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ARTICLE

Spatial distribution of agricultural farms led by women in Brazil

Distribuição espacial das mulheres na direção dos estabelecimentos agropecuários no Brasil

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Abstract: This work aims to analyze the spatial distribution of agricultural establishments managed by women in the Brazilian municipalities, based on data from the Agricultural and Livestock Censuses of 2006 and 2017, applying spatial econometrics. The results showed that the Northeast and North regions had the highest concentration of High-High clusters in 2006, and increased in 2017. These regions with greater and poorer rural areas expanded the participation agricultural establishments managed by women, and they were responsible for 72.42% the variation that occurred between both Censuses. The education variable was positively related to the increase of the establishments managed by women in 2017. In the municipalities where there was a process of disappearance of agricultural establishments, there was an increase in the presence of female managers. We concluded that the promotion of public policies for women in rural areas improves of potential to promote the development of these establishments as well as rural areas.

Keywords: woman, rural property, rural area, spatial distribution, agricultural, livestock census.

Resumo: O objetivo central do trabalho é analisar a distribuição espacial das mulheres que estão na direção de estabelecimentos agropecuários nos municípios brasileiros, a partir dos dados dos Censos Agropecuários de 2006 e 2017, aplicando a econometria espacial. Os resultados mostram que as regiões Nordeste e Norte apresentaram a maior concentração de *clusters* Alto-Alto em 2006, sendo ampliado em 2017. Essas duas regiões, com enormes áreas rurais pobres, expandiram a participação das mulheres na direção dos estabelecimentos e foram responsáveis por 72,42% da variação ocorrida entre os Censos Agropecuários. A escolaridade teve uma relação positiva com o aumento das mulheres dirigentes nos estabelecimentos agropecuários em 2017. Nos municípios onde ocorreu o processo de redução de estabelecimentos, houve aumento de presença de mulheres na direção. Nós concluímos que a promoção de políticas públicas para as mulheres nas áreas rurais tem grande potencial de promover o desenvolvimento desses estabelecimentos, bem como das áreas rurais.

Palavras-chave: mulher, estabelecimento agropecuário, área rural, distribuição espacial, censo agropecuário.

1. INTRODUCTION

In the literature and public policies, the discussions about the insertion of women in the economic, social, and political spheres have been intensified. Particularly noteworthy is their greater participation in the labor sphere, both in the labor markets and in self-employed activities. They took over more specifically the coordination and direction of the business in several activities in urban and rural areas, more particularly, the leadership of agricultural establishments.

The demographic behavior in the last decade of the last century in Brazil reveals that the number of women and young people in rural areas is decreasing, so there is a major presence of a mature age population contingent in these areas (Camarano & Abramovay, 1998; Brumer, 2006; Castro & Aquino, 2008). The aging of people contributes to their permanence in rural areas, as rural/urban migration tends to occur during youth (Valadares et al., 2016). Empirical research reveals that women living in rural areas tend to work in non-agricultural activities more than in agricultural activities (Nascimento et al., 2015; Staduto et al., 2017). These two movements may be motivated by several social and economic reasons, which are intertwined and are very difficult to be isolated. However, some factors can be mentioned in the economic scope, such as the greater number of opportunities for women to find jobs in urban centers in comparison to the rural areas (Gómez García & Rico González, 2004); the hard work done by them in rural areas, but is predominantly regarded as "light jobs" only because they are performed by women (Paulilo, 1987); the responsibility for the backyard activities of which, even if they generate direct and indirect income, are considered domestic activities (Abramovay & Silva, 2000); and the little space for women in commercial agriculture activities, which even with a large participation of them, are seen as "support", which is reflected in non-monetary remuneration or under-monetary remuneration, when there is payment for the work performed (Paulilo, 1982; Aguiar, 2016; Carneiro, 2001; Brumer, 2004, 2006; Lombardi, 2006).

In the social sphere, it is possible to mention: the little empowerment in household decisions; the devaluation and invisibility of the productive and reproductive activities that women perform in family farming (Brumer, 2004, 2006); and difficulties in accessing land, due to the prevalence of social contracts that benefit men instead of women in the last will and management of the rural farms (Carneiro, 2001; Deere & León, 2002; Mello et al., 2003; Deere, 2004; Gómez García & Rico González, 2004; Brumer, 2004; Spanevello, 2008; Hernández, 2015).

The data from the Agricultural and Livestock Censuses of 2006 and 2017 for the municipalities of Brazil show that there was a reduction from 5,175,636 to 5,056,525 in the number of agricultural establishments. However, in the same period, there was an increase of 44.16% in the number of establishments run by women – from 656,225 to 946,075, respectively (Instituto Brasileiro de Geografia e Estatística, 2007, 2019). On the one hand, over the last few decades, the literature has reported and analyzed the reduction in the number of women in rural areas, which compromises the existence of family farming structure (Staduto et al., 2017). On the other hand, data from the 2017 Census of Agriculture and livestock showed a significant percentage increase of women running agricultural establishments. The present work is a contribution to analyze this phenomenon and, based on the new structuring of agricultural establishments, several questions may be asked about this behavior, for instance, where are these agricultural establishments most intensely concentrated?

Therefore, from the described scenario, this work aims at analyzing the spatial distribution of agricultural establishments managed by women (AEMW) in Brazil from the data of the Agricultural and livestock Censuses from 2006 and 2017. Exploratory Spatial Data Analysis (ESDA) and spatial econometrics were methodologies used to verify and analyze the existence or not of spatial autocorrelation of AEMW in Brazilian municipalities.

This article is divided into five sections from this introduction. The second section presents a brief literature review. The third section explains the methodological procedures. In the fourth section are the results and discussions, and the work is summarized with the final considerations.

2. BRIEF LITERATURE REVIEW

"The category 'work', whether paid or not, has always been relevant to feminist thinking" (Paulilo, 2003, p.2). Paid work is essential to generate income, regardless of the husband's productive sphere (Paulilo, 2003). Inside the labor markets, social and economic inequality between men and women is more precisely revealed. The wage gap between men and women is a phenomenon found in countries with varying levels of development (Chevalier, 2007; Barón & Cobb-Clark, 2008). The causes of income inequality are related to the devaluation of female labor, mainly due to the different types of occupational insertion of men and women. They receive lower wages for usually taking on occupations in the economic sectors linked to the care and reproduction of the workforce (domestic services, health, and education) and to support and execution functions. The male population has occupied itself more frequently with the activities of production, construction, in the tertiary sector specialized in supporting the generation of wealth (credit, logistics etc.) and performs management and planning functions. Thus, male occupations would be more prestigious and valued than females (Kon, 2002; Bruschini, 2007).

The division of roles between women and men in society and the labor market outcome in marginalization are observed in the economic and social context (Magalhães, 1980). The inequality of wages has two basic explanations: a) the labor market discriminates when it remunerates men and women differently or whites and blacks with the same productivity; and b) many low-paid jobs are mostly occupied by women – several of them also showing low productivity. In this way, the labor market acts as a generator of income inequalities (Barros et al., 2007; Meerkerk, 2010).

