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ASSOCIATIONS BETWEEN AGRICULTURE AND REGIONAL SOCIO-ECONOMIC DEVELOPMENT IN BRAZIL

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ABSTRACT

The role of the agricultural sector to economic growth in the regional and national levels is striking, however, does the sector play the same role for socioeconomic development? This study seeks to relate the concentration of formal employment and income in the agricultural sector with the socioeconomic development of Brazilian municipalities. Thus, methods of regional analysis are used, such as the Locational Quotient (QL), relative participation in employment and income and the indicator of socioeconomic development (HDMI). Data were obtained from the Annual Relation of Social Information (RAIS), World Bank and UNDP in the year 2018. The results showed an inverse relationship between concentration of formal employment and income in the agricultural sector and the indicators of socioeconomic development. The work provides an important subsidy to promote discussion about the current economic foundation of the country and their real capacity to promote and stimulate economic development.

INTRODUCTION

The Brazilian agricultural sector is a segment that grows the geometric rates in terms of production and productivity. In terms of Gross Domestic Product (GDP), the sector grew by 2.18% between the years of 2005 to 2016, against the growth of 2.02% of the country (World Bank, 2018). Since 2005, it is the only sector of the Brazilian economy that accumulates successive trade surpluses. The country is the world's largest exporter of soya, sugar and orange juice, and still has one of the largest production of poultry and bovine and swine meat (FaoStat, 2018). The combination of the increase in agricultural production in Brazil with the significant overall increase in productivity, has resulted in the transfer of potential income for society (Silva, 2010; Bessa, 2017). Barros (2014) emphasizes that the performance of the agricultural sector is the result of integration among economic actors that go beyond the field, covering the expansion of agroprocessing and inputs

industries, to the growing relationship with the segments of technology and specialized services, and even an interconnection with the sectors of distribution and storage. Freitas et al. (2007) stresses that to the extent that the inter-relationships between the rural segments and other economic activities develop, they are translated into local development, resulting in the introduction of new factors of production, increasing the labor productivity and the quantity of goods and services available to society. The concept of local economic development (DEL) has several definitions. To Bartik (2003, p. 1), DEL represents an increase in capacity of the local economy to generate wealth for local residents". The World Bank (2009) extends the discussion and considers that the DEL activity is obtained with the participation of the local population, which works to achieve a sustainable economic growth, resulting in economic benefits and improvements in the quality of life for everyone in the community. ILO (2006, p. 2) defines DEL as a "process of participatory development, which encourages partnership agreements between the major private and public actors of a defined territory". This definition is based on four central characteristics, (i) having participation

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and social dialog; (ii) being anchored in a specific territory; (iii) involving the mobilization of local resources and competitive advantages; and (iv) being locally owned and local management. Thus, DEL allows the elaboration and joint implementation of a strategy of development policy, using local resources, competitive advantage in a global context with the ultimate goal of creating good jobs and stimulating the economic activity (ILO, 2006). The role of the agricultural sector to economic growth in the regional and national levels is striking, however, does the sector play the same role for socioeconomic development? Guided by this issue, this study aims to investigate the relationship between the socioeconomic development and the agricultural sector of Brazilian municipalities, by means of two routes, (i) by the level of development of the municipalities, as measured by the municipal human development index (MHDI); and (ii) the importance of agriculture in the national product and its ability to allocate jobs and income in the municipalities. It will use the method of cluster analysis, to allow grouping the municipalities with similar characteristics in terms of the degree of development and the concentration of employment and income in the production sector, allowing to identify the attributes that differentiate the municipalities with higher and lower levels of human development. The main contribution of this study was to provide subsidies to promote discussions about the current economic foundation of the country and its real capacity to promote and stimulate the local socioeconomic development.

MATERIALS AND METHODS

Methodology of regional analysis: A set of descriptive measures and of exploratory nature are commonly used in diagnosis of sectoral concentration, defining the regional patterns of spatial distribution of economic activities. Such measures may be divided among measures of location of sectorial nature, which seek to check standards of concentration or spatial dispersion. Whereas the measures of specialization concentrate the analyzes in the productive structure of each region, aiming to analyze the degree of regional specialization, as well as their change over time. Among the measures of location, Haddad (1989) uses the location quotient (LQ) to compare the percentage of participation of a region in a particular sector, with the percentage of participation in the same region in total employment in the economy of reference, equation (1). The data used refer to formal employment and the municipal production.

