity, the ability to be reproduced, and ease in obtaining and measuring the indicators (BRIGUGLIO, 2003).

3.2.2 Relative and temporal homogeneity/heterogeneity of the irca in the states

To measure the relative homogeneity/heterogeneity along the time of the average IRCA in each state, in the analyzed period, is used its coefficient of variation (CV). By definition, the CV is the percentage ratio between the standard deviation and the expected value of a random variable. The higher the CV value is, the more irregular (more heterogeneous) will have been the distribution of observations around the mean. Thus, in the case of this study, the CV can be used as a measure of how the states have appropriated the joint credit modalities over the years. This can be done comparatively. Higher CVs signal suggest greater relative heterogeneous (instable). The smaller the CV is, the more homogeneous (stable) will be the distribution of observations around the mean (GOMES, 1985; GARCIA, 1989; SORENSEN, 2000).

To use the CV as a measure of homogeneity/heterogeneity of distribution it is necessary to define its critical values. Gomes (1985) established limits for classifying CVs in agricultural experimentation (Table 2).

Table 2 - Classification of the CV according to its range.

CV Classification	CV Range
Low	$CV < 10\%$
Medium	$10\% \leq CV < 20\%$
High	$20\% \leq CV < 30\%$
Very High	$CV \geq 30\%$

Source: GOMES, 1985.

4 RESULTS AND DISCUSSION

The presentation and discussion begin by presenting the results found in the AF-DCP procedures used to generate the IRCA. The results found for the estimation of the components and factorial scores that are used to build the weights associated with each of the indicators that make up the IRCA are shown in Table 3.

It is observed that the estimates obtained are robust, from a statistical point of view, considering that the KMO test is 0.656 (the minimum acceptable is 0.5) ensures the quality of the adjustments, which is corroborated by the Bartlet test that confirms that the correlation matrix is not an identity matrix and by the explained variance of 72.5% (Table 3).

Table 3 - Results obtained with AF to estimate the IRCA weights.

Variable		Communalities	Components	Scores	Weights
Y_{it}	Relative Agricultural Costing	0.844	0.919	0.317	0.27
Y_{2t}	Relative Agricultural Investment	0.811	0.900	0.310	0.26
Y_{3t}	Relative Livestock Costing	0.681	0.826	0.285	0.24
Y_{4t}	Relative Livestock Investment	0.565	0.752	0.259	0.23
Statístics		KMO = 0.656	Bartlett's Test: P-value = 0,000	Explained Variance = 72.5%.	

Source: Values estimated using data research.

It can be observed that the weights generated from the components or the factorial scores are very close, varying from 0.23 to 0.27. An indicator that the credit modalities interfere in a not very differentiated way over the used variables to make up IRCA. Thus, based on the evidence shown in Table 3, the equation for the definition of the IRCA is presented below:

$$IRCA_{it} = 0.27\ Y_{1t} + 0.26\ Y_{2t} + 0.24\ Y_{3t} + 0.23\ Y_{4t} \qquad (2)$$

Applying this equation to each state, in the 19 studied years, it can be find the estimated values of the IRCA for each year. It was calculated the mean and CV of the index for the states in the 19 years and show these results in Table 4 and in figure 1.

Table 4 - Averages, Coefficients of Variation (CV) of the IRCA in the Brazilian States and Regions from 2000 to 2018 years

State/REGION	IRCA (%)	CV (%)
Acre	0.29	57.1
Amapá	0.08	100.9
Amazonas	0.25	88.8
Pará	2.21	51.3
Rondônia	2.74	27.8
Roraima	0.12	69.0
Tocantins	0.83	34.9
NORTH (TOTAL)	**6.52**	**61.4**
Maranhão	1.94	47.4

