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The Profile of Family Farmers in the Regions of Brazil

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Abstract

Despite the importance of modernizing Brazilian agriculture through capitalization, alongside agricultural public policies, at the regional level this process has taken place asymmetrically and continues as such to this day. Thus, this work aims to verify the characteristics of family farmers and their establishments in the different regions of Brazil, based on municipal data from the 2017 Agricultural Census, using the Logit Multinomial econometric model. The results suggest heterogeneity among the different regions of the country, which corroborates the process of asymmetric modernization of Brazilian agriculture, and, through the econometric estimation, based on variations in the characteristics observed, the South region of Brazil has, in general, more favorable characteristics when compared to the other regions.

Keywords: family farmers, Agriculture, Brazil

JEL Classification : Q12, Q18, C35.

1. Introduction

Agriculture is one of the sectors which augment the Brazilian Gross Domestic Product (GDP) the most, where, in 2017, it corresponded to 5.3% of GDP, and represented 0.8% of the gross added value. Furthermore, according to the Brazilian Institute of Geography and Statistics (*Instituto Brasileiro de Geografia e Estatística* - IBGE), family farmers had considerable participation in the value of the GDP (IBGE, 2019a). Brazil has great prominence in the global market due to its agricultural production capacity, from grains, vegetables, fruits, animal proteins to processed, in addition to being a source of raw materials (GONÇALVES; COSTA, 2019).

Agricultural policy instruments are considered one of the main promoters of agricultural activity in the country, with agricultural planning, rural credit, minimum price guarantee

policy and rural insurance being the most used by rural establishments. However, among these instruments, rural credit is considered to be of greater relevance, allowing the modernization and adoption of new technologies, therefore increasing production and, thus, having a positive effect on productivity. (COSTA; VIEIRA FILHO, 2018).

As a result of the transformations that took place in the Brazilian agricultural sector, the country's agricultural growth was directed towards the foreign market, making Brazil one of the world's largest food exporters (VIEIRA FILHO, 2016; NAVARRO, 2016). Consequently, rural credit mostly benefited large rural producers who had modern agricultural practices and agricultural companies, located mainly in the South and Southeast regions, thus Brazilian agriculture can be described as having large concentrations of land and income, in addition to structural heterogeneity, leaving family farming at a disadvantage (SILVA, 1998).

In the 1990s, the federal government began to focus on small producers, specifically in 1996, with the creation of the National Program for Strengthening Family Agriculture (*Programa Nacional de Fortalecimento da Agricultura Familiar* - Pronaf), aiming to promote the inclusion of this group of producers in making Brazilian agriculture more dynamic, providing increased production capacity, job creation and improved income in the sector (BUAINAIN *et al.*, 2014).

According to the 2017 Brazilian agricultural census, family farming represents 77% of all Brazilian agricultural establishments, but the area occupied by these farmers corresponded to only 23% of the area of all agricultural establishments, suggesting social inequalities in the countryside, through land concentration and problems in the country's agrarian structure.

However, it corresponded to 67% (about 10.1 million) of employed individuals in agricultural establishments, mostly in the Northeast region (46.6%), and to a lesser extent in the Center-West region (5.5%) of the country. When compared to the 2006 census, it appears that despite an increase of about 5% in the total area of agricultural establishments, specifically for family farming, there was a reduction, given that these corresponded to 24.3% of the total area; as for employed individuals, there was a decrease both for the sector as a whole (8.8%), and for family farmers, since in the 2006 census they corresponded to 74.4% (about 12.3 million) of individuals (IBGE, 2009; IBGE, 2019b).

In this sense, there is evidence of heterogeneity in the Brazilian rural environment, due to differences in income, education level, land, technology, among others (DIAS, 2020; DEPONTI, SCARTON AND SCHNEIDER, 2014; HELFAND, MOREIRA AND BRESNYAN, 2014). Furthermore, according to Silva (2015), Brazilian family farming itself is heterogeneous, comprising a great cultural, social and economic variety, ranging from subsistence farming to modernized small production, and one should take into account the differences in environment, characterized by the region where farmers develop their rural activities. Thus, it is necessary to analyze the more specific characteristics of these farmers in each region of Brazil.

Therefore, this work aims to identify and describe the profile of family farmers in the different regions of Brazil, motivated both by their economic diversity and social

characteristics, contributing to the literature, given the relatively few studies in relation to the analysis of the characteristics of family farmers among the regions of the country. For this purpose, data from the 2017 Agricultural Census at the municipal level is used, as it is the most recent data referring to agriculture in Brazil, and also the Multinomial Logit model.

This work is divided into five sections, in addition to this introduction. In the second section, a brief literature review on the history of family farmers in Brazil is presented, in addition to verifying their characteristics based on research made in previous years. Then, the following section discusses the methodology used, and, in the fourth section, the results are presented and commented upon. Lastly, the concluding remarks are featured, summarizing the main points.

2. Literature Review

2.1 Family Farming Financing

Historically, the modernization of Brazilian agriculture began in the 1960s with State intervention through the process of rural capitalization, concomitantly with financial and industrial capital (DELGADO, 2001). The main instruments of agricultural policy, which were intended to drive technological change in order to increase agricultural productivity were: the National Rural Credit System (*Sistema Nacional de Crédito Rural* - SNCR), which financed production; the Guaranteed Minimum Prices Policy (*Política de Garantia Preços Mínimos* - PGPM), which, as the name suggests, facilitated maintaining a certain level of prices and commercialization; the Brazilian Technical Assistance and Rural Extension Company (*Empresa Brasileira de Assistência Técnica e Extensão Rural* - EMBRATER), which aimed to transfer technology and provide technical assistance; the Brazilian Agricultural Research Company (Empresa Brasileira de Pesquisa Agropecuária - EMBRAPA), promoting technological innovations; and the Agricultural Activity Guarantee Program (*Programa de Garantia da Atividade Agropecuária* - PROAGRO), which provides agriculture insurance (GONÇALVES NETO, 1997).

However, these instruments of agricultural policy have a selective aspect, mainly benefiting medium and large producers, with agricultural production aimed, generally, at the foreign market, mostly located in the South and Southeast regions of Brazil, where there are greater advances in relation to the modernization processes when compared to the other regions (DELGADO, 2010; GRAZIANO DA SILVA, 1999; KAGEYAMA E GRAZIANO DA SILVA, 1983).

Although rural credit is offered uniformly without distinguishing the characteristics of the beneficiaries, small producers, during the period of modernization, had limited access due to the lack of information, bureaucracy, the guarantees needed to offer to the banking system, among other reasons; and as the other instruments of agricultural policy were linked to the access to rural credit, these restrictions also meant difficulty in accessing other types of credit, contributing to the growth of productive inequality in Brazil (ALMEIDA *et al.*, 2010; GONÇALVES NETO, 1997).

Thus, these policies for the modernization of Brazilian agriculture resulted in indebtedness,

unemployment, loss of land and the rural and agricultural exodus of the less favored. It was only after the 1990s that family farmers gained greater visibility and became targets of public policies, more specifically in 1996 with the implementation of the National Program for Strengthening Family Agriculture (*Programa Nacional de Fortalecimento da Agricultura Familiar* - Pronaf), promoting the inclusion of this group in the process of boosting Brazilian agriculture (BUAINAIN *et al*., 2014).

The emergence of Pronaf, the main policy aimed at family farmers, aimed to provide agricultural credit and institutional support through low interest rates and longer market terms, offering technical assistance support and infrastructure development, increasing production capacity, contributing to the generation of jobs and increased income in rural areas, in addition to improving the quality of life of these farmers (SCHNEIDER; CAZELLA; MATTEI, 2004). Thus, family farming, which until then was outside the rural development system, started to generate occupation, employment and income, reducing the rural exodus and contributing to individuals remaining in the countryside. (HENIG; SANTOS, 2016).