$$LQ_{ij} = \frac{\frac{E_{ij}}{\sum_i E_{ij}}}{\frac{\sum_j E_{ij}}{\sum_i \sum_j E_{ij}}} \qquad (1)$$

Where: E_{ij} = the formal employment sector level i in the micro-region j (i=1, 2, 3, …, m; j = 1, 2, 3, …, n); $\sum_j E_{ij}$ = the sum of the formal sector employment of i in all micro-regions j; $\sum_i E_{ij}$ = the sum of the formal employment of the micro-region j in all sectors and; $\sum_i \sum_j E_{ij}$ = the sum of employment in all sectors i of all micro-regions j. When LQij > 1, the micro-region j is more specialized in sector i is the set of all the other analyzed micro-regions. It is assumed that the sector meets local demand and generates a surplus to export to other

regions of the country or abroad. When LQij < 1, the micro-region j is less specialized in sector i than the set of all the analyzed micro-regions. With the objective of capturing the importance of an economic sector in the municipalities, i.e., the relative participation of the sector in total employment and total production of a municipality, this parameter is given by the Index of Relative participation (Part_%), equation (2).

$$Par(\%) = \frac{\sum E_{ij}}{\sum_i E_{ij}} . 100 \qquad (2)$$

Based on the results of indexes LQ and Part (%), it is possible to analyze, to a particular municipality, specialization and concentration with their potential effects of spillovers of the agricultural sector, for example, for the socioeconomic development of the municipality (Combes, 2000; Suedekum &Bilen 2005; Ribeiro *et al*, 2014).

Cluster analysis: To understand the concentration of economic activities in Brazilian municipalities, for example, it is necessary the use of techniques of grouping of municipalities, according to the characteristics of the level of development and the concentration of employment and income sector of these municipalities, in addition to data used to supplement and interpret the analyzes carried out, starting with the purpose of segmenting the observations into groups with similar characteristics among themselves and different to the others. Examining the relationship of a municipality within a group of similar municipalities, with any one of the other municipalities in this group, the method of Ward was used,which, according to López (2013), consists of using the analysis of variance to evaluate the distances among the groups (clusters). The method attempts to minimize the sum of the squares of these distances of two hypothetical groups which can be formed at each step. Ward's method is efficient but tends to create groups of small sizes. By using this method, it was possible to group the municipalities with similar characteristics. For the calculation of similarity and dissimilarity the square Euclidean distance was used, a requirement of the selected method. Thus, by grouping the municipalities based on the characteristics of the agricultural sector and socioeconomic development, it was not possible to analyze the medium characteristics of the municipalities grouping in each cluster. An important issue on the cluster analysis is how to choose the number of clusters. Calinski and Harabasz (1974) introduced the criterion of reason of variance (VRC). This criterion consists of the calculation of the ratio between the global variation among the segments and the global variation with the segment in relation to all the variables of grouping. The ratio for the variation is calculated for each possible cluster number, therefore, the determination of the number of clusters is given by the lowest rate of variation.

Local Spatial autocorrelation: In order to observe the existence of local spatial clusters of high or low value and which regions that contribute the most to the existence of spatial autocorrelation, one must implement the measures of local spatial autocorrelation, which are: diagram of dispersion of Moran (Moran Scatterplot) and Lisa (Local indicators of spatial association). The Local Moran index is a statistical tool used to test local autocorrelation and to detect spatial objects with influence on the global Moran indicator, based on the analysis of the covariances among different units of area. The Local Moran index evaluates the covariance between a given polygon and a certain neighborhood defined in function of a

distance *d* (Anselin, 1998). The distribution patterns of the indicators were examined on a smaller scale through the local Moran (LISA), producing a specific value for each municipality, allowing the visualization of groupings of municipalities with similar values for the selected indicators. Correlations of the type "high-high" show municipalities with high proportions of the indicator, surrounded by other municipalities also with high proportions of the same indicator; "low-low" municipalities with low proportion, surrounded by municipalities with a low proportion of the same indicator; "high-low" municipalities with high proportion, surrounded by municipalities with a low proportion of this indicator and "low-high" municipalities with low proportion, surrounded of municipalities with a high proportion of the same indicator. (Almeida & Haddad, 2004) (Anselin, 1995). The analyzes considered significance level of p<0.01 and cartographic products were developed by means of softwares GeoDa 1.12 and QGIZ 3.0.0.