Piauí	1.24	46.6
Ceará	1.85	39.6
Rio Grande do Norte	1.53	72.6
Pernambuco	1.76	38.7
Paraíba	0.83	39.2
Alagoas	0.80	17.1
Sergipe	0.75	24.1
Bahia	3.79	28.7
NORTHEAST (TOTAL)	**14.49**	**39.3**
Espírito Santo	3.51	25.0
Minas Gerais	12.49	11.1
Rio de Janeiro	0.77	24.6
São Paulo	4.55	18.1
SOUTHEAST (TOTAL)	**21.32**	**19,7**
Paraná	12.88	23.0
Rio Grande do Sul	23.78	12.2
Santa Catarina	11.64	14.3
SOUTH (TOTAL)	**48.30**	**16,5**
Goiás	4.24	29.0
Mato Grosso	3.91	42.6
Mato Grosso do Sul	1.22	73.3
Distrito Federal	0.03	65.7
MIDWEST (TOTAL)	9.40	52.7
TOTAL GENERAL	100.00	37.9

Source: Estimated values from Brazilian Central Bank data, various years.

From the evidences found in the study, shown in Table 4 and figure 1, it can be inferred that the South region presented the highest average relative participation of aggregate values of contracts in the modalities studied: agricultural funding; agricultural investment; livestock funding; and livestock investment. Indeed, in this region, the estimated average percentage for the period studied (2000 to 2018) was 48.3%. The Southeast region follows with 21.31%; the Northeast with 14.5%; the Midwest with 9.4% and, finally, the North region for which the estimated average percentage for the period was only 6.5% of the amount of Pronaf rural credit in the period investigated by the research.

The results also show that in the North and Northeast regions, which had the lowest shares in Pronaf fundraising between the years 2000 and 2018, the heterogeneities in these fundraisings, detected by the respective VCs were the greatest (Table 4)

These higher percentages of Pronaf appropriation in the Southern and Southeastern states may be associated with greater involvement of technical assistance and rural extension services and agricultural development in these states, in contrast what happens in the Northeast and North, where these services are precarious. In the Southern and Southeastern states, Pronaf's resources are largely used in activities that allow for a greater possibility of economic results such as the

cultivation of coffee, grapes, milk production, cheese production, among other more market-oriented activities.

The values of agricultural and livestock production obtained by family farming units in the states of these two regions are quite significant when compared to those obtained in the North and Northeast. This should be an evidence that the greatest capitation of Pronaf resources in the states of these regions materializes in expressive economic results for their family farmers (IBGE, 2017).

In the North and Northeast regions, agricultural activities are concentrated, fundamentally, in rainfed production of rice, beans, cassava, and corn, which are activities more focused on food security and with little market insertion. There is the use of Pronaf resources for extensive cattle raising in these regions. Probably for these reasons, the amounts raised by Pronaf in these regions are much lower than those observed in the South and Southeast regions where the agricultural activities of family farmers are more dynamic and market-oriented.

The modest relative participation of the Midwest region in the raising of Pronaf resources can be explained to the fact that in the states of this region (except the Federal District) there is a greatest dominance of agricultural activities practiced in non-family units (NFU). These production units have their sources of financing for their activities, coming from the so-called trading Companies that, in turn, guarantee the receipt of raw material. The representatives of these entities advance the resources to the producers, also buying the crop in advance. A well-known operation is the exchange of input supply and the trading in offering credits to producers. (SILVA, 2012; SCHIMIDT; CANÇADO, 2019).