According to Hirata & Kergoat (2007, p. 5) "[...], the social division of labor has two organizing principles: the principle of separation (there are men's jobs and women's jobs) and the hierarchical principle (a man's job has more value than a woman's job)". The authors also debate the "partnership paradigm" between men and women advocated at the 4th World Conference on Women in Beijing in 1995, in which this relationship is more associated with "a logic of reconciling roles than a logic of conflict and contradiction" (Hirata & Kergoat, 2007, p. 10). The contradictions exposed by gender relation inequalities reveal conflicts of power in various spheres of social, economic, and political life. According to Kabeer (2005), the empowerment process is strongly associated with the ability to make choices to act and express themselves freely. Thinking in the same way, disempowering means having this ability reduced[1].

Thus, the category 'work' is important for rural women because work is present in various activities developed by them at home and on small agricultural properties (Paulilo, 2003), and not exclusively in commercial production activities. Rural areas have mostly patriarchal structures and intra-household relationships are hierarchical, making it difficult for women to participate in the productive and public spheres, and, above all, in leading the main activity of rural property, even if they work intensively inside or outside the property sphere (marketing, associations, credit system and others). Production activities that are under the sphere of men, regardless of the degree of participation of women, they are seen predominantly as helpers (Paulilo, 1982; Aguiar, 2016; Carneiro, 2001; Brumer, 2004, 2006; Lombardi, 2006), and they are not at least seen as a minority "business partner" in the family enterprise. All these facts contribute to reduced participation of women in decisions about the productive activities of the property. Even though they perform important work tasks for income generation, the perception of intra-household social relations prevails, which predominantly reserves the reproductive space for women and the productive space for men (Paulilo, 1987; Brumer, 2004; Karam, 2004; Magalhães, 2009).

The family has a central role in allowing, restricting, and differentiating the participation of its members in the economic and social spheres (Kabeer, 1994; Quijano, 2015). The decision-making structure for the planning and management of agricultural activities is usually built by the social dispositions that privilege patriarchy, which establishes power relations favorable to men and weakens women's intra-household bargaining power (Carneiro, 2001). An example of this is that women are not usually in the succession line of

[1] Power is at the root of empowerment and it can have several understandings. According to Oxaal and Baden (1997), power comes from different social and political movements, and traditions. The feminist movement has emphasized collective organizations (power with) and has been influenced by the ideas of development (power within), that is, the empowerment of women can be understood as an individual process. And it can also be understood through practices that reach different levels: institutional, family and individual.

rural property (Deere & León, 2002; Deere, 2004). Opportunities for running agricultural activities are lacking, mainly through the transmission of the inheritance that leads many women to migrate; and for some, the opportunity to study is still given to them (Carneiro, 2001; Valadares et al., 2016).

In the first decade of this century, public policies were very active in promoting women in social and economic aspects, and also in gender equity and equality. The Special Secretariat for Policies for Women (SEPM) through the National Plan for Policies for Women (PNPM) implemented several actions aimed at advancing gender equality developed as part of a rural development agenda, which integrates a set of programs of the former Ministry of Agrarian Development (Brasil, 2016). The actions directed at women in rural areas are the result of a long process of struggle and demands from the social movements of rural workers, which culminated in the 'Marcha das Margaridas'. Several achievements have taken on important formats such as social security benefits: rural retirement and maternity assistance (Brumer, 2002; Kreter & Bacha, 2006). Other programs were essential, such as the National Documentation Program for Rural Working Women, created in 2004, which was extremely important for them to have access to public policies, such as 'Bolsa Família' Program (conditionality income transference for poor families) and social security rights (Butto, 2006). There are other actions focused on women such as mandatory joint land titling for plots of settlements constituted by couples; and the launch of a Call for proposal projects in 2006 to provide financial support for Technical Assistance and Rural Extension (ATER) programs for female rural workers and development agents.

The concept of PRONAF-Mulher (National Program for the Strengthening of Family Farming - Woman) in 2004 provided women with access to credit, increasing women's social and economic insertion, as they started to visit bank branches as clients and have more contact with other people. According to the study by Brumer & Spanevello (2011), for many women, PRONAF-Mulher was the first experience and the most direct contact with the branches and the banking financial environment. Hernández (2009) found the importance of agricultural credit, through PRONAF-Mulher, as they conquer public space, which provided preconditions for empowerment. This Program opened up new opportunities for women to empower themselves in rural areas in all strata of producers, especially among the poorest.

In this way, public policies contribute to women increasing participation and performance in rural activities, providing a political, social, and economic environment that promotes their involvement within the communities in which they are inserted. According to Pereira (2015, p. 34) in the “planning and gender” approach oriented to rural development “the main objective is to correct the existing asymmetries in the local community, freeing women from their subordinate role and providing a situation of equality and equity between them and men”.

Therefore, women have the potential to be a source of qualified human resources to increase the sustainability of the property, for example, being precursors of organic production (Karam, 2004) and, also, as a source of competitiveness for the agricultural sector, especially in agribusiness management (Cielo et al., 2014). Women make up the very important stocks of human and social capital to shift the production curve of both the most technological and the less technological agricultural sectors, whose stocks are also essential to achieve higher levels of economic, social and environmental development.

3. METHODOLOGICAL PROCEDURES

In this section, the methodological procedures are presented, namely: the variables used in this work, the Exploratory Spatial Data Analysis (ESDA), and the spatial econometric model.

3.1 Data Sources

The selected variables are derived from of the Agricultural and Livestock Censuses of 2006 and 2017, extracted from Brazilian Institute of Geography and Statistics’ (IBGE) Automatic Recovery System (Annex 1). The database includes the 5,548 and 5,570 Brazilian municipalities surveyed by the 2006 and 2017 Censuses, respectively.

IBGE considers agricultural establishments as units of production or exploitation of agricultural, forestry, and aquaculture activities, regardless of legal form, size, and location. According to the IBGE, every agricultural establishment has production as its purpose. In the 2006 Agricultural and Livestock Census, each production unit was counted as an agricultural establishment (Instituto Brasileiro de Geografia e Estatística, 2006a). However, in the 2017 Agricultural and Livestock Census, an agricultural establishment was considered as all production units within the municipal boundary that had the same owner in non-contiguous areas (Instituto Brasileiro de Geografia e Estatística, 2017a).

Despite this methodological change, which contributed to the reduction in the number of establishments in 2017, the remaining variables used are compatible with the two Agricultural and Livestock Censuses and characterize the managers of agricultural establishments, according to gender; average schooling; access to electricity; the number of establishments by farm size; access to technical guidance; the number of establishments with permanent and temporary crops; and number of agricultural machinery.

The variables were intensified by the total area of agricultural establishments in each municipality, except for the variables of size farm and education. The size farm variable for agricultural establishments managed by women (AEMW) was categorized into following classes: up to 10 hectares, 10 hectares to 100 hectares; and above 100 hectares, in which the classes were taken into percentage. In addition to the classification by hectares, the establishments have the classification of producer without any area; in these cases the producer does not have a specific plot of land. This is the case, for example, of honey producers, who place hives in the forest, extractivists, and animal breeders by the side of the roads, and owners of land who rent it to someone else. There are also cases in which the establishment is not owned by an individual, but by a legal person. These situations were not encompassed in this study.