Data base: In this study data on the distribution of formal employment were used prepared by the Annual Relation of Social Information (RAIS), of the Ministry of Labor and Employment (MTE); the production of the agricultural sector prepared by the Brazilian Institute of Geography and Statistics (IBGE), for the year 2015; Municipal Human Development Index, the figures for 2010 (UNDP, 2018); and national and sectorial production available at the World Bank, constant values in 2010. Table 1 shows the variables used for cluster analysis and the variables used to complement the analysis.

Table 1. Variables used in the cluster analysis in the agriculture sector

| Acronym	Variables	Source
LQ_GDP	Location quotient of value added (GDP) of agriculture	IBGE (2018a)
GDP_Agri%	Relative Participation of value added (GDP) of agriculture	IBGE (2018a)
LQ_Employ	Location quotient of agriculture sector employ	Brazil (2018)
Employ_Agri%	Relative Participation of employ	Brazil (2018)
MHDI	Municipal Human Development Index	PNUD (2018)
GINI	Gini Index	PNUD (2018)
GDP_Ind_%	Relative Participation of value added (GDP) of industry	IBGE (2018a)
GDP_Serv_%	Relative Participation of value added (GDP) of service	IBGE (2018a)
GDP_AdmP_%	Relative Participation of value added (GDP) of government	IBGE (2018a)
Employ_Ind_%	Location quotient of industry sector employ	Brazil (2018)
Employ_Serv_%	Location quotient of service sector employ	Brazil (2018)

Source: Elaborated by the authors

The Municipal Human Development Index (MHDI) was used as a measure of the social dimension. This index was developed from the Human Development Index (HDI), created by the United Nations as an alternative to GDP to analyze the development of the country. By measuring three dimensions (income, education and longevity), the MHDI gives an idea of the evolution of the population living conditions in a given municipality. According to the United Nations Development Program (UNDP), the MHDI varies: very low (0 to 0.499), low (0.500 to 0.599), medium (0.600 to 0.699), high (0.700 to 0.799) and very high (0.800) to 1 (UNDP, 2013). The calculation of the GDP of Municipalities obeys a uniform

methodology for all Brazilian states, and it is integrated conceptually to the procedures adopted in the System of National Accounts and Regional Accounts of Brazil, which follow the International Handbook of National Accounts (SNA, 2009). Thus, the results become consistent and comparable among themselves.

RESULTS AND DISCUSSION

The Brazilian agricultural sector, in 2016, was responsible for allocating 1,476,219 jobs, representing 3.20% of the total employment (Brazil, 2018). Regarding GDP, the sector generated US$ 84.6 billion, approximately 5.45% of the total product generated in the country (World Bank, 2018). Figure 1 shows the participation of the agricultural sector in the stock of labor force and domestic product.
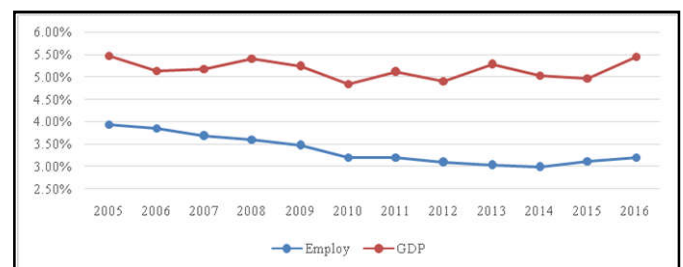
Source: Developed by the authors based on data from Brazil (2018) and World Bank (2018).

Figure 1. Participation of the agricultural sector in GDP and Employ (2005-2016)