Figure 1 - Averages of IRCA appropriation rates by Brazilian regions between 2000 and 2018.
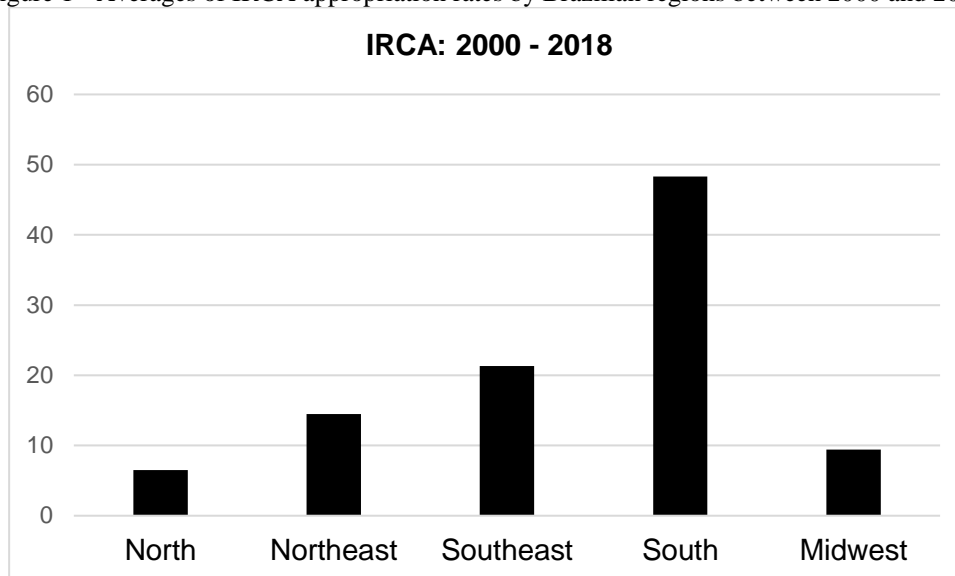
Source: Prepared by the authors. Data referring to Table 2.

Regarding to the average capture of the aggregate values of Pronaf by states, it was observed that family farmers in the Rio Grande do Sul earned the highest average percentage in the period investigated (23.8%). Paraná (12.9%), Minas Gerais (12.5%), and Santa Catarina (11.6%) were in the next positions in the descending hierarchy.

The Federal District, in which family farming activities have little participation in the formation of income, presented the lowest average percentage of funding from Pronaf in the evaluated period. Overall, are in the states of the North and Northeast regions, the lowest average participations, in percentage terms, of the amounts of Pronaf in the modalities studied in the period from 2000 to 2018.

These lower averages participation can also be attributed to the public policies of technical assistance, rural extension, and agricultural promotion, which are quite scrapped in all the states of these regions. This low participation in Pronaf uptake probably contributes to the low economic results observed in the states of these two regions (IBGE, 2017).

The evidences of the study also shows that in the states where the average appropriation of Pronaf, as measured by the IRCA, are lower (North, Northeast, and Midwest) the heterogeneities of these appropriations, measured by the respective CVs, are much greater. In Amapá, which presented the lowest average Pronaf appropriation, between 2000 and 2018, at a percentage of only 0.08%, the CV was 100% (Table 4).

In Figure 2 is showed the relative States participation in the amount of Pronaf credit between 2000 and 2018.