To acquire credit, families must seek the government, or the Technical Assistance and Rural Extension Company (*Empresa de Assistência Técnica e Extensão Rural*- EMATER) to obtain the Pronaf Aptitude Statement (*Declaração de Aptidão ao Pronaf* - DAP), which is issued by institutions authorized by the Brazilian Ministry of Agrarian Development (*Ministério de Desenvolvimento Agrário* - MDA), where, according to law nº 11.326, of July 24th 2006, known as the *Family Farming Law*, will be considered as family farming establishments only those which meet the following criteria: *i*) is a farmer or entrepreneur who practices activities in rural areas; *ii*) does not hold, in any capacity, an area greater than four fiscal modules[1]; *iii*) uses mostly family labor; *iv*) has family income predominantly originated from activities linked to the establishment itself; and v) manages the establishment or enterprise with their family (BRASIL, 2006).

Thus, in the last decades, there have been changes in the Pronaf program aiming at the distribution of resources that reaches all the diversity of farmers and regions, in which groups of beneficiaries were assigned according to their profiles and credit lines, those being: Group A; group A/C; Group B; Group V; Women, Youth, Agroindustry, Agroecology, Semiarid, Forest, Ecology, Cost, Industrialization, Investment (More Foods); Quota-Part; Rural Microcredit (BANCO DO NORDESTE, 2019). Categories B and V of Pronaf are particularly relevant to this work. Category B is for financing family farmers and rural producers (individuals) who have obtained a gross family income of up to 23,000 *reais*, in the 12 months of normal production that preceded the request for the Declaration of Aptitude to the program, and category V is aimed at family farmers with an annual family income of up to 415,000 *reais*.

[1] According to Bianchini (2005), the size of the fiscal module is fixed by the Brazilian National Institute of Colonization and Agrarian Reform (*Instituto Nacional de Colonização e Reforma Agrária* – INCRA), and varies between 5 and 110 hectares according to each municipality.

2.2 Family Farming and Its Diversity

Brazilian family farming is culturally, socially and economically diversified, covering both families that exploit smallholdings in precarious conditions, and modernized producers inserted in agribusiness and which manage to gain higher income. These differences are mainly due to the way agricultural development in Brazil took place, along with cultural heritage, differences in professional experience, public policies, and the access and availability of factors such as natural resources, human capital, social capital, among others (BUAINAIN, 2007).

Despite advances in public policies aimed at family farmers, inequality remains present. According to Corrêa, Fernandes and Muniz (2014), from 2003 onwards, there was an increase in the distribution of resources related to Pronaf in the Brazilian regions. However, despite that fact, there is a concentration of these resources in the South region of the country, because of the coordination of production linked to agribusiness through contracts, leading to a significant increase in the productivity of family farmers (STOFFEL; COLOGNESE, 2005).

This inequality is also seen by Araújo (2019), who based on data from the IBGE National Household Sample Survey (*Pesquisa Nacional por Amostra de Domicílios* - PNAD) from the IBGE for the year 2014, and the rural credit matrix of the Central Bank of Brazil, found that Pronaf has a positive impact both on income and on agricultural productivity, however, the author also finds that the policy is quite heterogeneous among Brazilian regions in relation to credit and the number of contracts. That is, despite observing positive results from the program, there is a large portion of the target population that does not have access to it, which can be characterized, according to the author, by the existence of credit restrictions.

The 2006 Agricultural Census featured, for the first time, the specification of family and non-family farmers, based on the criteria established by the *Family Agriculture Law*, and serves as a reference for this work. Thus, according to the data, family farming consisted of 4.3 million rural establishments, representing 84.4% of the total, where it was responsible for 38% of the gross value of agricultural production, 74.4% of the total rural occupations, but occupied only 24.3% of the total area of agricultural establishments.

Regionally, family farms were concentrated in the Northeast, with 50.09% of them, followed by the South (19.46%), Southeast (16.03%), North (9.45%) and Center-west (4.97%) regions. As such, family farming makes up more than half of the agricultural group present in all regions, representing: 89% of establishments in the Northeast, 86% in the North, 84% in the South, 75% in the Southeast and, lastly, 68% in the Center-west (SCHNEIDER; CASSOL, 2017; SCHNEIDER; CASSOL, 2013).

As for the condition of the family farmer in terms of access to or ownership of land, based on the 2006 Census: 74.72% own the establishments; 3.9% are settled without a definitive title of property; 4.49% are tenants; 2.9% are is some kind of partnership; 8.44% are occupants; and 5.54% are producers without any land. In addition, of the total number of people employed in agricultural establishments, 74.38% (12.3 million) were in family farming,

where 92.62% of those were aged 14 or over, and featuring child labor (7.38% were under 14). Most individuals were male, representing 62.22% of the sample, while 30.4% are women, and child labor also occurred in greater proportion for males. Of the 12.3 million people employed in family farming, 10.13 million (aged 14 or over) had family ties or kinship with the producer, 79.97% lived on the farm, 64.37% knew how to read and write, only 1.67% had professional qualification, 1.58% worked only in agricultural activity, and 3.33% received a salary.

Also according to 2006 Census data, only a small part of rural establishments received some type of technical assistance, in which the most well-structured establishments are the most benefited, and only about 20% of family establishments received technical guidance. From the groups of family farmers in each region, it is possible to confirm this hypothesis, where in the regions considered more developed in Brazil, the Southeast (24.58%) and the South (47%), there is greater access to assistance, in contrast to the Center-West (22, 17%), North (13.72%) and, particularly, the Northeast (7.16%) region (SCHNEIDER; CASSOL, 2013).

This diversity among regions is also due to the fact that each one has distinct natural and economic conditions, where, according to Embrapa (2020 a-e):

- The North Region: has the largest territorial extension in Brazil, featuring the Amazon Forest and holding the greatest biodiversity on the planet, with extensive fauna and flora; with a predominantly equatorial climate, hot and humid; and the economy is based on industrial activities, plant and mineral extraction, agriculture and tourism.

- The Center-west Region: the second largest territorial extension in the country, it has great biodiversity and is characterized by a semi-humid tropical climate, with two well-defined seasons: dry winter and hot, rainy summer; varying the temperature between 15ºC to 40ºC. The largest flooded plain in the world is featured in the regions, the Plateau, where the *Cerrado* vegetation is predominant. In rural areas, the main economic activities are extensive livestock and commercial agriculture, where the industrial sector is the least developed.

- The Northeast Region: third largest in the country, it has a diverse population and culture, with high temperatures, mostly in the semi-arid climate, comprising the *Caatinga*, Atlantic Forest and *Cerrado* biomes, where it is divided into four sub-regions: Mid-North, *Sertão, Zona da Mata* and *Agreste*. Considered as the poorest region in Brazil, the predominant activity is agriculture, especially sugarcane; however, industrial activities, oil exploration and tourism are also important to the region's economy.

- The Southeast Region: considered the richest in the country, it is the most populous, with a tropical climate with high temperatures and is marked by two seasons: rainy summer and dry winter; with vegetation that varies according to the climate, but most of it is formed by the Atlantic Forest, where, in Minas Gerais, the predominant vegetation is the *Cerrado*, and, in the north of the state, the *Caatinga* is found. Its population is mostly urban and has the most developed and industrialized economy in

Brazil, with advanced agricultural production, with emphasis on the exploration of minerals and oil, in addition to tourism also representing an important economic activity.

- The Southern Region: Brazil's smallest region in territorial extension, it has an economy distributed in the industrial, agricultural, extractivism, tourism sectors, among others. Its climate is predominantly subtropical, characterized by variations in temperature, being the coldest region in the country. Economically, it is based on polyculture, where, after the Southeast, it is the most industrialized region in Brazil. In addition, it also has the highest social indicators, denoting that it is a region that has good public policies for education and health.

Thus, there is heterogeneity among the Brazilian regions, mainly due to the asymmetrical form of the modernization process, which at first did not bring technologies to improve productivity to the North and Northeast regions of the country, as well as the difficulties in accessing rural credit by the family farming.