The education variable in the Agricultural and Livestock Censuses of 2006 and 2017 is in the form of series and/or completed degree, complete or incomplete, being stratified differently in each Census. Therefore, it was necessary to standardize such data in years of study. The education level variable for female managers was obtained by weighted average taking into account the years of study in the grade and/or the completion of the degree[2]. For those who do not have knowledge on how to read and write or did not attend school, zero (0); for incomplete elementary school five (5) years increasing empirically one (1) year to four (4) years, related to the former junior high school (middle 1st cycle, currently)/old primary (elementary), taking into account who start and do not finish elementary school (Helene, 2012); for complete or regular elementary school (1st grade) eight (8) years were considered; for high school, complete high school (technical or other) and/or former scientific/classic (middle 2nd cycle), 11 years were considered; and for higher education and other levels of education 15 years. For adult literacy programs, Literacy Classes, Youth and Adult Literacy (AJA), Youth and Adult Education (EJA) and elementary school supplements, 0.5 years of study were established following the Resolution/CD/FNDE number 6, of April 16th, 2010, in its Article 9, items I to III (Brasil, 2010) which establishes that literacy courses can have duration and workload, varying between six months (0.5 years) to eight months (0.66 years). For the EJA's high school, it was opted for the understanding that the attribution of 0.5 years of study should be computed only for the period related to high school considering, in this case, that elementary school education/middle 1st cycle/old primary had been attended regularly for 8 years.

The total number of agricultural machinery per agricultural establishment is the sum of tractors, seeders/planters, combine harvesters, fertilizer spreaders, and/or lime spreaders. This sum is a proxy for physical capital. Ney & Hoffmann (2003) emphasize that physical capital is important to explain the difference of income in agriculture. Lobão (2018) used the electric energy variable as a way of verifying the living conditions of people in rural areas, and also if there is basic infrastructure. The variables' establishment with temporary crops and

[2] For 2006 and 2017, the institutional framework of Law number 9,394, of December 20, 1996, which establishes the Guidelines and Bases of National Education (LDB) (Brasil, 1996) prior to Resolution CNE/CEB number 3, of August 3rd, 2005 (Brasil, 2005) and Resolution/CD/FNDE number 6, of April 16th, 2010, Article 9, items I to III (Brasil, 2010).

permanent crops were used to verify the spatial disposition of women managers of agricultural establishments, considering the different demands held by each type of crop.

3.2 Exploratory spatial data analysis (ESDA)

ESDA is understood as a set of techniques that describe and visualize spatial distributions, atypical locations, patterns of spatial association and clusters, and suggest spatial regimes (Anselin, 1998). The spatial weights matrix shows spatial arrangements and interactions of the social and economic phenomenon under study.

3.2.1 Global Spatial Autocorrelation

The Global Spatial Autocorrelation aims to test whether the data exposes a random spatial distribution, that is, whether the values of one region do not depend on the others. For this, Moran's I spatial correlation coefficient is used, given by the Equation 1:

$$I = \frac{n}{\sum\sum w_{ij}} \times \frac{\sum\sum w_{ij}\left(y_i - \bar{y}\right)\left(y_i - \bar{y}\right)}{\sum\left(y_i - \bar{y}\right)^2} \tag{1}$$

Where: n is the number of municipalities; y_i is the number of AEMW; w_{ij} is the space weight for the pair of space units i; and j is the measure of the degree of interaction between them.

The positive spatial autocorrelation demonstrates that there is a similarity between the values of the studied area (Almeida, 2012). If the spatial autocorrelation is negative, it means that municipalities with high values for female leaders are surrounded by municipalities with a low value for this variable and vice versa.

3.2.2 Local Spatial Autocorrelation

If the tests show the presence of global spatial autocorrelation, we can verify whether there is compliance with local association standards. (Almeida, 2012). Thus, Anselin (1998) decomposed Moran's I indicator into categories to see the local autocorrelation by the Equation 2:

$$I_i = \frac{\left(y_i - \bar{y}\right)\sum_j w_{ij}\left(y_i - \bar{y}\right)}{\sum_i\left(y_i - \bar{y}\right)^2 / n} = z_i \sum_j w_{ij} z_j \tag{2}$$

Where: $_i$ and z_j are standardized variables. The sum on j is such that only the values of neighbors $j \in J_i$ are included. The set J_i includes the neighbors of municipality i. Almeida (2012) sees this indicator as an indication of the degree of a grouping of similar values around a municipality, identifying statistically significant spatial clusters.

The clusters are divided into four types, being: High-High (HH) those that present high values of the variable, surrounded by spatial units that also present high values of the same variable; Low-Low (LL) which are the spatial units with low values of the variable, surrounded by units that also have low values; High-Low (HL), which have a high value of a variable surrounding space unit, with a low value for that variable; and Low-High (LH), which has a low value for the variable, surrounded by municipalities with a high value for this variable (Almeida, 2012).

3.3 Spatial econometric model

The spatial econometric model contains the spatial process related to the phenomenon under study[3]. In this case, the spatial lag is incorporated, to control the spatial dependency,

[3] For the development of the spatial econometric model and the elaboration of maps, the free and open source spatial software GEODA 1.14 (GEODA, 2019) was used.

which can be in the dependent variable (*Wy*), in the independent variables (*WX*) and/or lag in the error term (*Wξ* ou *Wε*). According to Florax et al. (2003), the following procedure should be adopted for the specification of the model that takes into account the presence of spatial autocorrelation:

1) Estimate the classic linear regression model by OLS;

2) Compute the Lagrange multiplier for the spatial lag (ML_ρ) and the Lagrange multiplier for the spatial error ML_ρ and MLλ);

3) If both test statistics are not significant, the CLRM a-spatial model with the best specification is considered, otherwise the next step is followed;

4) If both tests are significant, the model for which the statistic of the Lagrange multiplier test is most significant is chosen. For example, if ML_ρ > MLλ the SAR model is estimated. If ML_ρ < MLλ the SEM model is estimated. Otherwise, proceed to the next step;

5) If the MLρ test is significant and the MLλ is not, it is estimated by the SAR model. If it is not, proceed to the next step; and

6) If the MLλ test is significant and the ML_ρ is not, it is estimated by the SEM model.

The spatial lag model (SAR) should be used when the spatial autocorrelation is diagnosed in the dependent variable, a behavior that is captured with the inclusion of a spatially lagging dependent variable, *WEstFt*, functioning as one of the explanatory variables, such as the empirical models of the Equations 3 and 4:

$$EstF_{2006} = \rho WEstF_{2006} + EduF_{2006}\beta + GuidF_{2006}\beta + SzFarmF_{2006}\beta + EnergF_{2006}\beta + CropPerm_{2006}\beta + CropTemp_{2006}\beta + Mach_{2006}\beta + \varepsilon_{it} \quad (3)$$

$$EstF_{2017} = \rho WEstF_{2017} + EduF_{2017}\beta + GuidF_{2017}\beta + SzFarmF_{2017}\beta + EnergF_{2017}\beta + CropPerm_{2017}\beta + CropTemp_{2017}\beta + Mach_{2017}\beta + \varepsilon_{it} \quad (4)$$

In which EstF is a Nx1 vector of observations of the variable representing AEMW; *WPt* is a Nx1 vector of spatial lag of AEMW; *ρ* is the spatial autoregressive coefficient; EduF is the average education of women managers of agricultural establishments; GuidF is the number of AEMW who received technical guidance, SzFarm are the groups of size farm AEMW (subdivided into 3 classes: up to 10 hectares, 10 to less than 100 hectares and over 100 hectares); EnergF is the number AEMW with electricity, CropPerm is the number of establishments with permanent crops, CropTemp is the number of establishments with temporary crops and Mach is the number of agricultural machinery in agricultural establishments. These variables are part of the Nx*K* matrix of independent variables, with an associated *K*x1 vector of regression coefficients *β;* and *ε* is a Nx1 vector of random error terms with normal distribution, zero mean and constant variance.