Figure 2 - Averages of Pronaf rural credit uptake rates by Brazilian states between 2000 and 2018
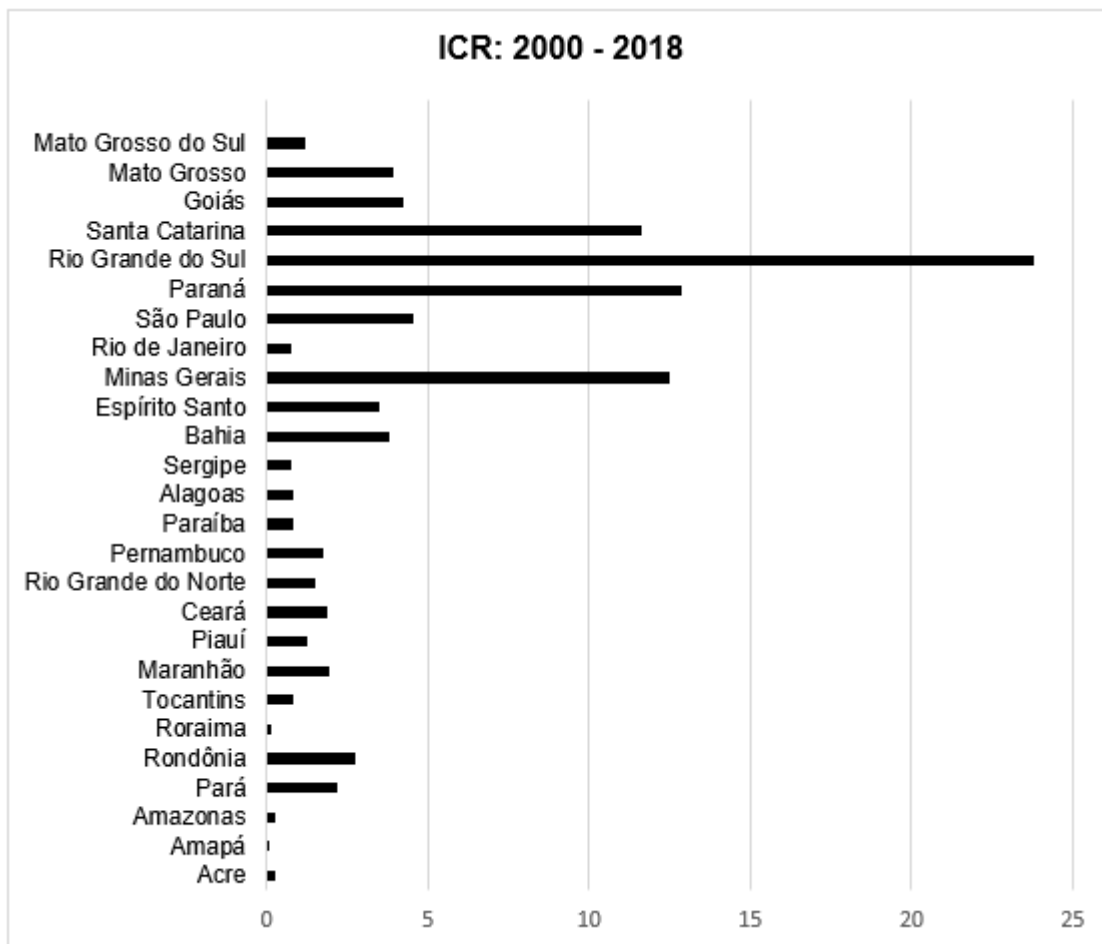
Source: Data shown in Table 2.

About the quantities and average values of Pronaf contracts by region, it can be seen that the highest average number of contracts was observed in the Northeast Region (677,214/year), where the average value per contract was the lowest among all the regions (US$ 694.59/year) with the highest homogeneous distribution (CV = 54.7%).

On the other hand, the Midwest region had the lowest average number of contracts (49,261/year), but had the highest average value per contract in the investigated period (US$ 4,695.24/year). In that region, it was observed a more homogeneous distribution of the number of contracts (CV=19.3%), but it presents the third largest heterogeneity around the average value per contract (CV=70.4%). The South region had the third highest average value per contract

(US$ 3,281.82/year), but had the second highest heterogeneity around the average (CV=80.0%). The North region, in its turn, presented the lowest average of contracts (68.021/year) with the second highest heterogeneity in the distribution in the period (CV=39.6%), but presented the highest average value per contract (US$ 3,306.37/year), but also showing the greatest heterogeneity measured by a CV=80.2% between 2000 and 2018. The high average per contract in this region can be attributed to the fact that the vast majority of financing is aimed at livestock activity.

Table 6 - Contracts, average values, and coefficients of variation (CV) of Pronaf financing modalities in Brazilian regions between 2000 and 2018.

Contracts	North	Northeast	Southeast	South	Midwest
Totals	1,292,404	12,867,063	4,100,307	10,305,314	935,960
Annual average (contract/year)	68,021	677,214	215,806	542,385	49,261
CV (%) (contract/year)	39.6	54.4	32.9	26.5	19.3
Averagevalue (US$/year)	3,306.37	694.59	2,930.01	3,281,82	4,695,24
CV (%) (US$/year)	80.2	54.7	64.3	80.0	70.4

Source: Estimated values from Bacen data. various years.