2.3 Recent Contributions in Academic Literature

In terms of recent literature, several authors have researched family farmers in Brazil. For instance, Nascimento, Aquino and Delgrossi (2022) study the results of the 2017 Agricultural Census in Brazil, released at the end of 2019 by the IBGE, which opened up debates about the characteristics and reasons for the reduction in the number of family farmers in Brazil *vis-à-vis* the figures presented in 2006. The authors use microdata from the National Household Sample Survey - PNAD (from 2006 to 2015) to assess the evolution of the number of family farmers in the country. The research results suggest that pluriactivity has become, due to the application of the criteria of the Family Agriculture Law of 2006, a potential element to prevent a significant part of self-employed families from being classified as family farmers, which contributes to reducing the number of this segment of farmers in official statistics. In turn, alongside family farming that sells part of its production, the work shows that a growing portion of the category is dedicated to productive activities for its consumption, requiring public policies for productive inclusion and rural development.

Valadares (2022) proposes to draw an overview of the changes in land use and the type of production that occurred in Brazilian family agriculture between the 2006 and 2017 Agricultural Censuses, having, as a background, the reduction in the number of family establishments in the period between the two censuses. The objective is to verify how this reduction is explained by variations in the forms of land use – farming, livestock, vegetable production *etc*. – observed between 2006 and 2017. The hypothesis extracted from the data analysis is that Brazilian family farming, historically marked by small farming in the Northeast and South and their socioeconomic differences, would be undergoing a change in profile, with the growing predominance of family farming with larger landholdings - and more focused on livestock - in the North region, above all, and in the Center-West region of the country.

Brum *et al.* (2022) also research this topic, but specifically analyze family farming in the southern region of Brazil. The authors sought to identify the different profiles of family farmers in the southern region of the state of Rio Grande do Sul, by grouping their demographic and socioeconomic characteristics and their levels of satisfaction with farming. A quantitative analysis was performed with a cross-sectional design, conducted through 104 household interviews via a structured questionnaire, with the 'snowball' technique, in the period from September 2018 to February 2019. Descriptive statistics, analysis of variance and cluster analysis were employed. Three different clusters were identified defined by variables which represented satisfaction with farming, type of housing, income, length of stay in farming and level of education. According to the authors, the cluster of family farmers satisfied with agriculture is composed mostly by men. These farmers reside in their own house, have longer time working in agriculture and lower average monthly family income in relation to the others.

Gunaziroli and Vinchon (2019) also focus on a specific region of the country, the Southeast, and the state of Rio de Janeiro. The authors study family farming in different regions of that state and the determinants of farm income, and use multiple regression analysis based on data from the BNDES/UFscar/Cresol research project "*Studies to guide new agricultural business opportunities, collective investment and alternative marketing possibilities*". The regression results suggest that the use of technical assistance by farmers, their participation in rural cooperatives, the area of these establishments and the increase in the years of schooling of the agricultural producer boost the generation of gross income. Therefore, they argue, it can be said that public policies that focus on the development of family agriculture should include aspects that involve the education and training of rural producers, as well as encouraging participation in rural cooperatives and the use of technical assistance.

3. Methodology

3.1 Data

To achieve the objective established, data from the 2017 Brazilian Agricultural Census at the municipal level is used, which is carried out by the Brazilian Institute of Geography and Statistics (*Instituto Brasileiro de Geografia e Estatística* - IBGE), and made available through the IBGE Automatic Recovery System (*Sistema IBGE de Recuperação Automática* - SIDRA).

The data were based on the crop year (October 2016 to September 2017), thus it is not strictly comparable to the Censuses carried out previously, given that the 2006 Agricultural Census uses the calendar year as the reference period, and the Agricultural Census of 1995/1996, despite also using the crop year as a reference, adopted a different period.

In the Multinomial Logit model, the Brazilian regions are considered as a dependent variable, assuming the following values: i) 0 (zero) if the family farm is in a municipality in the North region; ii) 1 (one) if the family farming establishment is in a municipality in the Northeast region; iii) 2 (two) if the family farming establishment is in a municipality in the Southeast region; iv) 3 (three) if the family farming establishment is in a municipality in the South

region; and v) 4 (four) if the family farming establishment is in a municipality in the Center-west region.

Chart 1 below presents the description of the explanatory variables used in the model, in order to obtain characteristics both in relation to production, as well as to the establishment and family farmers in the regions, in addition to information on credit.

Chart 1. Description of the explanatory variables used in the model

Variables	Description
Regions	Dummy variables for the regions of Brazil (North, Northeast, Southeast, South and Center-west).
Gross value of production	Gross value of agricultural production by family farming establishments per municipality in thousand *reais* (R$).
Establishment area	Area of family farming rural establishment by municipality in hectare.
Productivity	Gross Production Value (thousand *reais*) / Planted area (hectare).
Capital	Number of tractors, agricultural machinery and equipment in family establishments per municipality.
Labor	Number of people employed in family agricultural establishments per municipality.
Labor with family ties	Number of persons employed with family ties with the producer in family agricultural establishments by municipality.
Irrigation	Number of agricultural establishments using irrigation per municipality.
Technical assistance	Number of agricultural establishments that received technical assistance by municipality.
Agricultural practice	Number of agricultural establishments that have had some type of agricultural practice per municipality.
Electricity	Number of agricultural establishments with access to electricity per municipality.
Cooperative	Number of agricultural establishments where there was some type of association between the producer and the cooperative by municipality.
Class entity - union	Number of agricultural establishments where there was some type of association between the producer and the trade association/union by municipality.
Commerce sale	Number of agricultural establishments that put the products produced for sale, by municipality.
Self-consumption	Number of agricultural establishments that produced for their own consumption, by municipality.
Owner	Number of agricultural establishments in which the rural farmer is the owner, by municipality.
Manages the establishment	Number of agricultural establishments where the rural producer manages the establishment, by municipality.
Under 25 years old	Number of agricultural establishments with a farmer under 25 years of age, per municipality.
25-35 years old	Number of agricultural establishments with a farmer between 25 and 35 years old, per municipality.
35-45 years old	Number of agricultural establishments with a farmer between 35 and 45 years of age, per municipality.
45-55 years old	Number of agricultural establishments with a farmer between 45 and 55 years of age, per municipality.
55-65 years old	Number of agricultural establishments with a farmer between 55 and 65 years of age, per municipality.
65-75 years old	Number of agricultural establishments with a farmer between 65 and 75 years of age, per municipality.
75 years old and over	Number of agricultural establishments with a farmer aged 75 years or over, by municipality.
White	Number of agricultural establishments where the family farmer is white, by municipality.
Male	Number of agricultural establishments where the family farmer is male, by municipality.
Can read and write	Number of agricultural establishments where the family farmer can read and write, by municipality.
Pronaf B	Number of agricultural establishments that fall into category B of the Pronaf, by municipality.
Pronaf V	Number of agricultural establishments that fall into category V of Pronaf, by municipality.
Non-pronaf	Number of non-Pronaf agricultural establishments, by municipality.
Investment	Number of agricultural establishments that obtained financing for investment by municipality.
Cost subsidy	Number of agricultural establishments that obtained funding for costs per municipality.
Commercialization	Number of agricultural establishments that obtained financing for marketing by municipality.
Maintenance	Number of agricultural establishments that obtained financing for maintenance by municipality.

Source: Prepared by the authors

3.2 Multinomial Logit Model

In general, the binomial logit model is used when the dependent variable is dichotomous, that is, when two values are assumed that are represented by a dummy variable. However, in this work, the variable of interest (outcome) features five categories (North, Northeast, Southeast, South and Center-west), seeking to capture the heterogeneity among the Brazilian regions, through variables related to family farming.

Thus, the method to be used is the Multinomial Logit Model, also known as the polytomous logistic regression model, which can be referred to as an extension of the binomial logit model, in which the dependent variable can take on multiple unordered categories, that is, the permutation of categories does not affect statistical analysis. Considering J categories, J-1 equations must be generated, one of these categories being used as the base category. Thus, given that this work has five categories, there will be, therefore, 4 equations.

According to the academic literature, the agricultural modernization process has benefited

mainly large and medium-sized farmers, located mostly in the South and Southeast regions of the country, and even with the implementation of Pronaf, which aims at the inclusion of family farmers in Brazilian agriculture and making the sector more dynamic, Corrêa, Fernandes and Muniz (2014) also observed a concentration of resources in these regions.