The econometric model of spatial error (SEM) is used when it is detected that the spatial lag is linked to the error term (Almeida, 2012). This model is represented empirically, by Equations 5, 6, 7, and 8:

$$EstF_{2006} = EduF_{2006}\beta + GuidF_{2006}\beta + SzFarmF_{2006}\beta + EnergF_{2006}\beta + CropPerm_{2006}\beta + CropTemp_{2006}\beta + Mach_{2006}\beta + u_{it} \quad (5)$$

$$u_{it} = \lambda Wu + \varepsilon \quad (6)$$

$$EstF_{2017} = EduF_{2017}\beta + GuidF_{2017}\beta + SzFarmF_{2017}\beta + EnergF_{2017}\beta + CropPerm_{2017}\beta + CropTemp_{2017}\beta + Mach_{2017}\beta + u_{it} \quad (7)$$

$$u_{it} = \lambda Wu + \varepsilon \quad (8)$$

Where EstF is a vector Nx1, observations of the variable AEMW, EduF, GuidF, SzFarm, EnergF, CropPerm, CropTemp and Mach are part of the Nx*K* observations matrix; *β* is a *K*x1 vector of regression coefficients; and u is a vector in the error terms. The variable Wu represents the spatially lagging errors, λ represents the autoregressive coefficients and ε is an error term with zero mean and constant variance.

For the estimation of the parameters, the methodological procedures of Almeida (2012) were adopted. If in the estimation of the OLS model, the Lagrange Multiplier indicates the SAR model and it has normal residues, the method used for the estimation was the Maximum Likelihood. If there is no normality of the residues, the method used is the Quasi-Maximum Likelihood or Instrumental Variables estimation. If the Lagrange Multiplier indicates the SEM model and it has randomness of residues, the estimation is by Maximum Likelihood. If the randomness of the residues does not occur, the estimation is by Generalized Method of Moments or by Quasi-Maximum Likelihood.

4 ANALYSIS AND DISCUSSION OF RESULTS

4.1 DESCRIPTIVE STATISTICS OF REGIONS

Table 1 shows the population in rural areas in 2006 and 2015 for the Brazilian regions, and the number of agricultural establishments, as well as women managers in 2006 and 2017[4]. In 2006, 15,379 million women were residents of rural areas in Brazil. In 2015, this contingent represented 14,942 million – a decrease of 2.84% compared to 2006 –, while among the male rural resident population, the decrease was softly lesser (-2.52%). Among the regions, the Midwest was the one that lost the most female population (-14.65%). On the other hand, North and Northeast regions had an increase in the female and male population in rural areas.

The total of agricultural establishments managed by women in 2006 was 656,225 – or 12.68% of the total. In 2017, there was an increase of 18.71%, meaning 946,075 establishments, which represented a 44.16% growth in the number of women managers. While the number of AEMW increased, the number of properties decreased, as well as the population in Brazilian rural areas (Table 1).

The North region had the greatest expansion in the percentage AEMW compared to the other regions. In 2006, it represented 10.11%, in 2017 this percentage increased to 19.36%. The Northeast region had an expressive value in 2006 (15.99%), presenting the greatest absolute variation among the Censuses (145,695) and an increase in 37.13% and, also, the largest female participation in Brazil in 2017 (23.20%). In the last position was the South region, with 12.18% of establishments in 2017, followed by the Southeast region with 14.08%.

Figure 1 shows the spatial distribution of AEMW. The white to dark grayscale indicates the intensity of the presence of these establishments, from the smallest areas to those with the highest incidence of establishments, respectively.

Among the municipalities in the Northeast region in 2006, Feira de Santana in the state of Bahia stands out with the largest number of AEMW. There was also an increase in the concentration of establishments in the North region and some municipalities in the states of Paraná and Rio Grande do Sul (Figure 1).

In the comparison between 2006 and 2017, the number of AEMW in the Northeast and North regions intensified, and the number of establishments in some municipalities in the Midwest and South regions of Brazil had lesser increase. According to Table 2, of the ten municipalities with the highest percentage of AEMW for the years 2006 and 2017, nine were in the Northeast and North, except the municipality of Campo de Goytacazes in the state of Rio de Janeiro, which appears in 2006.

[4] The data for the rural resident population in 2006 and 2015 comprise the National Household Sample Survey, as the annual PNADs were interrupted in 2015, and from that year only continuous PNADs are available, which are not comparable.

Table 1 - Rural population (in thousands) in 2006 and 2015, and the number of agricultural establishments with female managers in Brazil and regions 2006 e 2017.

Region	Rural population 2006		Rural population 2015				Agricultural establishments 2006			Agricultural establishments 2017			Δ 2006/2017 in % Female Manager
	Male	Female	Male	Female	Δ% Male	Δ% Female	Total	Female	% Female	Total	Female Manager	% Female Manager	
NORTH	2,284	1,972	2,346	2,032	2.71	3.04	475,778	48,079	10.11	579,929	112,256	19.36	133.48
NORTHEAST	7,769	7,248	7,855	7,372	1.11	1.71	2,454,060	392,436	15.99	2,319,876	538,158	23.20	37.13
MID-WEST	981	853	850	728	-13.35	-14.65	317,498	30,329	9.55	345,192	56,780	16.45	87.21
SOUTHEAST	3,323	3,056	3,105	2,791	-6.56	-8.67	922,097	95,256	10.33	962,689	135,528	14.08	42.28
SOUTH	2,417	2,250	2,195	2,019	-9.18	-10.27	1,006,203	90,155	8.96	848,839	103,353	12.18	14.64
BRAZIL	16,774	15,379	16,351	14,942	-2.52	-2.84	5,175,636	656,255	12.68	5,056,525	946,075	18.71	44.16

Source: Data from PNAD 2006 and 2015 (Instituto Brasileiro de Geografia e Estatística, 2006b, 2015) and Agricultural Census 2006 and 2017 ((Instituto Brasileiro de Geografia e Estatística, 2007, 2019).

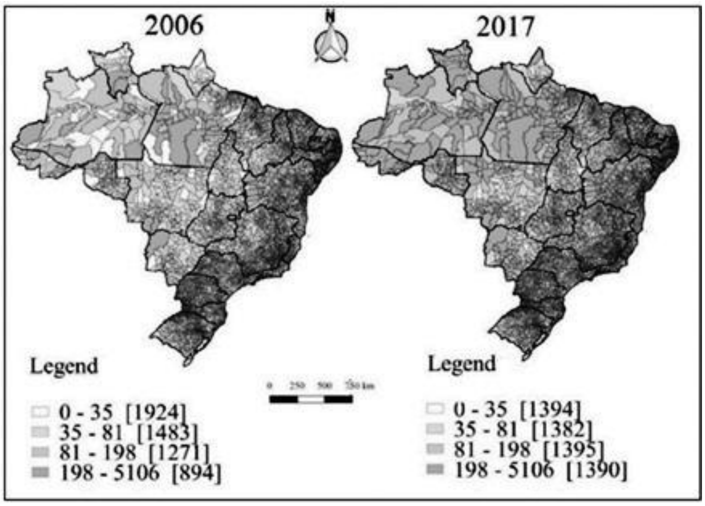

Figure 1 - Spatial distribution of agricultural establishments with female managers for the Agricultural and Livestock Censuses 2006 and 2017. Source: Research results.