The expectation of farmers and researchers was that the creation of Pronaf would contribute to the reduction of inequalities among Brazilian regions and states in the access to rural credit. The evidence found in this research shows that in the period from 2000 to 2018 this did not happen. It is known that in fact the program began in 1999. Table 4 reveals that, after 18 years of effective operation, the largest amounts of rural credit, of the different modalities of Pronaf, are concentrated precisely in the richest regions and in the richest states of the country. And the Northeast, which is the poorest region, had the lowest average value of Pronaf/year in the period (Table 4).

5 FINAL CONSIDERATIONS

The advances registered by Pronaf, since its creation, represented a great achievement for rural workers, making possible the development and expansion of several modalities and forms of access to rural credit for family farmers. Many had the opportunity to get credit for funding and investment in agriculture and livestock, expanding their production, acquiring equipment, technology and training.

However, access to Pronaf's resources generates some questions about its distribution in the regions and states of Brazil. Thus, this study showed that the South and Southeast regions concentrate the largest volumes of rural credit for costing and investment for agricultural and livestock activities of Brazilian family farmers.

The analyses presented in this search make it possible to understand that the appropriation of Pronaf's resources occurs in a heterogeneous way, presenting greater irregularities in the regions considered the poorest in Brazil. captured by the respective coefficients of variation.

Because of what was presented in this study, it is considered that Pronaf can generate great benefits and development for Brazilian family farmers. However, it needs policies aimed at reducing inequality in the distribution of resources, balancing the appropriation among regions and their respective states. However, it is recognized that this role should be shared by the states of the poorest regions (North and Northeast), which should strengthen their systems of technique assistance, rural extension and agricultural development.

Thus, the overall conclusion of the study is that its guiding answer has been answered. The evidence found in the research shows how these resources were appropriated in the states and regions, and showed that the appropriation of Pronaf's resources has been quite uneven since the beginning of its inauguration, which practically started in the year 2000. This conclusion meets the objectives proposed in the research.

REFERENCES

AZEVEDO, F. F.; PÊSSOA, V. L. S. (2011). The national program of strengthening of family agriculture in Brazil: an analyze on the regional and sector resources distribution. *Sociedade & Natureza*, 23, 483-496.

BRASIL. (1996). Decreto nº 1.946, de 28 de junho de 1996. Regulamenta a Lei nº 8.171, de 17 de janeiro de 1991, que dispõe sobre a política agrícola, e dá outras providências. Diário Oficial da República Federativa do Brasil, Brasília, DF, 1º jul. 1996. http://www.planalto.gov.br/ccivil_03/decreto/D1946.htm

BRASIL. IBGE (Instituto Brasileiro de Geografia e Estatística). (2006). Censo Agropecuário 2006. https://biblioteca.ibge.gov.br/index.php/biblioteca-catalogo?view=detalhes&id=749

BRASIL. IBGE (Instituto Brasileiro de Geografia e Estatística). (2017). Censo Agropecuário 2017. https://biblioteca.ibge.gov.br/index.php/biblioteca-catalogo?view=detalhes&id=73093

BRASIL. IBGE (Instituto Brasileiro de Geografia e Estatística). (2017). Agricultura Familiar no Brasil e nas Unidades Federativas: Notas Estatísticas. Rio de Janeiro: IBGE. https://biblioteca.ibge.gov.br/visualizacao/periodicos/3096/agro_2017_agricultura_familiar.pdf

BRIGUGLIO, L. (2003). The Vulnerability Index and Small Island Developing States: A Review of Conceptual and Methodological Issues. *Paper prepared for the AIMS Regional Preparatory Meeting on the Ten Year Review of the Barbados Programme of Action*, 1-5.

BROOKS, N. (2003). Vulnerability, risk and adaptation: A conceptual framework. *Tyndall Centre for Climate Change Research*. University of East Anglia, Norwich. Working Paper No. 38.

Buainain, A. M., Romeiro, A. R., & Guanziroli, C. (2003). Family agriculture and the new rural world. *Sociologias*, 5(10), 312-347.