Thus, given that the southern region of Brazil has historically been privileged with access to capital and technologies, and since the average productivity of family farms per municipality in the South is higher than the other regions, as shown in Table 1, this region was chosen as basis for estimating the model.

Table 1. Productivity of family agricultural establishments in Brazilian regions in thousand *reais*

Region	Mean	Standard Deviation
North	0.83	1.21
Northeast	1.31	2.64
South-east	2.82	3.10
South	4.26	3.04
Center-West	1.29	1.08

Source: Prepared by the authors.

Thus, assuming that $0 < P_{ij} < 1$ and that $\sum_{j=1}^{J} P_{ij} = 1$ for any *i*, and ensuring the identification of the model by setting β_j to the base category, the probabilities can be defined, in general, as:

$$prob\ (y_i = j \mid w_i) = P_{ij} = \frac{e^{wi\beta j}}{1+\sum_{j=1}^{J} e^{i\beta ji}}, \quad \text{for} \quad j = 1, ..., J \qquad (1)$$

in which, P_{ij} represents the probability of municipality "*i*" belonging to region "*j*", considering that in this work, *J* portrays the Brazilian regions and *i* the municipalities; w_i is the matrix of explanatory variables; and β is the vector of parameters to be estimated from the reference category.

According to Greene (2018)[2], the model used is estimated by the maximum likelihood method, where the coefficients denote the relative changes in probabilities in relation to the baseline reference category. However, to interpret the results, the relative risk ratio (RRR) is commonly used, based on the variation of odds in favor of a given category (region) over others, expressed in the following equation:

$$RRR = \frac{\frac{Prob\ (yi = j \mid w+1)}{Prob\ (yi = k \mid w+1)}}{\frac{Prob\ (yi = j \mid w)}{Prob\ (yi = k \mid w)}} \qquad (2)$$

4. Results

4.1 Descriptive Analysis

[2] For more details on the econometric method, see Greene (2018, p. 829-833).

The sample consisted of 4,859 municipalities that contain family farm establishments. Table 2 presents the descriptive statistics of the explanatory variables for Brazil, while the statistics for the regions are found in Table 1A in the Appendix.

The variables were divided into four groups (production, establishment characteristics, farmer characteristics and credit) in order to facilitate the analysis. Thus, regarding the production group, it can be seen that, on average, the gross value of family agricultural production in Brazil was 21,163.56 thousand *reais*, comprising an average area of family rural establishments per municipality with 15,334.36 hectares, and, therefore, a productivity of 2.45 thousand *reais* per hectare.

In regional terms, the South region of the country has the highest gross production value, followed by the North, Center-west, Southeast and, lastly, the Northeast region. Although the South also features greater productivity (4.26 thousand *reais* per hectare), the North, previously followed by the South in relation to the gross production value, is the region with the lowest productivity, with only 0.83 thousand reais per hectare, on the other hand. On the other hand, the Northeast, which used to have the lowest gross production value, became the third region with the highest productivity (1.31 thousand *reais* per hectare).

It was also possible to analyze regional inequalities related to agrarian structure, corroborating the study by Antunes (2011), who using the 2006 Agricultural Census, found that the North and Central-West regions have municipalities where family farms have larger areas, however, while Antunes (2011) found that the Northeast and Southeast had family establishments with the smallest average areas, in this work, it was found that the regions of establishments with the smallest average area per municipality were, respectively, the Southeast and South.

On average, Brazilian municipalities hold 179.48 units of capital (tractors, machinery and agricultural equipment) in rural establishments, 1,866.78 individuals employed, and 1,632.92 individuals employed with family ties or some kinship with the family farmer. Also, on average, there are 73.8 establishments per municipality with use of irrigation, 139.58 which received technical assistance, and 408.13 which obtained some type of agricultural practice. Considering the gap between the averages of the number of existing capital in establishments in the South (474.42) and Northeast (26) regions, this corroborates the tendency with how the modernization process of Brazilian agriculture occurred.

As for labor, Guanziroli and Cardim (2000), using microdata from the 1995/96 Agricultural Census, observed that the Northeast region had the highest number of employed people among family farmers, followed by the South region, being the Center-West with less emphasis, however, in this work, at the municipal level and based on the 2017 Census, the region with the highest average per municipality in relation to labor, in general, was the North, followed by the Northeast regions, South, Center-west and, lastly, the Southeast.

The Northeast was the region with the largest number of establishments with irrigation, and that had some type of agricultural practice, while the South had, on average, the largest number of establishments that received technical assistance.

As for the second group, the Southeast presented, in general, less favorable conditions in relation to the characteristics of the establishment, representing the region with the lowest number of establishments with access to electricity, production destined for commerce and self-consumption, as well as the region with fewer establishments where the rural farmer is the owner of the establishment, and where the rural producer manages the establishment. It is noteworthy that in the 2006 Agricultural Census, Antunes (2011) found that the region with the lowest proportion of establishments with access to electricity was the North, with almost half of family agricultural establishments without access to it.

On the other hand, the Northeast was the region with the highest average of establishments that has access to electricity, where there was some type of association between the producer and a trade union, which produce for their own consumption, and where the rural producer manages the establishment. The North was the region with the largest number of establishments that produce for sale and where the rural producer owns the establishment; and the South region featured the highest average in relation to agricultural establishments where there was some type of association between the producer and a cooperative enterprise.

In terms of farmer characteristics, it can be observed that the sample is composed mostly of establishments with family farmers aged between 55 and 65 years old, with the exception of the North region, where farmers aged between 45 and 55 years old predominate. It is also seen that the South region, followed by the Northeast, has a higher numbers of establishments where family farmers are white. The North, also followed by the Northeast, represented the regions with the highest number of establishments in which the family farmer is a male, and in which the farmer knows how to read and write, as opposed to the Southeast, although Antunes (2011), using the 2006 Census, observed that the South region had the highest education and professional qualification when compared to the other regions.

Lastly, considering the credit group, it can be seen that family agricultural establishments fall into category B of Pronaf, with the exception of the South region, where category V of Pronaf predominates; while a smaller part of the sample is of non-Pronaf establishments. As for the destination of the credit, investment seems to be the norm, where most of the financing was allocated to the South region mainly for cost funding subsidies.

Table 2. Descriptive statistics of the explanatory variables

	Variables	Obs.	Mean	Std. Dev.	Min	Max
Product	Gross value of production	4,859	21163.56	27004.53	64	305540
	Establishment area	4,859	15334.36	23322.25	8	429428
	Productivity	4,859	2.45	2.98	0.053	56.06
	Capital	4,859	179.48	331.32	0	5791
	Labor	4,859	1866.78	2312.82	8	43736
	Labor with kinship ties	4,859	1632.92	2046.98	5	39985
	Irrigation	4,800	73.80	182.72	0	3654
	Technical assistance	4,859	139.58	194.73	0	3050
	Agricultural practice	4,859	408.13	540.28	0	8204

Characteristics of the establishment	Electricity	4,859	605.56	683.64	0	9122
	Cooperative	4,859	83.62	147.49	0	1746
	Syndicate/ Workers' Union	4,859	289.35	400.07	0	4941
	Commerce sales	4,859	435.07	527.95	0	6081
	Own consumption	4,859	286.89	560.47	0	5812
	Owner	4,859	588.21	681.16	0	11002
	Manages the establishment	4,859	531.90	618.87	2	9017
Characteristics of the farmer	Under 25 years of age	4,859	13.54	26.86	0	481
	25-35 years of age	4,859	61.14	101.46	0	2126
	35-45 years of age	4,859	118.55	162.27	0	2885
	45-55 years of age	4,859	167.40	186.78	0	2505
	55-65 years of age	4,859	176.34	179.68	0	1956
	65-75 years of age	4,859	124.87	133.88	0	1380
	75 years of age or over	4,859	60.11	73.57	0	881
	White	4,859	327.92	360.56	0	6306
	Male	4,859	581.88	630.76	3	8931
	Can read and write	4,859	738.89	727.61	5	11334
Credit	Pronaf B	4,859	492.21	700.18	0	10139
	Pronaf V	4,859	224.51	271.81	0	3538
	Non-Pronaf	4,859	5.24	11.51	0	186
	Investment	4,847	68.59	87.93	0	950
	Cost subsidy	4,847	53.82	87.18	0	1258
	Commercialization	4,847	1.93	6.81	0	162
	Maintenance	4,847	16.54	34.09	0	545

Source: Prepared by the authors

4.2 Estimation of the Multinomial Logit

This subsection presents the results estimated by the Multinomial Logit model, to identify the probability of a family farmer being located in the i) North; ii) Northeast; iii) Southeast; and iv) Center-west regions of Brazil. A model was estimated for each region, with the South used as a reference category.