Table 2 - Ranking of the 10 Brazilian municipalities with the highest number of total and female agricultural establishments.

Municipalities	2006		Municipalities	2017	
	Total	Female		Total	Female
Feira de Santana (BA)	8,969	4,482	Feira de Santana (BA)	9,179	5,106
Teresina (PI)	6,881	2,275	Cametá (PA)	12,886	3,209
Santarém (PA)	9,242	2,232	Abaetetuba (PA)	9,405	2,894
Santo Estêvão (BA)	4,633	1,936	Santo Estêvão (BA)	4,971	2,759
Araci (BA)	6,583	1,692	Santarém (PA)	7,376	2,598
Ipirá (BA)	6,860	1,667	Serrinha (BA)	5,841	2,531
Campos dos Goytacazes (RJ)	8,098	1,610	Araripina (PE)	7,374	2,401
Lagarto (SE)	7,868	1,554	Conceição do Coité (BA)	5,597	2,063
Bacabal (MA)	3,245	1,504	Teresina (PI)	5,152	2,036
Codó (MA)	6,727	1,442	Buíque (PE)	5,651	2,018

Source: Research results

The value of the estimated Global Moran's I coefficient in the municipalities in Brazil was higher than the expected value in the two years observed, indicating the existence of spatial autocorrelation of the location of AEMW in Brazilian municipalities (Table 3). There is positive and significant autocorrelation, which constitutes the existence of a pattern of spatial concentration so that those municipalities with the largest number of AEMW tend to be surrounded by municipalities with a large number of AEMW as well. These elements signal the global spatial effect of these variables. To capture the local effect, Local Indicators of Spatial Autocorrelation (LISA) method was used, which enabled the visualization of the formation of clusters, in line with the global autocorrelation patterns, therefore, it provides the local indication.

Table 3 - Moran's I Statistics for agricultural establishments with female managers (EstF) of Brazilian municipalities for the years 2006 and 2017.

Type	Moran's I	p-value	Type	Moran's I	p-value
EstF06	0.4195	0.0010	EstF17	0.4345	0.0010

Source: Research results

Note: The empirical pseudo-significance is based on 999 random permutations and E (I) is –0.0002. The spatial weights matrix used was the neighboring K4 convention for 2006 and neighboring K5 for 2017.

The formation of clusters of AEMW for 2006 and 2017 is shown on Figure 2. In 2006 there was a configuration of High-High clusters, that is, in municipalities with high values of AEMW, the surroundings also present several AEMW. It can be seen that this configuration is more present in the municipalities of the Northeast region and, also, there are some High-High clusters in the municipalities of the North and South regions. The Low-Low configuration occurred in the municipalities in the Southeast region and a few municipalities in the South, North, Midwest, and Northeast. In 2017, the High-High configuration continued to be present in the Northeast region and also started to have clusters in the North region. However, the Low-Low configuration was concentrated in the Southeast and rarefied in the other regions. LISA corroborates the data discussed in Figure 1 and Tables 1 and 2.

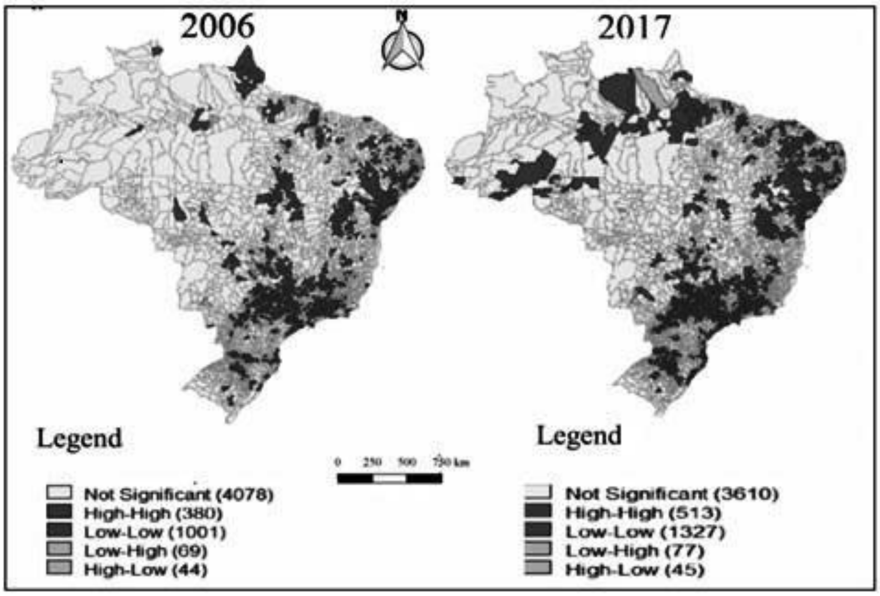

Figure 2 - Clusters of agricultural establishments managed by females for 2006 and 2017. Source: Research results

The number of agricultural establishments in Brazil had increased from 1920 to 1985, reaching about 5,860 thousand in that year, expressing the entire process of expansion and occupation of new areas through the displacement of agricultural borders (Gasques et al., 2010). However, in the Agricultural and Livestock Censuses in the years[5] 2006 and 2017 the number of establishments decreased, may be indicated a trend of reduction[6], more specifically in the Northeast and South regions. It is interesting to note that these regions are precisely the same, which showed an increase in the number of AEMW. In the case of the Northeast region, which had an expressive value in 2006 (15.99%, see Table 1), the participation of women in 2017 increased to 37.13%. On the other hand, in the case of the North region, there was a dramatic increase of AEMW (133.48%) and 21.9% of the total (Figure 3).

The North and Northeast regions represented 22.14% and 50.28%, respectively, of the increase of AEMW in Brazil between the 2006 and 2017 Censuses; both regions present a total variation of 72.42%. It is noteworthy that these regions also had an increase in the population of men and women in rural areas, while the others had population loss. Both regions have similar behaviors, but it should be noted that they are very different in terms of land structure in at least two aspects: (a) the average size of establishments in the North is much higher than in the Northeast; and (b) the North is still an agricultural frontier that reflects economic, political and social processes which can lead to its expansion. In contrast, in the Northeast, the agricultural frontiers have been exhausted or are moving unnoticeably. It should also be noted that in the case of the North, women may be leading some new establishments which emerged in 2017.

Despite these differences, rural areas in both regions have the worst social indicators. Particularly concerning poverty, the Northeast is even more vulnerable (Rocha, 2013). The Northeast concentrates many smaller agricultural establishments, where the impoverished population is located, actions are needed to improve the production capacity and productivity to raise the quality of life of that population (Buainain & Garcia, 2013). Stege & Parré (2011) corroborate this perception and consider that in the North and Northeast regions are located the micro-regions with the worst rates of multidimensional rural development.

