

Identification and Geographical Delimitation of a Local Productive Arrangement of Forestry Basis

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Abstract

Local Productive Arrangements nowadays are targets for local and regional development politics. This study aimed to identify, qualify and geographically limit the municipalities that are part of a potential Local Productive Arrangement of Forestry Base in the southeast of Rio Grande do Sul. The hierarchical grouping analysis was used to identify the existence of groups and the analysis of main components to qualify them. Afterwards, industrial cluster indicators were used to quantify the specificity of a sector within a region for the formed groups. The hierarchical grouping analysis established four groups of municipalities, presenting different levels of development referring to the forestry sector. It is concluded that there is a Local Productive Arrangement of Forestry Base in the studied area limited by the municipalities of Cachoeira do Sul, Pantano Grande, Dom Feliciano, Amaral Ferrador, Encruzilhada do Sul, Piratini and Canguçu.

Keywords: regional development, cluster, forestry economy, forestry market.

1. INTRODUCTION AND OBJECTIVES

Industrial agglomeration, which is characterized by the clustering of actors located in the same area, has helped companies of various sizes, and particularly micro, small and medium enterprises, to overcome barriers to their growth, especially in the early years of the project. Among the advantages this business association can provide are: cooperation, work specialization, collective infrastructure, specialization of services, reduction of raw material input costs, among others, thus becoming a target of local and regional development policies (Oliveira et al., 2013; Sobrinho & Azzoni, 2015).

Productive clusters and industrial districts can be described as productive arrangements in which some aspects, on a greater or lesser scale, are present: (a) strong cooperation among agents; (b) socio-cultural identity; (c) institutional environment; (d) industrial atmosphere; (e) support from

local authorities; (f) existence of coordination institutions; (g) high survival rate of companies; (h) dynamism and industrial competitiveness; (i) favorable local factors (natural resources, human resources, logistics, infrastructure) and (j) strong economic links between agents (Quandt, 2012).

The south of Brazil presents some examples of local productive arrangements that stand out in the use of forest's raw material: Timber Local Productive Arrangement from the region of the Iguaçu Valley – Paraná and Santa Catarina (Enderle et al., 2005); Local Productive Arrangement of Furniture from the region of Araçuaçu, PR (Silva & Martins, 2017); and Local Productive Arrangement of Furniture from Bento Gonçalves, RS (Macadar, 2007).

In view of the benefits presented by Local Productive Arrangements, this study aims to identify, qualify and geographically limit the municipalities that are part of a potential Local Productive Arrangement with Forestry Base in the “Serra do Sudeste” region, Rio Grande do Sul.

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2. MATERIALS AND METHODS

2.1. Studied area

The city of Encruzilhada do Sul and its neighboring municipalities, Amaral Ferrador, Cachoeira do Sul, Canguçu, Dom Feliciano, Pantano Grande, Piratini and Santana da Boa Vista (Figure 1), are prominent in the state of Rio Grande do Sul due to its well-known forestry basis (Brasil, 2016;

Rio Grande do Sul, 2016). These municipalities belong to the physiographic region named “Serra do Sudeste”, in the “Sudeste Riograndense” mesoregion and to the “Serra do Sudeste” micro-region.

The studied area is characterized by a significant forestry basis, with emphasis on plantations of the genera *Eucalyptus*, *Pinus* and *Acacia*, also presenting a clear agglomeration of industries (Ageflor, 2017; Brasil, 2015) related to the production of forestry raw material.