Considering the statistical significance at the level of 5%, in general the estimated coefficients, presented in Table 3, were significant, mainly for the Northeast and Southeast regions. However, these coefficients do not directly represent the marginal responses, so the interpretation of the results is made using the Relative Risk Ratio (RRR), in which the values above one indicate an increase in the predicted probability for family farmers being in the North, Northeast, Southeast and Center-West regions of Brazil. Coefficients less than one suggest the opposite, *i.e.*, the family farm establishment is in the South region of the country.

Thus, it can be observed that, in relation to the production group, the increase of 1,000 *reais* in the gross value of production increases the probability that the family farm establishment is in the North region by 0.01%, and decreases the probability it is in the Northeast by 0.017%.

In terms of an increase in the area of the establishment, it can also be noted that the probability the family farm is in regions other than the South is small, with the most likelihood being in the North, with 0.034% chance. The odds of the family establishment being in other regions decrease when there is a variation of 1,000 *reais* per hectare more in productivity. This decrease is of the magnitude of 62.27%, 3.9% and 37.21%, respectively, for the North, Southeast and Center –West regions, and, for the Northeast region, there is no effect.

As for a variation of one more unit of capital, the results are: 2.4% in the Northeast region, 1.94% in the North region, and 0.68% in the Center-west region, with no effect detected for the Southeast. The use of physical capital (machines, equipment and agricultural implements) is more intensive in the South region when compared to other regions, and the relative risk for the Northeast region is 2.84% lower, indicating the lower use of capital for family farmers in that region.

As for the workforce, the chances of hiring an extra worker in the family farm establishment per municipality is higher in all regions, when compared to the South region, and for the Northeast the odds are of approximately 1.33%. On the other hand, the presence of workers with family ties with the producer decrease the likelihood for all other regions, indicating that although the South is not the region with the highest concentration of labor, it has the highest relative number of labor with kinship ties with the producer.

The increased use of irrigation by an agricultural establishment per municipality increases the probability that the family farmer is from somewhere other than the South, mainly the Northeast, with 1.52% probability. Regarding agricultural practices, municipalities in the South region are more likely to use some type of agricultural practice when compared to other regions of the country, with the exception of the Northeast, where there was no effect. Lastly, the North region increases the probability by 1.16% of receiving technical assistance, when compared to the South region; there were no differences for the other regions.

As for the characteristics of the family farm establishment, results suggest that a variation of one more establishment per municipality with access to electricity, some type of association between the producer and the cooperative, or some type of association with the trade association/union, reduces the probability that family farm is from somewhere other than the South. More specifically, the results showed that, with respect to electricity and the producer having an association with cooperatives, the region with the lowest probability was the Northeast; and as for association with class/union entities, there is a lower probability associated with the Center-west region.

The increase of one more establishment which produces aiming to sell their output in commerce and where the producer manages the establishment per municipality, increases the probability that it is in other regions, mainly in the North (1.02% chance) and Northeast (1.4% chance), respectively. However, the variable that determines the number of establishments per municipality where the producer owns the rural establishment does not appear show relevant differences.

In terms of farmer characteristics, it is observed that, regarding the age of the family farmers, only the Northeast and Southeast regions had statistically significant coefficients, with the exception of farmers aged between 55 and 65 years, which only had an effect for the Southeast region.

Thus, the family farmer per municipality aged between: i) 25 and 35 years of age, has a probability of 16.25% being in the Northeast or Southeast regions; ii) 35 and 45 years old, has a probability of 15.94% of being in the Northeast or Southeast regions; iii) 45 and 55 years has probability of 9.26% chance of being in the Northeast or Southeast regions; iv) 55 and 65 years has a probability of 10.03% of being in the Southeast; v) 65 and 75 years has a probability of 13.28% of being in the Northeast, and 11.05% in the Southeast; and, finally, vi) 75 years old or older has a probability of 19.71% of being in the Northeast or Southeast regions.

Being white increases the chances of the family farmer being located in municipalities in the South region, when compared to other regions, especially the North. On the other hand, when this family farmer is male, the chances of him being from a municipality in the North, Northeast, Southeast and Center-west regions, are higher than being from municipalities in the South region, with the North and Northeast with the highest probabilities. The fact that the family farmer knows how to read and write increases the chances in 0.49% that he is from the Center-west region, while the chances decrease by 1.58% and 0.55% of belonging to municipalities in the Northeast and Southeast, respectively.

Lastly, in terms of credit, when analyzing the category of family farmers, the coefficients were only statistically significant for the Northeast and Southeast regions, with the exception of the non-Pronaf category, where there was only an effect for the Southeast region. Thus, the increase of one establishment per municipality that falls into categories B and V of the Pronaf program, decreases the chances of that family farm being in the Northeast and Southeast regions by approximately 8.23% and 11.41%, respectively, and 11.33% less chance it is in the Southeast for the non-Pronaf category.

Considering the destination of the financing, it is observed that the increase of establishments by municipalities with financing for investment and funding decreases the probability that the family farm is somewhere other than the South, where the variable that captured the investment effect was only significant for the Center-west region. As for commercialization, the results are shown to be favorable for all the regions, especially for the Northeast, and, lastly, for maintenance, there was only an effect for the Southeast region, of 3.89%.

Table 3. Results of the Multinomial Logit model for the determining characteristics of family farmers in the Brazilian regions

		North		Northeast		Southeast		Center-west	
	Variables	**Coefficient**	**RRR**	**Coefficient**	**RRR**	**Coefficient**	**RRR**	**Coefficient**	**RRR**
Production	Gross value of production	-0.9746***	0.3773	-0.0765	0.9264	-0.0397**	0.9610	-0.4654***	0.6279
	Establishment area	-0.0196***	0.9806	-0.0242***	0.9761	0.001	1.0010	-0.0068***	0.9932
	Productivity	0.0086***	1.0086	0.0132***	1.0133	0.0098***	1.0098	0.0068***	1.0068