In both regions, women are taking on significant importance. According to Soares et al. (2016) National Household Sample Survey (PNAD) data from 2004 to 2013 show that in the Northeast region, households headed by women had low levels of poverty. Heredia & Cintrão (2006) highlight the importance of technical training for recognition of women as farmers, which contributes to family income and a personal position inside and outside the family. It is believed, therefore, to be a way of encouraging women to take positions of greater recognition and economic and social responsibility in rural properties, as shown by Hernández (2015) when discussing the positive effect of PRONAF-Mulher in the process of empowering women farmers in the municipality of Rodeio Bonito in the state of Rio Grande do Sul.

The level of education in the states between 2006 and 2017 evolved. It can be observed, even in relative terms, there is a relationship between the number of AEMW and the level of education. The average education of women advanced between the regions at different rates from 2006 to 2017: North, Northeast, Southeast, South, and Midwest increased, respectively, 48%, 70%, 27%, 19% and 24%. The highlights are the states of Bahia, Piauí, Alagoas, and Amazonas with positive variations of 83%, 78%, 75%, and 63%, respectively. The Northeast and North regions led this process of promoting the educational level in rural areas. Cezar et al. (2015) emphasize that the harmful consequences of lower educational levels are more severe for women than for men in rural areas, directly reflecting on wages. Also, higher levels of education have the potential to positively interfere in the intra-household relationships of rural producers, both to promote visibility of women's work and to expand access to public policies.

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[5] The 1995 Agricultural and Livestock Census data collection was not compatible with the other Census, which influences the number of establishments.

[6] In Brazil, the process of modernization of the agricultural sector intensified from the 1970s onwards without changing the land structure in terms of the fractionation of large properties, quite the opposite started a process of land concentration, in addition, there was an increase in disparities in income, the rural exodus increased, the rate of exploitation of the workforce in agricultural activities increased, that is why this whole process was called “conservative modernization” (Graziano da Silva, 1982; Palmeira, 1989; Souza Pires & Ramos, 2009).

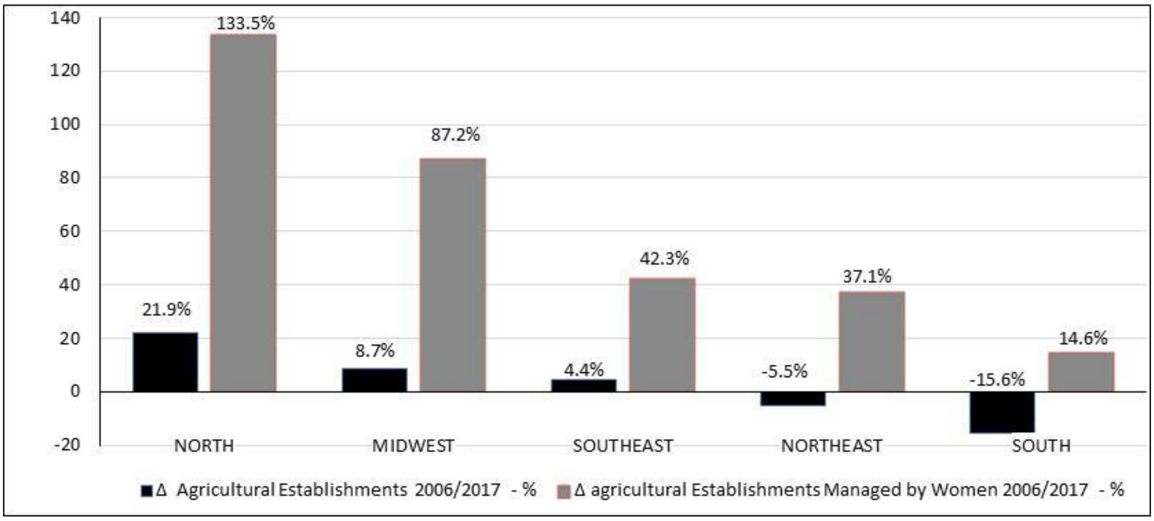

Figure 3 - Percentage change in the number of total agricultural establishments and the number of agricultural establishments with female managers by regions – 2006/2017. Source: Research results

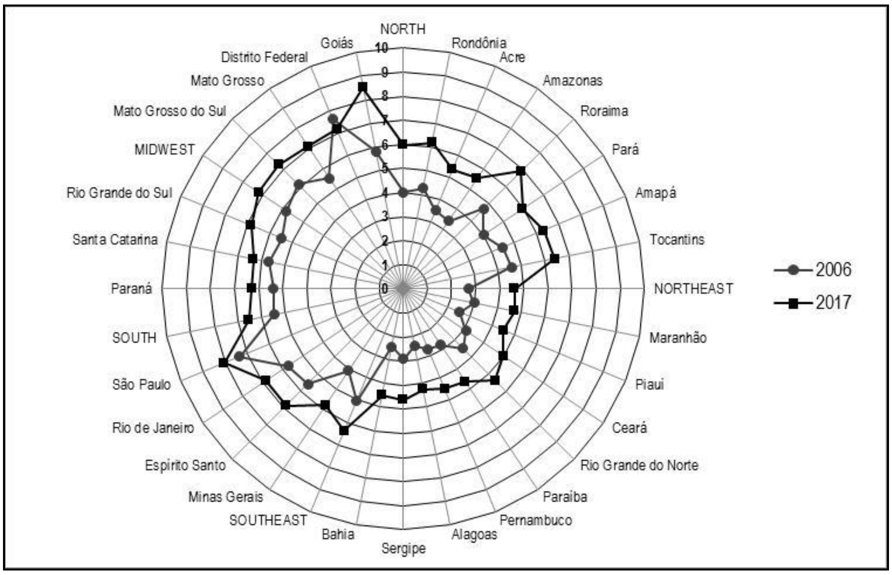

Figure 4 - Average education of the female manager/producer of the agricultural establishment in 2006 and 2017 by region and state. Source: Research results

Although the Northeast region showed an increase of 70% in the average level of education of managers, it is still the region with the lowest education compared to the others. The Brazilian's Constitution of 1988 enabled the implementation and evolution of public education management policies, including education in the rural areas – highlighting the National Program for Education in Agrarian Reform (Pronera) created in 1997; the Support Program for Higher Education in Rural Education Degree (Procampo) created in 2007; and the National Rural Education Program (Pronacampo) created in 2012.

These policies represent the capacity for the articulation of social movements and indicate the growing need to ensure projects aimed at the rural areas, whose organization holds culture and the work of social classes as references. The political training of workers and the recognition of social conscience are some adversities faced by education in the rural area (Santos & Silva, 2016)[7]. These programs were effective in producing an increase in education in rural areas as shown in Figure 4. And they are contributing to the convergence of the level of education between the states, that is, faster growth in the number of years of

[7] About PRONACAMPO see Brasil (2013).

study in the disadvantaged regions, which are also the poorest compared to the wealthiest ones.

The impoverished population has less education, which reduces the possibilities of obtaining better payment jobs (Rocha, 1995). In the 1990s, the Brazilian Northeast region concentrated the greatest rural poverty. Mariano & Neder (2004) reveal that in 2001 the proportion of families below the poverty line was estimated at around 47% in the Northeast. Melo Caldas & Sampaio (2015) found a similar number in 2009, i.e., 48%. Also, the authors show that the Northeast has one of the highest percentages of households without access to housing and consumption items, and in rural areas, this restriction is slightly more severe. Kreter et al. (2015) also found similar results for housing conditions in areas in the Northeast region. In this sense, for Soares et al. (2016), the reduction of poverty in regional terms has not changed much, with the North and Northeast regions presenting the highest prevalence rates of poverty, as well as rural areas in all regions. Extreme poverty has been reduced, but it is still present in rural areas and in the North and Northeast regions.