Castro, C. N. de. (2012). Agriculture in northeast Brazil: opportunities and limitations to development. Instituto de Pesquisa Econômica Aplicada, Texto para Discussão n. 1786.

Chayanov, A. V. (1966). On the theory of non-capitalist economic systems. In D. Thonner, B. Kenblay, & R. E. F. Smith (Eds.), *The theory of peasant economy* (pp. 1-28).

Diamond, J. (2002). Evolution, consequences and future of plant and animal domestication. *Nature*, 418, 700-707.

de Janvry, A. (1989). Políticas y Programas de Desarrollo Rural. In F. Jordan (Ed.), *La economía campesina:* crisis, reactivación y desarrollo (pp. 239-248).

Fávero, L. P. (2009). *Data analysis:* multivariate modeling for decision making. Elsevier.

Feitosa, M., & Lemos, J. de J. S. (2020). Simulations to make sustainable soybean production in Matopiba region. *Regional Development in debate*, 10, 196-221.

Garcia, C. H. (1989). *Tables for classifying the coefficient of variation*. IPEF.

Gomes, F. P. (1985). *Course in experimental statistics* (13th ed.). ESALQ/USP.

Grisa, C., Wesz Junior, V. J., & Buchweitz, V. D. (2014). Revisiting Pronaf: old questions, new interpretations. *Journal of Economia e Sociologia Rural*, 52(2), 323-346.

Guillaumont, P., & Simonet, C. (2011). Designing an Index of Physical Vulnerability to Climate Change. FERDI Working paper.

Hair Jr, J. F., et al. (2005). *Multivariate Data Analysis* (5th ed.). Bookman.

Lemos, J. J. S. (2001). Levels of Degradation in Northeast Brazil. *Northeast Economic Magazine*, 12, 406-429.

Lemos, J. J. S. (2020). Induced vulnerabilities in the Brazilian semiarid. *Regional Development in Debate*, 14(1), 245-268.

Lira, J. S., Lemos, J. J. S., & Lima, P. V. P. S. (2016). Recoverability of family farming in Brazilian Northeast: Analyses to period 1990-2012. *Northeast Economic Magazine*, 27(107), 6-17.

Maroco, J. (2003). *Statistical analysis using SPSS* (2nd ed.). Sílabo.

Monteiro, A. P., & Lemos, J. de J. S. (2019). Inequalities in the distribution of Pronaf resources among Brazilian regions. *Agricultural Policy Magazine*, 28(1).

Navarro, Z., & Pedroso, M. T. M. (2014). Family farming in Brazil: from an initial promise to its current impasses. *Northeast Economic Magazine*, 25(106), 107-121.

Oliveira, M. A. (2012). Brazilian agricultural fields, from the colonial period to the present: Historical and formal characterization of a typological category. *Varia Historia*, 28(48), 755-780.

Sachs, I. (1997). Sustainable development, decentralized bio-industrialization and new rural-urban configurations. In P. F. Vieira & J. Weber (Eds.), *Renewable natural resource management and development:* New challenges for environmental research (pp. 469-494).

Schmidt, J. G. A., & Cançado, M. P. (2019). Exploration through complexity: A theoretical model to analyze how the extraction of value takes place in the soy agro-industrial complex. In J. F. Rodrigues (Ed.), *Innovation, management and Sustainability* (pp. 314-330).

Silva, F. P. (2012). *Financing the grain chain in Brazil:* The role of trading companies and input suppliers. (Master's thesis). State University of Campinas, Campinas, SP, Brazil.

Sousa, J. M. P. (2008). *Evaluation of family agriculture financing in production, occupation and income.* (Master's thesis). Federal University of Ceará, Fortaleza, CE, Brazil.

Thornton, P. K., et al. (2008). Climate change and poverty in Africa: Mapping hotspots of vulnerability. *African Journal of Agricultural and Resource Economics*, 2(1), 24-44.