	Capital	-0.0086***	0.9915	-0.0157***	0.9844	-0.0128***	0.9873	-0.0065**	0.9935
	Labor	0.013***	1.0130	0.0151***	1.0152	0.0111***	1.0112	0.0095***	1.0096
	Labor with kinship ties	0.0115***	1.0116	0.0003	1.0003	0.0028	1.0028	-0.001	0.9990
	Irrigation	-0.0055***	0.9945	-0.0016	0.9984	-0.0039***	0.9961	-0.008***	0.9921
	Technical assistance	-0.0079**	0.9921	-0.0159***	0.9843	-0.0017	0.9983	-0.0092**	0.9908
	Agricultural practice	-0.0132***	0.9869	-0.0144***	0.9857	-0.0042**	0.9958	-0.0011	0.9989
Characteristics of the establishment	Electricity	-0.0135***	0.9866	-0.0045**	0.9955	0.0002	1.0002	-0.0164***	0.9837
	Cooperative	0.0101***	1.0102	0.008***	1.0080	0.0072***	1.0073	0.0058***	1.0058
	Syndicate/ Workers' Union	0.0029	1.0029	-0.0049*	0.9951	-0.0005	0.9995	0.0002	1.0002
	Commerce sales	0.0025	1.0025	0.0139***	1.0140	0.0091***	1.0091	0.0016	1.0016
	Own consumption	0.0248	1.0252	0.1505***	1.1624	0.1507***	1.1627	0.023	1.0233
	Manages the establishment	-0.0143	0.9858	0.1537***	1.1661	0.1421***	1.1527	0.0746*	1.0774
Characteristics of the farmer	25-35 years of age	-0.0439	0.9570	0.0878**	1.0917	0.0894***	1.0935	0.0282	1.0287
	35-45 years of age	-0.047	0.9541	0.0713	1.0739	0.0955***	1.1003	0.025	1.0253
	45-55 years of age	-0.0535	0.9479	0.1248***	1.1329	0.1048***	1.1105	0.0156	1.0157
	55-65 years of age	-0.0471	0.9540	0.1793***	1.1964	0.1806***	1.1979	0.0341	1.0347
	65-75 years of age	-0.0467***	0.9543	-0.0228***	0.9774	-0.0193***	0.9809	-0.0297***	0.9707
	75 years of age or older	0.0224***	1.0226	0.0168***	1.0170	0.0275***	1.0279	0.003	1.0030
	White	-0.0007	0.9993	-0.016***	0.9842	-0.0055***	0.9945	0.0048***	1.0048
	Male	0.0322	1.0327	-0.0865**	0.9172	-0.1217***	0.8854	-0.0221	0.9782
	Can read and write	0.0379	1.0386	-0.0852**	0.9183	-0.1206***	0.8864	-0.0047	0.9953
Credit	Pronaf B	0.0479	1.0491	0.116	1.1230	-0.1202***	0.8867	0.0477	1.0488
	Pronaf V	-0.0085	0.9915	0.0027	1.0027	0.0032	1.0032	-0.0241***	0.9762
	Non Pronaf	-0.0563***	0.9453	-0.0592***	0.9425	-0.0536***	0.9478	-0.0067	0.9933
	Investment	0.1893***	1.2084	0.2607***	1.2979	0.2066***	1.2294	0.2243***	1.2514
	Cost subsidy	0.015	1.0151	0.0175	1.0176	0.0381**	1.0389	-0.0021	0.9979
	Commercialization	1.154***	3.1707	0.9823***	2.6706	1.1155***	3.0510	0.6473***	1.9103
	Maintenance	-0.9746***	0.3773	-0.0765	0.9264	-0.0397**	0.9610	-0.4654***	0.6279
	Constant	-0.0196***	0.9806	-0.0242***	0.9761	0.001	1.0010	-0.0068***	0.9932

Source: Prepared by the authors. Note: Statistical significance is *** at the 1% level, ** at the 5% level, * at the 10% level.

5. Concluding Remarks

This work aimed to identify and describe the profile of family farmers in the five different regions of Brazil, given the heterogeneity among them, in addition to using the most recent data that provide information on family farming in the country, the 2017 Brazilian Agricultural Census.

In terms of descriptive statistics, it can be observed that the South region of the country, as expected, had the highest average of productivity and capital among the family farming establishments per municipality, as well as the highest average of establishments per municipalities that had access to technical assistance, where there was some type of

association between the producer and the cooperative, and where family farmers were identified as white in terms of ethnicity.

However, it was in the Northeast region where there was the highest average of establishments per municipality with the use of irrigation, agricultural practice, and where there was some type of association with a syndicate or union, as well as the largest part of production being destined for their own consumption, and, still, where the producer manages the establishment.

Furthermore, it was possible to observe that the North region had the highest averages of establishments by municipalities in relation to the largest area of the establishment, with greater numbers of labor, greater production destined for sale in commerce, the producer owns the establishment, is a male, and can read and write. In general, the regions of Brazil have mostly family farmers who are aged between 55 and 65 years old, who fall into category B of the Pronaf program, and whose financing is destined for investment.

To accomplish this work's objective, the Logit Multinomial econometric method was used, which confirmed the existing heterogeneity among regions based on variations in the characteristics used in the model. The Southern region of Brazil was used as a reference category, and had a variation in its favor in terms of productivity, capital, employed labor with family or kinship ties, agricultural practice, electricity, cooperative participation, class entity – union participation, being white, being part of the Pronaf program in categories B, V, and also for those who are not part of the program (non-Pronaf), investment and cost subsidies; increasing the chances of family farming establishments being in this region in relation to the four other categories.

As this work corroborates the heterogeneity among the regions, and presents favorable characteristics for the South of the country in relation to the other regions of Brazil, the need for specific public policies for family farmers for each region can be argued, despite the existing initiatives.

In this sense, it is relevant, as an example of specific public policies, to suggest the restructuring of the Pronaf program (a policy with a national dimension), given the concentration of credit in the South and Southeast regions, thus defining specific credit lines for each region, especially for the most vulnerable (Northeast and North), based on the profile of the family farmers.

In addition, despite the existence of policies aimed at the economic and social development of these regions, such as the Constitutional Fund for the Northeast (FNE) and the Constitutional Fund for the North (FNO), these have been unable to reduce the gap among the five regions of Brazil. Thus, it is important that these credit policies seek to reach the majority of family farmers in each region, according to their profiles and needs.

Lastly, it is also recommended that future works seek to comprehend the factors that increase this asymmetry, as there may be risk aversion on the part of farmers, as well as a certain "myopia" in relation to the credit lines, consequently increasing, even if marginally, persistent heterogeneity observed in the literature.

References

Almeida, L. F., Zylbersztajn, D., Klein, P. G. (2010). Determinants of contractual arrangements in agricultural credit transactions. *Revista de Administração*. São Paulo, *45*(3), 209-220.

Alves, E., Silveira, J. M. Da, & Navarro, Z. (Org.). *O mundo rural do século 21: a formação de um novo padrão agrário e agrícola*. Brasília, DF: Embrapa, p. 829-864.

Antunes, D. S. (2011). Características da agricultura familiar. In: IBGE. *Atlas do espaço rural brasileiro.* IBGE: Rio de Janeiro, cap. 5, p. 113-118. Available at: <https://biblioteca.ibge.gov.br/visualizacao/livros/liv63372_cap5.pdf>. Accessed: 03rd jul. 2022.

Araújo, J. A. de. (2019). Crédito rural: plano safra e o PRONAF. *In:* Vieira Filho, J. E. R., Vieira, A. C. P., *et al*. (org.). *Diagnóstico e desafios da agricultura brasileira*. Rio de Janeiro: IPEA, p. 161-188 (Available at: <https://www.ipea.gov.br/portal/images/stories/PDFs/livros/livros/191126_diagnostico_e_desafios_da_agricultura_brasileira.pdf>. Accessed on: 01st jun. 2022.

Banco Do Nordeste. (2019). Grupos e Linhas de Crédito PRONAF - Quadro Resumo (Plano Safra 2019/2020). Available at: <https://www.bnb.gov.br/documents/165130/228956/tabela_grupos_Pronaf_19122018.pdf/9e353e24-d3e9-39ef-2698-14f212171a61>. Accessed on: 30th May 2022.

Bianchini, V. (2005). *O universo da agricultura familiar e sua contribuição ao desenvolvimento rural"***.** *Rio de Janeiro*. Curso de Aperfeiçoamento em Agroecologia. REDCAPA – Rede de Instituições Vinculadas à Capacitação em Economia e Política Agrícola da América Latina e Caribe.

Brasil. Lei n° 11.326, de 24 de julho de 2006. (2006). Estabelece as diretrizes para a formulação da Política Nacional da Agricultura Familiar e Empreendimentos Familiares Rurais. *Diário Oficial [da] República Federativa do Brasil*, 25 jul. Available at <http://www.planalto.gov.br/ccivil_03/_Ato2004-2006/2006/Lei/L11326.htm>. Accessed on: 10th jun. 2022.