Figure 1, it is noted that the inverse behavior between labor force participation and the participation in the GDP, in which the first showed a reduction of 1.71% in the participation in formal employment, expressing the loss of about 165.9 thousand formal jobs in the period. The constant movement of incorporation of new technologies for agricultural production in Brazil has increased remarkably its productivity, being expressed by participation in the GDP, however, contributed to the elimination of many of their jobs. In an initial analysis, it was sought to verify the existence of spatial autocorrelation, which indicates if the data distribution in the space follows some non-random pattern (Almeida & Haddad, 2004). In case there is a spatial pattern for the variable under analysis there are two possibilities: positive autocorrelation, in which case the similar values are closer in space, or negative, in which case the values depart spatially. In addition, the statistics of Local Indicators of Spatial Association (LISA) was applied to illustrate the results found by the index I of Moran. It was opted to analyze first the spatial autocorrelation of the variable GDP_Agri_%, which relates to the participation of agribusiness sector in the formation of income of municipalities with the HDIM of the respective municipalities. Figure 2 shows the graph of spatial autocorrelation for the variables GDP_Agri% and Mhdi. The visual analysis of the Graph of Moran suggests the existence of positive spatial autocorrelation in the participation of the agricultural sector in the formation of municipal income compared with the HDIM of municipalities, given that these rates are concentrated in the first and third quarters. It is also verified that, municipalities with high (low) participation of the agricultural sector in the composition of income and high MHDI are located nearby. Corroborating with the visual analysis, the statistic I of Moran is significant at a level of 0.01%, from tests with approximately 10,000 permutations, presenting value of 0.079.
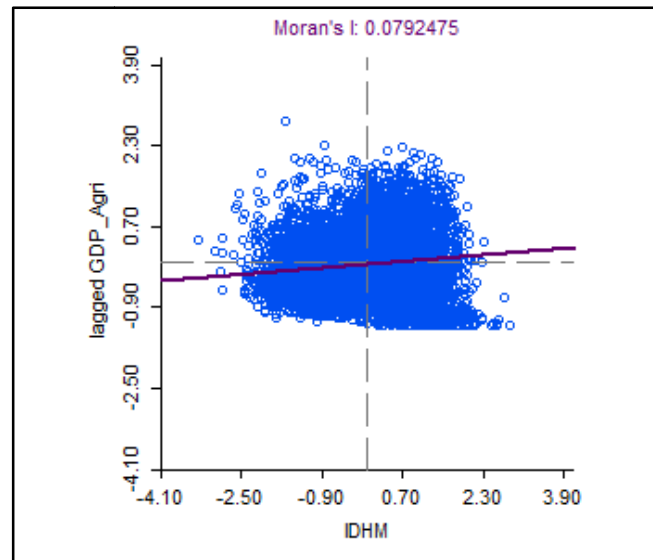
Source: Elaborated by the authors

Figure 2. Diagram of dispersal of Moran: GDP_Agri% e MHDI
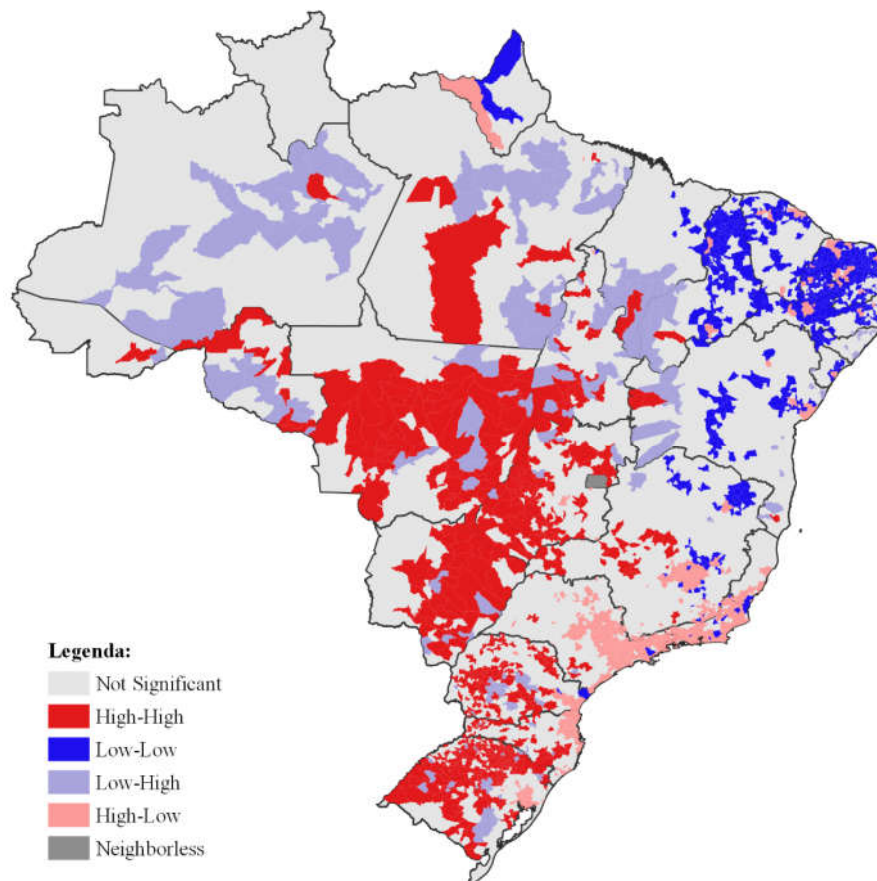
Source: Elaborated by the authors