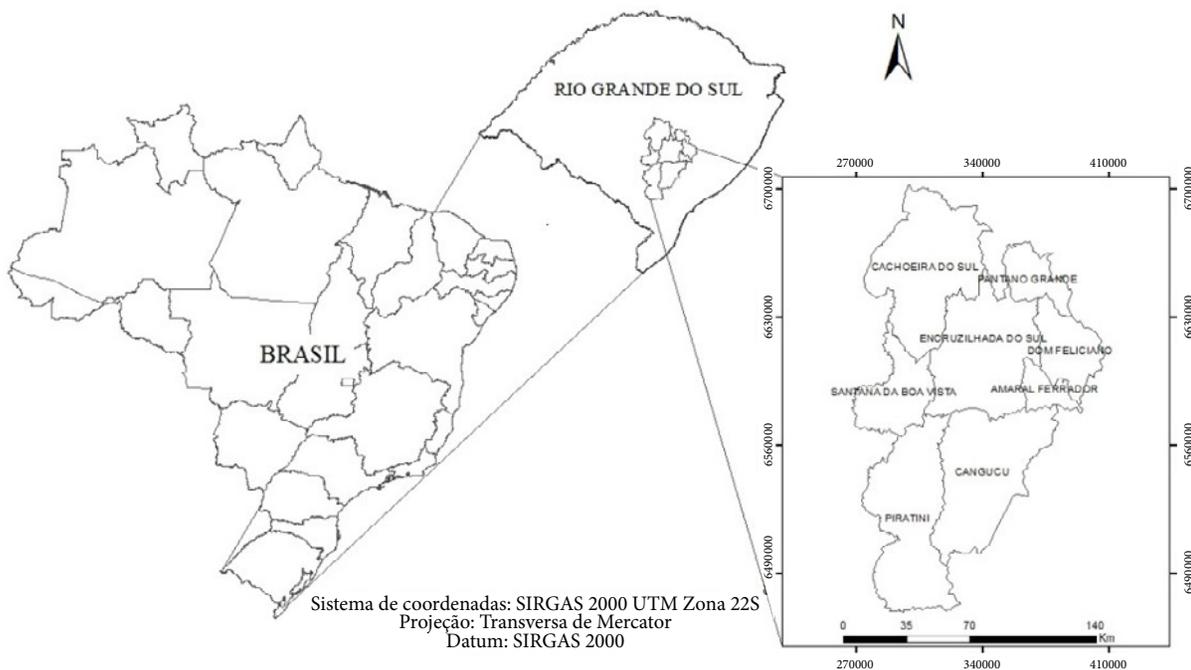


Figure 1. Spatial localization of the studied area in the Brazilian and state context.

2.2. Statistical design

To group municipalities based on similarities between socioeconomic indicators relevant to the proposed objective, two multivariate techniques were used: hierarchical grouping analysis, with Euclidean distance as a measure of similarity and horizontal dendrogram obtained by Ward’s method of connection, and principal component analysis to verify which variables influenced the formation of each observed group.

Several authors employed Multivariate Analysis techniques to characterize the main factors that differed the firms’ capabilities, compare among clusters, analyze qualitative aspects of the clusters, as well as to identify the diverse groupings of companies within a local productive arrangement (Negrão et al., 2015; Stallivieri et al., 2009; Vignandi et al., 2013).

In this study, an 8×19 matrix was used for the analysis of hierarchical grouping and principal components, in which

were considered the eight municipalities of the studied area and 19 socioeconomic indicators – which were obtained through an online survey, accessing the database of the Annual Social Information Report – RAIS (Brasil, 2015), the Economics and Statistics Foundation – FEE (Rio Grande do Sul, 2016) and the Brazilian Institute of Geography and Statistics – IBGE (Brasil, 2016):

- RAIS – Number of jobs on the municipalities for the CNAE/classes Forest Production – Planted Forest; Wood sawmill; Specialized Retail Trade of Furniture, Bedspreads and Lighting Articles; Manufacture of Wooden Artifacts, Straw, Cork, Wicker and Braided Material not specified before, Except Furniture; Forest Production Support Activities; Manufacture of Furniture with Wood Predominance; Manufacture of Wooden Structures and Carpentry Articles for Construction;

Forest Production – Native Forests; Wholesale Trades of Paper and Cardboard, Raw and Packaging.