Brum, A. N., Brum, A. A., Gomes, L. T., Santos, J. S., Tessmer, F. H., Pegoraro, R. K., … & Pupo, M. A. V. (2022). O Agricultor Familiar e sua Satisfação com a Agricultura no sul do Brasil. *Research, Society and Development*, *11*(5), e38911528263. http://dx.doi.org/10.33448/rsd-v11i5.28263

Buainain, A. M. (2007). *Agricultura familiar e inovação tecnológica no Brasil: características, desafios e obstáculos*. Campinas: Editora Unicamp, 238 p.

Buainain, A. M., Santana, C. A. M., Silva, F. P., Garcia, J. R., & Loyola, P. (2014). O tripé da política agrícola brasileira: crédito rural, seguro e Pronaf. *In*: Buainain, A. M.

Corrêa, V. P., Fernandes, F. F., & Muniz, A. L. P. (2014). Análise do perfil da distribuição dos recursos do Pronaf entre 1999 e 2009 e um estudo das particularidades da região Nordeste. *In:*

Schneider, S., Ferreira, B., & Alves, F. (org.). *Aspectos multidimensionais da agricultura brasileira: diferentes visões do Censo Agropecuário 2006*. Brasília: Ipea, p. 357-385. Available at: <http://ifibe.edu.br/arq/20150813152417182555567.pdf>. Accessed on: 01st jun. 2022.

Costa, E. M., & Vieira Filho, J. E. R. (2018). Choque de oferta no crédito rural e seu impacto produtivo na agricultura brasileira *In:* SACHIDA, A. (org.*). Políticas públicas: avaliando mais de meio trilhão de reais em gastos públicos*. Brasília: Ipea, p. 207-224. Available at: <https://www.ipea.gov.br/portal/images/stories/PDFs/livros/livros/181009_politicas_publicas_no_brasil.pdf>. Accessed on: 13th May 2022.

Delgado, G. C. (2010). O papel do rural no desenvolvimento nacional: da modernização conservadora dos anos 1970 ao Governo Lula. *In*: Delgado, N. G. *Brasil rural em debate: coletânea de artigos*. Brasília (DF): Condraf/Nead, p.28-78.

Delgado, G. C. (2001). Política econômica, ajuste externo e agricultura. *In*: LEITE, Sergio. *Políticas públicas e agricultura no Brasil***.** Porto Alegre (RS): Editora da UFRGS, p. 15-52.

Deponti, C. M., Scarton, L. M., Schneider, S. (2014). O retrato da extensão rural a partir dos dados do censo agropecuário 2006. *In:* Schneider, S., Ferreira, B., Alves, F. (org.). *Aspectos multidimensionais da agricultura brasileira: diferentes visões do Censo Agropecuário 2006*. p. 241-260. Brasília: Ipea, Available at: <https://www.ipea.gov.br/portal/index.php?option=com_content&view=article&id=21595>. Accessed on: 19th May 2022.

Dias, T. K. M. (2020). *O Crédito Rural sob as Perspectivas da Posse da Terra e Dda Produtividade dos Agricultores Familiares*. Dissertation (Mestrado em Economia Rural) - Centro de Ciências Agrárias, Universidade Federal do Ceará, Fortaleza, (2020). Available at: <http://www.repositorio.ufc.br/bitstream/riufc/49627/5/2020_dis_tkmdias.pdf>. Accessed on: 19th May 2022.

Empresa Brasileira De Pesquisa Agropecuária - Embrapa. Região Centro-Oeste. Available at: <https://www.embrapa.br/contando-ciencia/regiao-centro-oeste>. Acessed on: 03 june 2022.

Empresa Brasileira De Pesquisa Agropecuária - Embrapa. Região Norte. Available at: <https://www.embrapa.br/contando-ciencia/regiao-norte>. Acessed on: 03 june 2022.

Empresa Brasileira De Pesquisa Agropecuária - Embrapa. Região Nordeste. Available at: <https://www.embrapa.br/contando-ciencia/regiao-nordeste>. Acessed on: 03 june 2022.

Empresa Brasileira De Pesquisa Agropecuária - Embrapa. Região Sudeste. Available at: <https://www.embrapa.br/contando-ciencia/regiao-sudeste>. Acessed on: 03 june 2022.

Empresa Brasileira De Pesquisa Agropecuária - Embrapa. Região Sul. Available at: <https://www.embrapa.br/contando-ciencia/regiao-sul>. Acessed on: Acessed on: 03rd june 2022.

Gasques, J. G. (2016). *Agricultura, transformação produtiva e sustentabilidade*. Brasília: IPEA, chapter3, p. 89-108.

Gonçalves Neto, W. (1997). *Estado e agricultura no Brasil: política agrícola e modernização econômica brasileira, 1960-1980.* São Paulo (SP): Hucitec.

Gonçalves, J. B., & Costa, A. (2019). Importância dos alimentos na geopolítica. *In:* Vieira, P. A., Contini, E., Henz, G. P., Nogueira, V. G. C. *Geopolítica do alimento: o Brasil como fonte estratégica de alimentos para a humanidade*. Brasília, DF: Embrapa, p. 27-34. Available at: <https://ainfo.cnptia.embrapa.br/digital/bitstream/item/205102/1/GEOPOLITICA-ALIMENTO-ed04-2019.pdf>. Accessed on: 13th May 2022.

Graziano Da Silva, J. (1999). *Tecnologia e agricultura familiar***.** Porto Alegre (RS): Editora da UFRGS.

Greene, W. H. (2018). *Econometric Analysis***.** 8th ed. New York: Pearson.

Guanziroli, C. E., & Cardim, S. E. C. S. (2000). *Novo retrato da Agricultura Familiar**: o Brasil redescoberto*. Projeto de Cooperação Técnica INCRA/FAO, MDA, Brasília, DF: INCRA/FAO, MDA. Available at: <https://www.agencia.cnptia.embrapa.br/recursos/novoretratoID-3iTs4E7R59.pdf>. Acessed on: 03 jul. 2022.

Guanziroli, C. E., & Vinchon, K. (2019). Agricultura familiar nas regiões serrana, norte e noroeste fluminense: determinantes do processo de geração de renda. *Revista de Economia e Sociologia Rural, 57*(3). https://doi.org/10.1590/1806-9479.2019.186584

Helfand, S. M., Moreira, A. R. B., & Bresnyan Junior, E. (2014). Agricultura familiar, produtividade e pobreza no Brasil: evidências do censo agropecuário 2006. *In:* Schneider, S., Ferreira, B., Alves, F. (org.). *Aspectos multidimensionais da agricultura brasileira: diferentes visões do Censo Agropecuário 2006*. Brasília: Ipea, p. 279-311. Available at: <https://www.ipea.gov.br/portal/index.php?option=com_content&view=article&id=21595>. Acessed on: 19th May 2022

Henig, E. V., & Santos, I. Â. dos. (2016). Políticas públicas, agricultura familiar e cidadania no Brasil: o caso do PRONAF. *Revista Brasileira de Políticas Públicas (Online),* Brasília, 6(1), 255-269. Available at: <https://www.publicacoesacademicas.uniceub.br/RBPP/article/view/3343/pdf>. Accessed on: 23rd July 2022.

Ibge – Instituto Brasileiro De Geografia E Estatística. (2009). *Censo Agropecuário 2006: Agricultura Familiar: primeiros resultados: Brasil, grandes regiões e unidades da federação.* Rio de Janeiro: IBGE. Available at: <https://biblioteca.ibge.gov.br/visualizacao/periodicos/50/agro_2006_agricultura_familiar.pdf>. Acessed on: 04th July 2022

Ibge – Instituto Brasileiro De Geografia E Estatística. (2019a). Available at: <https://agenciadenoticias.ibge.gov.br/agencia-sala-de-imprensa/2013-agencia-de-noticias/releases/25921-em-2017-pib-cresce-1-3-e-chega-a-r-6-583-trilhoes#:~:text=O%20Produto%20Interno%20Bruto%20(PIB,Servi%C3%A7os%20cresceram%200%2C8%25>. Acessed on: 01 July 2022

Ibge – Instituto Brasileiro De Geografia E Estatística. (2019b). *Censo agropecuário 2017: resultados definitivos*. Rio de Janeiro, p. 1-105. Available at: <https://biblioteca.ibge.gov.br/visualizacao/periodicos/3096/agro_2017_resultados_definitivos.pdf>. Acessed on: 19th May 2022

Kageyama, A., & Graziano Da Silva, J. (1983). Os resultados da modernização agrícola dos anos 70. *Estudos econômicos, 13*(3), 537-559.