Figure 3. Map of dispersion of Moran for Brazilian municipalities

In order to illustrate the special autocorrelation, Figure 3 shows the results of the statistic LISA, with a confidence level of 95%, presenting four spatial regimes. Figure 3 confirms that at a level of 95% of confidence there is a standard for the spatial configuration of the participation of the agricultural sector in the composition of GDP and HDIM of the municipalities. It is noted the concentration in municipalitiesof the Midwest region, among other things, considering that most municipalities in standard low-low, i.e., districts with low livestock sector in the composition of GDP and MHDI, that are surrounded by municipalities in the same condition. The setting low-low was concentrated in the cities of the Northeast region. From these first discoveries, and seeking to meet the objectives proposed, Table 2 presents the clusters formed from the level of development (HDIM) and the concentration of employment and income sectors of Brazilian municipalities, in addition to data used to supplement and interpret the analyzes carried out. 5 clusters were built that involve the municipalities with similar characteristics to the variables. Thus, the clustering of municipalities enabled to find patterns that have a

justification for their level of development. Figure 4 aims to highlight the compositions of clusters, regarding the participation of the agricultural sector in the formation of income and allocation of employment, and at the level of MHDI of each municipality.

In a brief analysis about the relationship MHDI and *share of agricultural sector*, it is possible to highlight the cluster 1 and 2, the municipalities belonging to these two groups have MHDI high and low participation of industry in the formation of their income.

Table 2. Summary of variables used per cluster. [supplementary]

Parameters	Cluster					Total
	C.1	C.2	C.3	C.4	C.5	
Number of municipalities	1,033	546	421	1,919	1,646	5565
Percentage of municipalities	18.56%	9.81%	7.57%	34.48%	29.58%	100.00%
LQ_GDP_Agricola	1.163	2.426	6.975	2.766	8.047	4.3156
Percentage of GDP_Agricultural	5.02%	10.48%	30.13%	11.95%	34.76%	18.64%
LQ_Employ	1.831	7.965	13.161	1.115	2.649	3.285
Percentage of LQ_Employ	5.72%	24.87%	41.09%	3.48%	8.27%	10.26%
MHDI	0.734	0.685	0.671	0.599	0.671	0.6592
GINI	0.475	0.480	0.492	0.518	0.482	0.494
GDP Industry%	23.61%	17.56%	9.91%	9.05%	8.12%	12.38%
GDP Services%	42.23%	36.12%	27.26%	27.67%	26.58%	30.85%
GDP_PublicAdm%	18.56%	28.07%	27.12%	46.02%	25.61%	31.69%
Employ Industry%	21.68%	12.02%	6.98%	10.79%	20.04%	15.38%
Employ Services%	50.55%	46.88%	39.35%	69.55%	51.28%	56.11%