- FEE – Average production of firewood in cubic meters of each municipality considering the period between 2006 and 2013; Average timber log production for each municipality considering the period between 2006 and 2013.
- IBGE – Number of inhabitants of the municipality in 2010; Number of inhabitants of the municipality in 2014; Demographic density inhabitants/km² of the municipality in 2013; Territorial area of the municipality – km²; Gross domestic product (GDP) per capita of the municipality in 2012; Total exports of the municipality in US\$ FOB for the year 2014; Quantity of planted forest (year – 2006); human development index (HDI – 2010) of the municipality.

The standardization of matrix data used the methodology proposed by Vicini (2005), which requires a data matrix with p variables ($j = 1, 2, \dots, p$) in n objects ($i = 1, 2, \dots, n$). In this matrix, the value of the i -th object and j -th variable was denoted by x_{ij} , having its standardized value subsequently represented by z_{ij} . Being each i fixed, where $i = 1, 2, \dots, n$ and $j = 1, 2, \dots, p$, these variables divided by the standard deviation (S_j) were standardized and had mean 0 and constant variance 1, the most commonly used form of normalization, represented in Equation 1:

$$Z_{ij} = \frac{X_{ij} - X_{mean_j}}{S_j} \quad (1)$$

2.3. Indicators of industrial clusters

To identify the specificity of a sector within a region, some industrial cluster indicators were used. These indicators use a smaller geographic base in relation to a larger one as reference; in this case, the smaller geographical base was obtained via hierarchical group analysis and the reference was the state of Rio Grande do Sul, where the groups are located.

The Locational Quotient already used by Suzigan et al. (2003) was one of the indicators applied and it is based on the employment data of the RAIS to obtain the information on formal employment in the selected municipalities.

Also, to refine the classification of groups, the participation of the economy class in the region in relation to the total employment in the State (P), and the absolute minimum number of establishments (E) were also used as indicators.

This methodological structure is based on the works of Cabral Junior et al. (2010), which in turn was based on the procedures performed by Suzigan et al. (2006).

The following is a description of the equations:

(1) Locational Quotient (LQ) – index of specialization of the region regarding economic activity, given by Equation 2:

$$LQ = \frac{\frac{E_j^i}{E_j}}{\frac{E_{RS}^i}{E_{RS}}} \quad (2)$$

E_j^i : employment of industrial activity i in the region j ; E_j : total industrial employment in the region j ; E_{RS}^i : employment of industrial activity i in the state (RS); E_{RS} : total industrial employment in the state.

When:

$LQ > 1$, it means that the region is specialized in the sector; $LQ = 1$, it means that the participation of the sector in the region is equal to participation in the state as a whole;

$LQ < 1$, it means that the region is not specialized in the sector.

(2) Participation of the employment of the economy class in the region in relation to the total employment in the state (P), given by Equation 3:

$$P (\%) = \frac{E_j^i}{E_{RS}^i} \times 100 \quad (3)$$

E_j^i : employment of industrial activity i in region j ; E_{RS}^i : employment of industrial activity i in the state (Rio Grande do Sul).

Regarding the last criterion, the minimum number of establishments (E), represented in the results by the absolute number of companies surveyed for the groups formed, were obtained through the RAIS data (Brasil, 2015), using as parameter the CNAE's Forest Production – Planted Forest, Support Activities to Forestry Production, and transformation of logs into boards, in view of the great concentration of the sector in these three classes.

2.4. Typology of the industrial clusters

The methodology proposed by Cabral Junior et al. (2010) was used to classify the typology of the industrial clusters from the Local Productive Arrangement of Forestry Basis, where the degree of importance to the sector and to the place discriminates the types of clusters (Table 1).

Table 1. Importance of the Local Productive Arrangement based on the cluster indicators.