Nascimento, C. A., Aquino, J. R., & Delgrossi, M. E. (2022). Tendências Recentes da Agricultura Familiar no Brasil e o Paradoxo da Pluriatividade. *Revista de Economia e Sociologia Rural*. *60*(3). https://doi.org/10.1590/1806-9479.2021.240128

Navarro, Z. (2016). O Mundo Rural No Novo Século (Um Ensaio De Interpretação). In:

Schneider, S., & Cassol, A. (2013). A agricultura familiar no Brasil. *Serie Documentos de Trabajo N° 145. Grupo de Trabajo: Desarrollo con Cohesión Territorial. Programa Cohesión Territorial para el Desarrollo*. Rimisp, Santiago, Chile. Setembro.

Schneider, S., & Cassol, A. (2017). Diversidade e heterogeneidade da agricultura familiar no Brasil e implicações para políticas públicas. *In:* Delgado, G. C., Bergamasco, S. M. P. P. (orgs.). *Agricultura familiar brasileira: desafios e perspectivas de futuro.* Brasília: Ministério do Desenvolvimento Agrário, p, 84-109. Available at: <https://www.cfn.org.br/wp-content/uploads/2017/10/Agricultura_Familiar.pdf>. Acessed on: 06th June 2022.

Schneider, S., Cazella, A., & Mattei, L. (2004). Histórico, caracterização e dinâmica recente do Pronaf-Programa Nacional de Fortalecimento da Agricultura Familiar. *In*: SCHNEIDER, S., SILVA, M. K., & Marques, P. E. M. (Orgs.) *Políticas públicas e participação social no Brasil rural.* Porto Alegre (RS): Editora da UFRGS, p.21-49.

Silva, Graziano Da J. (1998). *A Nova Dinâmica Da Agricultura Brasileira***.** 2 Ed. Campinas, SP: UNICAMP. IE.

Silva, S. P. (2015).A agricultura familiar e suas múltiplas interações com o território: Uma análise de suas características multifuncionais e pluriativas. *Texto para Discussão*, n. 2076, Brasília: IPEA.

Stoffel, J. A., & Colognese, S. A. (2005). Formas de organização produtiva da pequena produção agrícola familiar no Oeste do Paraná: potencialidades e obstáculos. *Cadernos de Economia*, Chapecó, *9*(16), 25-42.

Valadares, A. A. (2022) O Perfil na produção da agricultura familiar entre os Censos Agropecuários de 2006 e 2017: um panorama e sinais de mudança. *In:* Santos, G. R., Silva, R.

P. (Org.). Agricultura e Diversidades: trajetórias, desafios regionais e políticas públicas no Brasil. Brasília: Ipea. DOI: http://dx.doi.org/10.38116/td2755

Vieira Filho, J. E. R. (2016). A fronteira agropecuária brasileira: redistribuição produtiva, efeito poupa-terra e desafios estruturais logísticos. *In*: Vieira Filho, J. E. R., Gasques, J. G., Carvalho, A. X. Y. et al. (org.). *Agricultura, transformação produtiva e sustentabilidade***.** Brasília: Ipea, p. 89-107. Available at: <https://www.ipea.gov.br/portal/images/stories/PDFs/livros/livros/160725_agricultura_transformacao_produtiva.pdf >. Acessed on: 22nd July 2022.

Vieira Filho, J. E. R., & Gasques, J. G. *Agricultura, transformação produtiva e sustentabilidade*, Brasília: IPEA, Cap. *3*, 89-108.

Appendix

Table 1A. Descriptive statistics of explanatory variables by region

		North		Northeast		Southeast		South		Center-west	
	Variables	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev
Production	Gross value of production	27206.19	28446.92	10339.51	10790.02	16649.97	22898.51	37401.72	35787.85	20826.39	24387.41
	Establishment area	47869.59	53910.28	16433.89	18760.35	8697.29	11036.84	9775.28	9259.71	21629.99	24350.19
	Productivity	0.83	1.21	1.31	2.64	2.82	3.10	4.26	3.04	1.29	1.08
	Capital	52.25	59.64	26	62.93	134.93	206.65	474.42	512.10	120.09	147.41
	Labor	3532.11	4171.20	2990.72	2741.13	1057.72	1310.32	1374.35	1307.01	1207.22	1216.40
	Labor with kinship ties	3112.92	3784.33	2596.26	2398.47	891.94	1136.18	1257.12	1192.42	1063.88	1059.50
	Irrigation	76.11	132.29	118.14	234.34	76.30	213.55	38.61	67.04	26.70	82.23
	Technical assistance	99.08	112.39	85.53	118.32	108.83	144.56	276.87	279.20	79.78	131.75
	Agricultural practice	535.85	769.66	667.88	687.65	223.70	318.42	418.56	431.38	141.54	193.60
Characteristics of the establishment	Electricity	821.84	904.91	921.48	882.80	392.63	464.96	521.92	490.87	439.26	418.62
	Cooperative	37	59.98	15.79	33.59	65.01	122.31	211.21	205.54	52.94	87.39
	Syndicate/ Workers' Union	327.55	488.03	471.02	539.12	166.27	266.29	297.66	297.85	122.63	158.38
	Commerce sales	796.07	916.06	456.55	578.76	335.86	422.02	456.69	408.44	350.45	359.75
	Own consumption	312.44	512.46	705.56	849.80	100.71	246.32	109.26	164.88	133.20	186.31
	Owner	934.70	1088.24	910.46	852.46	361.07	425.04	490.42	436.15	379.97	351.13
	Manages the Establishment	828.80	962.18	888.29	778.67	338.55	384.47	358.00	325.47	348.47	336.14
Characteristics of the farmer	Under 25 years of age	37.02	56.79	24.03	30.49	5.23	12.12	7.94	15.31	5.93	9.34
	25-35 years of age	142.49	206.63	108.52	116.57	27.39	48.55	38.53	54.14	27.72	36.66
	35-45 years of age	237.30	293.18	200.37	189.10	61.78	90.75	80.86	95.93	70.27	82.11
	45-55 years of age	268.76	284.34	254.95	224.38	100.17	122.46	141.79	132.03	120.74	119.19
	55-65 years of age	233.63	230.16	262.57	225.59	115.29	127.45	157.41	130.42	132.21	122.26
	65-75 years of age	135.25	136.83	203.42	182.47	83.61	91.44	100.86	83.91	88.64	80.36
	75 years of age or older	54.06	59.46	108.24	106.74	43.10	48.81	38.58	35.18	38.14	34.46
	White	246.34	272.71	302.77	307.71	270.92	323.87	494.38	463.54	231.43	216.06
	Male	886.44	943.04	878.45	768.76	371.69	425.28	496.35	448.78	394.45	365.90
	Can read and write	1092.64	1146.92	915.35	811.12	551.84	571.50	691.32	587.56	682.59	587.18
Credit	Pronaf B	719.91	912.02	1032.65	947.06	252.21	337.60	215.97	237.56	252.60	271.20
	Pronaf V	385.42	417.75	128.35	142.22	180.19	226.09	338.50	327.16	224.64	222.31
	Non Pronaf	3.18	4.21	1.10	2.53	4.17	8.57	11.48	18.29	6.40	10.60
	Investment	81.15	103.70	105.71	111.55	41.23	65.17	67.82	71.41	44.41	54.04
	Cost subsidy	28.35	37.89	35.98	49.89	27.09	38.72	125.54	137.32	30.99	36.09
	Commercialization	1.53	3.83	4.41	10.43	0.85	3.51	1.05	5.92	0.93	3.27
	Maintenance	22.35	33.93	35.29	49.64	9.25	26.63	6.29	8.24	8.41	14.05

Source: Prepared by the authors using data from the Brazilian Agricultural Census (2017)