Note: The municipalities Balneário Rincão, Pescaria Brava, Mojuí dos Campos, Pinto Bandeira and Paraiso das Aguas were excluded, because they do not have information on all the analyzed variables.
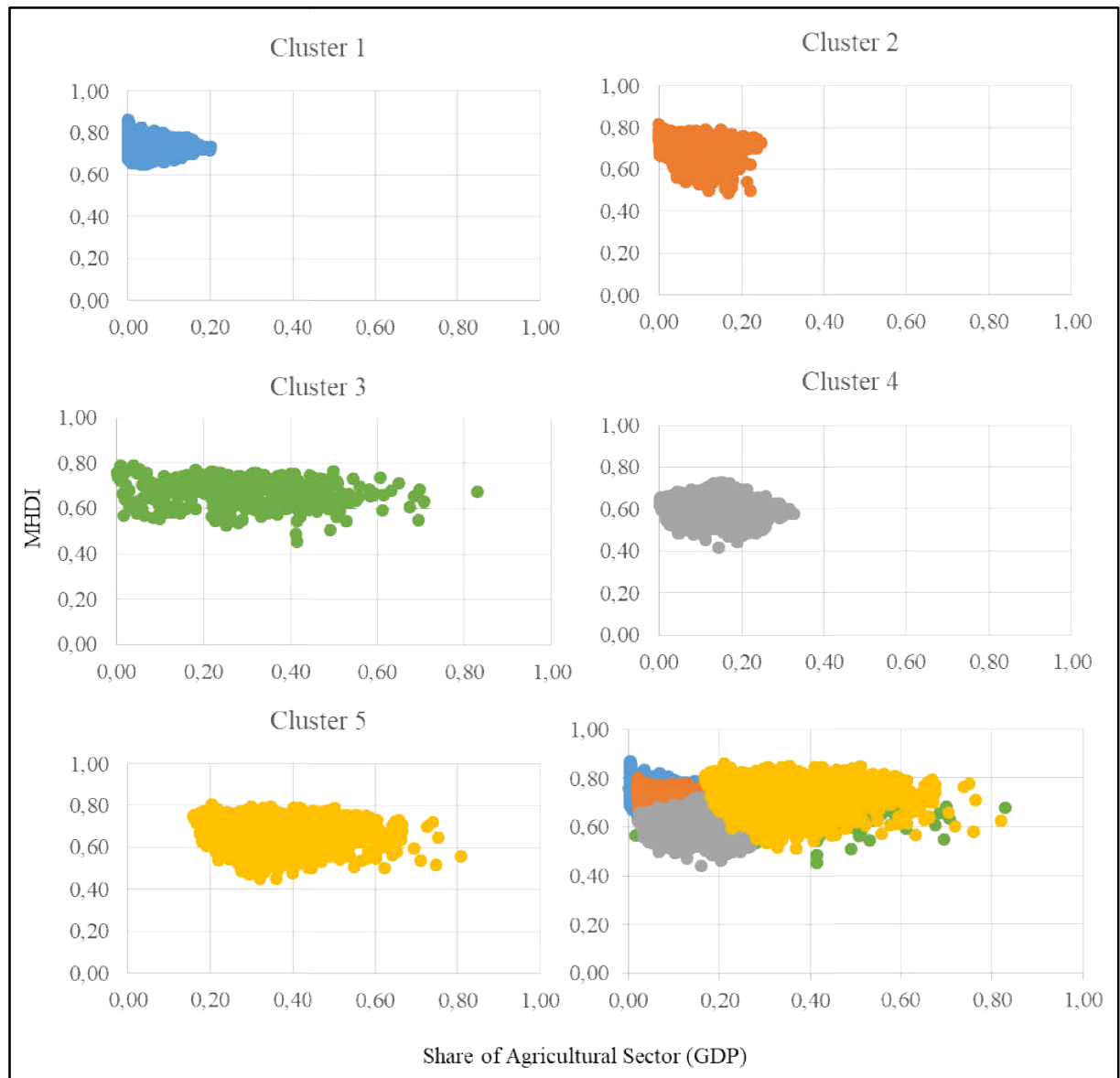
Source: Research result.

Figure 4. Distribution of municipalities, by Participation of Agribusiness and MHDI

The municipalities belonging to clusters 3 and 5 are distinguished by a greater concentration of the sector's participation in the composition of their incomes. The clusters were classified and named according to their points in common, from the information contained in Table 2, such as: (i) independent municipalities of agriculture (cluster 1); (ii) municipalities semi-independent of agriculture; (iii) municipalities with dynamic agriculture; (iv) municipalities with agriculture in development; and (v) municipalities with concentrated agriculture and livestock. The cluster 1 (C.1) was classified as independent municipalitiesof agriculture and live stock. This group comprises 1,033 municipalities, concentrated in the Southeastern region (mainly the states of São Paulo and Rio de Janeiro), being composed in its majority by municipalities of these two states). Uberaba/SP, São José dos Campos/SP and Divinópolis/MG are cited as examples of cities included in these clusters.

Cluster C.1 has as intrinsic characteristic the low participation of the agricultural sector in the municipal GDP, with an average of 5.02% and high value of MHDI (0.734), the latter considered with "high" development. In these municipalities the services sector represents a greater participation in the composition of income, with an average of 42.23%, and allocation of work force (50.55%), in addition to the lower concentration of income, which can be expressed through the Gini Index (0.4758). It should be emphasized that these municipalities are responsible for 75.01% of the Brazilian GDP. Therefore, the main feature of the cluster C.1 is the concentration of national production, and also the concentration of formal employment in the services sector, which provides evidence of a strong correlation between economic activity and development in this group of municipalities.

Cluster 2 (C.2) was classified as independent municipalitiesof agriculture and live stock. This cluster is composed of 546 municipalities, concentrated in the Southeastern region, for example the municipalities of Santo Antônio da Alegria/SP, Gastão Vidigal/SP and Coroaci/MG. A priori, cluster C.2 resembles the "independent municipalitiesof agriculture" of the cluster C.1, however, some characteristics distinguish them. The first is the concentration of the factor labor force in the agricultural sector, representing on average 24.87% of formal employment. Another characteristic is that in this cluster the agricultural sector has higher participation in the income generation, on average 10.48%. Still regarding GDP, the municipalities of this cluster incorporate 10.22% of national production, and 9.78% of the product generated by the agricultural sector in Brazil.