4.2 SPATIAL ECONOMETRICS ANALYSIS

To test the occurrence of spatial autocorrelation in the proposed model, it was initially estimated by OLS – without the spatial element –, obtaining the Moran's I of the residues and the Lagrange Multiplier, to choose the model that best suited the approach of spatial dependence. Table 4 shows the results of Moran's I and the Lagrange Multiplier tests for the municipalities in 2006 and 2017.

Table 4 - Moran's I coefficient and Lagrange Multiplier tests for municipalities in 2006 and 2017.

				2006				
Tests	**Queen**	**p-value**	**Rook**	**p-value**	**K4**	**p-value**	**K5**	**p-value**
Moran's I	16.191	0.0000	15.530	0.0000	17.267	0.0000	16.756	0.0000
Lag	70.877	0.0000	63.783	0.0000	42.713	0.0000	25.737	0.0000
Robust Lag	2.957	0.0855	2.292	0.1300	0.030	0.8631	1.803	0.1793
Error	258.207	0.0000	237.530	0.0000	293.960	0.0000	276.206	0.0000
Robust Error	190.287	0.0000	176.039	0.000	251.277	0.0000	252.272	0.0000
				2017				
Tests	Queen	p-value	Rook	p-value	K4	p-value	K5	p-value
Moran's I	35.184	0.0000	34.897	0.0000	37.759	0.0000	39.890	0.0000
Lag	19.319	0.0000	20.062	0.0000	32.947	0.0000	32.605	0.0000
Robust Lag	2.471	0.1340	2.470	0.1161	3.2036	0.0730	3.249	0.0714
Error	1,224.020	0.0000	1,204.279	0.0000	1,416.0910	0.0000	1,572.800	0.0000
Robust Error	1,206.924	0.0000	1,186.687	0.0000	1,386.3470	0.0000	1,543.440	0.0000

Source: Research results. Note: The value of I (E) -0.0002 for 999 permutations.

The results show that the K4 the closest neighbor convention is the most appropriate for 2006 and the K5 the closest neighbor convention is the most appropriate for 2017. The Lagrange multiplier indicated the SEM model (spatial lag in the term error) for both years.

Table 5 shows the results of the estimates of the models by OLS and SEM models for 2006 and 2017. It is noticed that in the OLS model, the Jarque-Bera test, the errors do not follow a normal distribution, the Breusch-Pagan suggests heteroscedasticity and the Condition Number suggests non-multicollinearity. These tests indicate the estimation of the models is not by maximum likelihood, but by the method of generalized moments, developed by Kelejian & Prucha (1997)[8].

Spatial effects under control, the variables present different values from the estimates by OLS (Almeida, 2012). For 2006, the Lambda variable, which captures the effects of the

[8] Further details in Almeida (2012).

spatial lag in the error term, was significant and positive, as well as in the year 2017. This indicates that the non-modeled effects show positive spatial autocorrelation, and high values of the non-modeled effects cause shocks of high values in the surrounding municipalities. These less intense shocks are observed in the neighborhood with less intensity. In this way, a sudden change in a municipality overflows not only to its close neighbors, but also to other neighbors (Barreto, 2007).

Table 5: Results of the estimates of the OLS and SEM models for Brazilian municipalities in 2006 and 2017.

Variable	OLS				SEM			
	2006		2017		2006		2017	
	Estimate	p-value	Estimate	p-value	Estimate	p-value	Estimate	p-value
Intercept	0.0008	0.1014	4.8758	0.0000	-0.0002	0.6166	2.5395	0.0105
N0a10ha	0.0004	0.4592	1.0046	0.0000	0.0013	0.0309	-0.1233	0.2881
N10a100ha	-0.0012	0.0006	0.9869	0.0000	0.0001	0.8601	0.0029	0. 0008
Above100ha	-0.0014	0.1098	1.0912	0.0083	-0.0003	0.6742	0.0044	0.0000
EduF	0.0003	0.4017	-0.4667	0.0000	0.0005	0.2331	1.0780	0.0000
GuidF	0.8023	0.0000	0.0409	0.0000	0.7619	0.0000	1.0057	0.0000
EnergF	1.1172	0.0000	-0.0387	0.0000	1.1195	0.0000	0.9938	0.0000
Mach	-0.0474	0.0000	-0.0074	0.0000	-0.0434	0.0000	-0.0284	0.0011
CropPerm	0.0719	0.0000	-0.0041	0.0000	0.0795	0.0000	-0.0055	0.0000
CropTempp	-0.06771	0.0000	0.0060	0.0000	-0.0789	0.0000	0.0313	0.0125
R^2	0.8749	-	0.9926	-	0.8746		0.9926	
R^2 Ajusted	0.8747	-	0.9926	-	-	-	-	-
Jarque Bera	371,440,242.327	0.0000	46,931,055.935	0.0000	-	-	-	-
Breusch-Pagan	66,596.790	0.0000	1,944.30	0.0000	-	-	-	-
Condition Number	17.066	-	10.745	-	-	-	-	-
Lambda	-	-	-	-	0.2686	0.0000	0.5527	0.0000
Moran's I residuals	-	-	-	-	-0.0036	0.3140	0.3425	0.0110

Source: Research results

The results showed that in 2006 the class of farm area up to 10 hectares managed by women was positive and significant, showing a direct relation with AEMW with very small properties, and the vast majority are smaller than the fiscal module[9]. The other classes of areas farms were not significant. In 2006, education did not impact the variation. Still, in the 2006 Census, it was found that the variables of access to technical guidance and electricity were positive and significant. Access to electricity reveals a higher quality of life for rural families and better production infrastructure on the rural property (Lobão, 2018). Technical training promoted by governmental companies and NGOs contributes to recognition for rural women in agriculture and improves the visibility of their activities (Heredia & Cintrão, 2006). On the other hand, establishments with agricultural machinery have a negative and significant estimate, revealing an inverse relationship. In the 2006 Agricultural Census, permanent crops positively interfered in AEMW. However, temporary crops had a negative impact on these establishments, which indicates that the type of crop employed behaves differently.

In the 2017 Census of Agriculture, the class of farms areas up to 10 hectares was not significant, and classes of 10 to 100 hectares and above 100 hectares became positive and significant. Small, medium and large farms have a positive relationship with the leadership of women, but when they are very small, they do not significantly impact the leadership position of women. These estimates reveal that the reduction in the number of establishments in 2017

[9] Fiscal module is a unit of measure, in hectare. The size of a fiscal module varies according to the municipality where the property is located. The value of the fiscal module in Brazil ranges from 5 to 110 hectares. Fiscal module table is available at Instituto Nacional de Colonização e Reforma Agrária (2020).

is in the opposite direction to the increase in the number AEMW – the data indicates that it was more relevant for properties larger than 10 hectares. This movement to reduce the number of establishments in Brazil and the regions had occurred since 1985, in which the last increase in the number of establishments occurred, being a persistent trend over time. The novelty is the increase of women in the management of these properties.

For 2017, the education of female managers became significant and showed a positive relation with AEMW. According to Caumo (2015), who used data from the 2006 Agricultural and Livestock Census, for the southern region of Brazil, the education of women employed in family farming is lower concerning women not employed on the property. However, Caumo (2015) realized that the greater the number AEMW, the greater the man's education. Therefore, women's education has important effects not only for their children but also for their spouses. The improvement in the level of education is a process that has been occurring since the 1990s, and according to Heredia & Cintrão (2006), with PNAD data, from 1992 to 2002, there was an improvement in access to education and a sharp increase in years of study for women in rural areas.

In 2017, AEMW with technical guidance, access to electricity and agricultural machinery showed similar behavior to the 2006 Census, with the first two variables being positive and the last negative. In 2017, establishments with temporary crops became positive and significant estimate, showing a change in structure regarding temporary crops. The variable establishments with permanent crops became negative in 2017, which allows us to observe the decline in relevance to women managers.

A more general reflection should be made concerning the reduction in the number of establishments by the new methodology applied in the Agricultural and Livestock Census of 2017 which reduces the double counting of this variable. This double counting may also be reflected in the variable agricultural establishments with agricultural machinery, which remained negative among the Censuses. Relationship between the number of implements and the number of female managers is inverse. The reduction of establishments has several factors involved, among them those related to land concentration and rural-urban migration. Anyway, the data reveal that in the municipalities where there was a process of reduction of agricultural establishments, there was an increase in the presence of women in the management of the establishments.

5 FINAL CONSIDERATIONS

The objective of this work was to analyze the spatial distribution of agricultural establishments managed by women (AEMW) in Brazilian municipalities, using data from the Agricultural and Livestock Censuses of 2006 and 2017. Descriptive statistics, ESDA, and spatial econometrics methodologies were applied, which made it possible to answer the question about where these establishments are concentrated, and what is the relationship with some economic variables available in both Censuses.

The survey revealed important data, and it may be highlighted that, between 2006 and 2017, the number of women residing in rural areas declined 2.84%, while the number of AEMW increased 44.16%. The Northeast region had the largest number of AEMW. However, the North region was the one with the highest expansion percentage between the Censuses. In all Brazilian regions, there was an improvement in the average female education, especially for the North and Northeast regions, which contributed to the reduction of educational disparities between the states. Positive global spatial autocorrelation was found in AEMW in both years. The formation of High-High (HH) clusters was concentrated in municipalities in the Northeast region in 2006 and 2017, and in the last Census, municipalities in the North region had also concentrated HH clusters. Most of the municipalities of the Low-Low clusters were concentrated in the Southeast region.

For both years analyzed, the results suggest that the non-modeled effects caused shocks of high values in the surrounding municipalities, as well as shocks of lesser intensity. Some variables had different behaviors in the years analyzed. The most important was the education of the female managers, which became significant and showed a positive relation with AEMW in 2017. This result highlights the importance of the relationship between education and leadership in rural areas. In the municipalities where there was a process of "disappearance" of establishments, there was an increase in the presence of female leaders. This "disappearance" may also be related to both land concentration and the new 2017 Census methodology.

The North and Northeast regions represented 22.14% and 50.28%, respectively, of the increase of AEMW in Brazil between the 2006 and 2017 Censuses; both regions present a total variation of 72.42%. The growth in the number AEMW reveals the improvement of women's empowerment. The women's contribution to the economic and social development of rural areas is strongly associated with their greatest cognitive potential. The impacts of woman's empowerment are likely to be more important in the poorest regions of the country – North and Northeast – due to contributions to overcome more poverty areas.

This study also reveals a clear expansion of the women's human capital, in which contribute to strengthening the structures of family and commercial production. To expand and improve the quality of their participation, the government should implement policies for women and sensitive to gender. These policies can impact the greater organizational capacity of rural communities to improve social capital that promote the development of these areas and, consequently, of agricultural production. Government actions can promote and ensure more equal opportunities for women.

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Annex 1: Table with the Variables used, corresponding SIDRA table and year of the Agricultural Census.

Variable	Source	Year
Establishments with a female manager	Table 3349 – Number of agricultural establishments, by type of agricultural practice, gender of producer, the residence of producer and group of economic activity	2006
Education of female managers of establishments	Table 3346 – Number of agricultural establishments, by type of electricity source, gender of producer, technical guidance, the origin of technical guidance, level of education of the person who runs the establishment and groups of economic activity	2006
Establishments with female managers with electricity	Table 3346 – Number of agricultural establishments, by type of electricity source, gender of producer, technical guidance, the origin of technical guidance, level of education of the person who runs the establishment and groups of economic activity	2006
	Table 3352 – Number of agricultural establishments and Area of establishments, by land use, gender and producer residence, technical guidance and origin of technical guidance	
Area classes of establishments with female managers	Table 787 – Number of establishments and Area of agricultural establishments, by producer legal status concerning land, gender of manager, groups of the total area	2006
Establishments with women managers with technical guidance	Table 3352 – Number of agricultural establishments with owner producer by the form of land acquisition, gender of the producer, age class of the person who runs the establishment, level of education of the person who runs the establishment and groups of the total area	2006
Establishments with permanent crops	Table 3346 – Number of agricultural establishments, by type of electricity source, gender of producer, technical guidance, the origin of technical guidance, level of education of the person who runs the establishment and groups of economic activity	2006
Establishments with temporary crops	Table 3346 – Number of agricultural establishments, by type of electricity source, gender of producer, technical guidance, the origin of technical guidance, level of education of the person who runs the establishment and groups of economic activity	2006
Agricultural machinery by establishments	Table 861 – Number of agricultural establishments and number of existing agricultural machines and implements, by type of machine and agricultural implement, condition of the producer concerning the land, groups of the area of farming, groups of total area and groups of economic activity	2006
Establishments with a female manager	Table 860 – Number of agricultural establishments with tractors and number of existing tractors in agricultural establishments by tractor power, condition of the producer concerning the land, groups of the area of farming, groups of total area and groups of economic activity	2017
Education of female managers of establishments	Table 6755 – Number of agricultural establishments by gender, literacy, age, and color or race of the producer	2017
Establishments with female managers with electricity	Table 6709 – Number of agricultural establishments, by the existence of electricity, gender of the producer, education of the producer, legal status of the producer, direction of the work of the agricultural establishment and groups of the total area	2017
Area classes of establishments with female managers	Table 6857 – Number of agricultural establishments, by the existence of electricity, gender of the producer, education of the producer, legal status of the producer, direction of the work of the agricultural establishment and groups of the total area	2017
Establishments with women managers with technical guidance	Table 6761 – Number of agricultural establishments, by the association of the producer with the cooperative and/or class entity, gender of the producer, education of the producer, legal status of the producer, direction of the work of the agricultural establishment and groups of the total area	2017
Establishments with permanent crops	Table 6759 – Number of agricultural establishments, by the origin of the technical guidance received, gender of the producer, education of the producer, legal status of the producer, direction of the work of the agricultural establishment and groups of the total area	2017
Establishments with temporary crops	Table 6883 – Number of agricultural establishments and Area of establishments, by land use, producer legal status, the direction of work of the agricultural establishment and groups of the total area	2017
Agricultural machinery by establishments	Table 6883 – Number of agricultural establishments and Area of establishments, by land use, producer legal status, the direction of work of the agricultural establishment and groups of the total area	2017

Source: Instituto Brasileiro de Geografia e Estatística (2019).