Cluster 3 (C.3) was classified as composed of municipalities with a dynamic agriculture, being formed by 421 municipalities, mostly concentrated in the Midwest region, such as Santo Antônio do Leste/MT, Bom Jesus do Araguaia/MT and Nova Maringá/MT. These cities are characterized by a high concentration in the factors income and employment. The presented medium LQs, respective of 6.975 and 13.161, i.e., the relative participation of employment in the agricultural sector, in the municipalities belonging to t cluster C.3 is 13.161 times higher compared to other cities in the country. The relative concentration of these factors in cluster C.3 is reflected on the participations in the income formation (30.13% on average) and allocation of formal employment (41.09% on average), a fact that occurs in the other clusters. Another thing to point out is that, in cluster C.3 is that the group of municipalities showed, in its constitution, a small industrial sector, reflecting both in employment (6.98%), as well as in industrial production (9.91%); and high participation in the services sector, in the allocation of formal employment (39.35%) and in the formation of product (27.26%). In the socioeconomic sector, it is possible to highlight the MHDI indicators, with values of 0.671 and the Gini Index, with average values of 0.4926. Thus, the main feature of cluster C.3 is the concentration of the product and the concentration of formal employment in the agricultural sector, however, it has a low reflection in relation to national production, with only 3.14% of GDP, which provides evidences of a strong inverse correlation between the intensity of economic activity and formation of national product.

Cluster 4 (C.4), formed by municipalities with agriculture in development, possessing 1,919 municipalities, mostly concentrated in the North and Northeast regions, for example Alvorada do Gurguéia/PI, Curuá/PA and Vila Nova dos Martírios /MA. The municipalities formed by this cluster have certain concentration on the income formation (LQ = 2.766), however, concentrating only 3.48% of the formal employment. Another point to highlight in this cluster is the low degree of socioeconomic development, with HDMI value considered "medium" (0.599) and the Gini index of 0.519, reflecting the income inequality in these municipalities. Despite the numbers displayed on the cluster C.4, which demonstrates a weak socio-economic dynamism, with a dominance of the public sector in the generation of income (46.02%) and low participation in the industrial sector (9.05%). These characteristics provides evidence of a strong correlation between the industrialization and economic development.

Cluster 5 (C.5) encompasses municipalities with concentrated livestock, being formed by 1,646 municipalities, spread in all regions of the country. Jatei/MS, Morro da Garça/MG and André da Rocha/RS are cited. This cluster is responsible for 43.89% of the total production of the agricultural sector in the country, as well as the concentration of production in the municipalities belonging to this cluster, on average 34.75%, concentrating until 80.87% of income in some municipalities, as in the case of Codajás/AM. Regarding the allocation of labor force, the low concentration of formal employment must be highlighted in the agricultural sector and industrial in cluster C.5, presenting a high degree of concentration in the services sector, on average 51.28% of the formal employment. Thus, although the agricultural sector has, on average, greater participation in the municipal production in this cluster, the same does not have the capacity to generate jobs within these municipalities. It is the service sector that maintains the most formal jobs, reflecting the economic dynamics in these municipalities. The clustering of municipalities and the grouping performed allows a comparison of the attributes of each cluster in relation to the national average, by means of descriptive statistics, and therefore to describe the average level of development and the productive profile of each group of municipalities, separately.

Clusters C.3 and C.5 contain mostly municipalities whose means of participation of the agricultural sector, in the generation of the product exceeds the national average, with values ranging from 30.13% to 34.76% of the GDP. However, cluster C.1, in which prevails municipalities in which the agricultural sector is not the main economic activity, and that
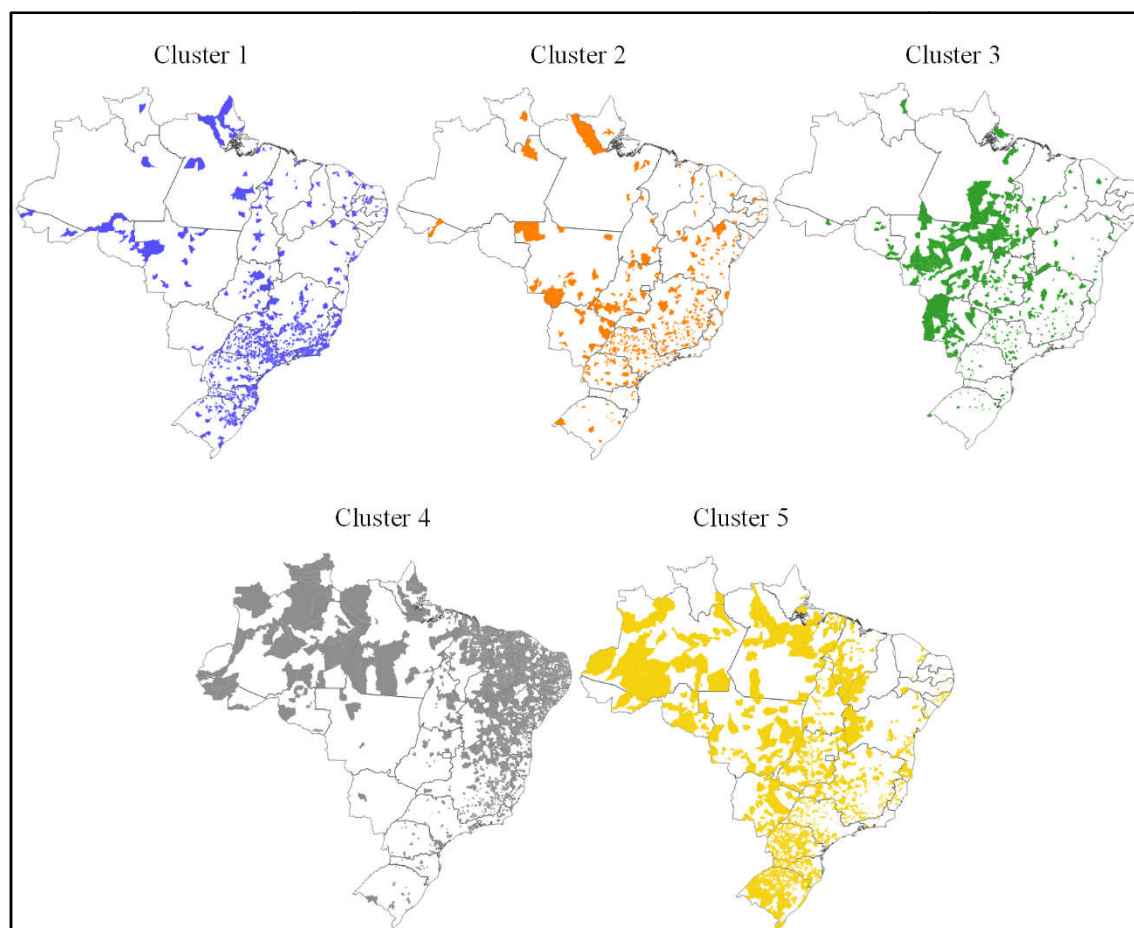
Source: Research result.

Figure 5. Graphical representation of the clusters in Brazil

focused 75.01% of the national production. One reason for this concentration is the large concentration of industry and service sectors, focusing 42.23% and 23.61%, respectively. Cluster C.4 differentiates itself from other groups by owning municipalities with low MHDI and low industrialization, with its formation of concentrated income in the sector of public administration. Therefore, it is possible to say that the concentration of income in the agricultural sector in the municipalities do not necessarily mean the same behavior in the concentration of national income, path that is driven by service sectors and industry, as evidenced, by the cluster C.1.

Final Considerations

This work relates the concentration of formal employment and income composition in the agricultural sector with the socioeconomic development of Brazilian municipalities, by means of cluster analysis, which allowed to group them according to their characteristics. The results indicate that the municipalities with the highest concentration of formal jobs and incomes in the agricultural sector, have low performance on the indicators of socioeconomic development in comparison to the other groups. The municipalities that have a low concentration of agricultural and livestock sector showed good socioeconomic performances, pointing, as well, an inverse relationship between the concentration in the agricultural sector and the indicators of socioeconomic development. Thus, the present study provides subsidies for discussions on the current economic basis of the country, concentrated in the agricultural sector, and their real capacity to promote and stimulate economic development.

This article is not intended to exhaust the discussion regarding the subject, because this is a relevanttopic to the Brazilian and state reality. New and complementary studies are suggested on the subject, and this analysis may be done for other sectors, other periods as well, more specific analyzes can be carried out for certain locations and economic activities.

Aknowledgements

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