Typology of local productive arrangement	Importance for the sector	
	Low	High
Local Importance	<p>Local development vector</p> <p>Important for the region without significant contribution to the sector in the State.</p> <p>$E \geq 10$</p> <p>$P \leq 0,05$ (5%)</p> <p>$LQ > 5$</p>	<p>Nucleus of Sectoral/ Regional Development</p> <p>Important for the region and the sector.</p> <p>$E \geq 10$</p> <p>$P > 0,05$ (5%)</p> <p>$LQ > 5$</p>
	<p>Local productive arrangement embryo</p> <p>Incipient cluster stage, not very important for the sector and the region.</p> <p>$E \geq 5$</p> <p>$0,01$ (1%) $< P \leq 0,05$ (5%)</p> <p>$LQ \leq 5$</p>	<p>Advanced Vector</p> <p>Important for the sector with low impact for the region.</p> <p>$E \geq 5$</p> <p>$P > 0,05$ (5%)</p> <p>$LQ \leq 5$</p>

Source: Cabral Junior et al. (2010).

3. RESULTS AND DISCUSSIONS

The hierarchical clustering analysis resulted in the formation of four groups, using a cut in half on the Euclidean distance as a reference parameter (Figure 2).

The Euclidean distance indicates how much two municipalities diverge or converge with each other based, in the case of this study, on the economic and social indicators that were adopted for the calculation. Thus, the municipalities that had the greatest divergence due to the greatest Euclidean distances – in descending order – were Cachoeira do Sul and Piratini (9.5), Cachoeira do Sul and Encruzilhada do Sul (9.3), Cachoeira do Sul and Santana da Boa Vista (9.2) and Cachoeira do Sul and Amaral Ferrador (9.2). These

situations correspond to the greater divergence found, which indicates the greater economic and social contrast between the municipalities.

The shorter Euclidean distances observed were between Amaral Ferrador and Santana da Boa Vista (1.7), Amaral Ferrador and Dom Feliciano (1.8), Dom Feliciano and Santana da Boa Vista (2.2) and Dom Feliciano and Pantano Grande (3.4), meaning these four municipalities were the most similar regarding social and economic indicators.

Through the principal components analysis (Figure 3) it was possible to highlight the substantial points responsible for the formation of the groups, thus reducing the mass of data previously obtained and facilitating the interpretation and visualization of the results.

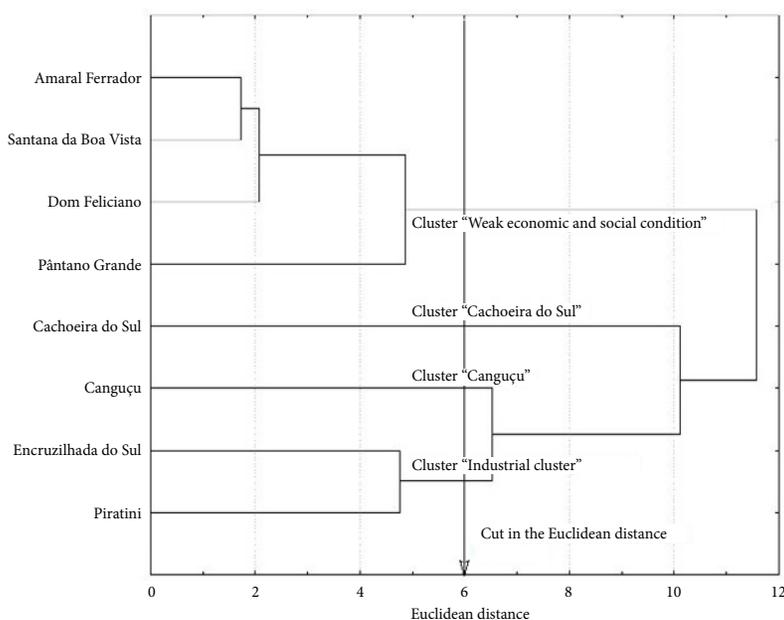


Figure 2. Horizontal dendrogram resulting from the hierarchical grouping analysis (HGA) of the municipalities.

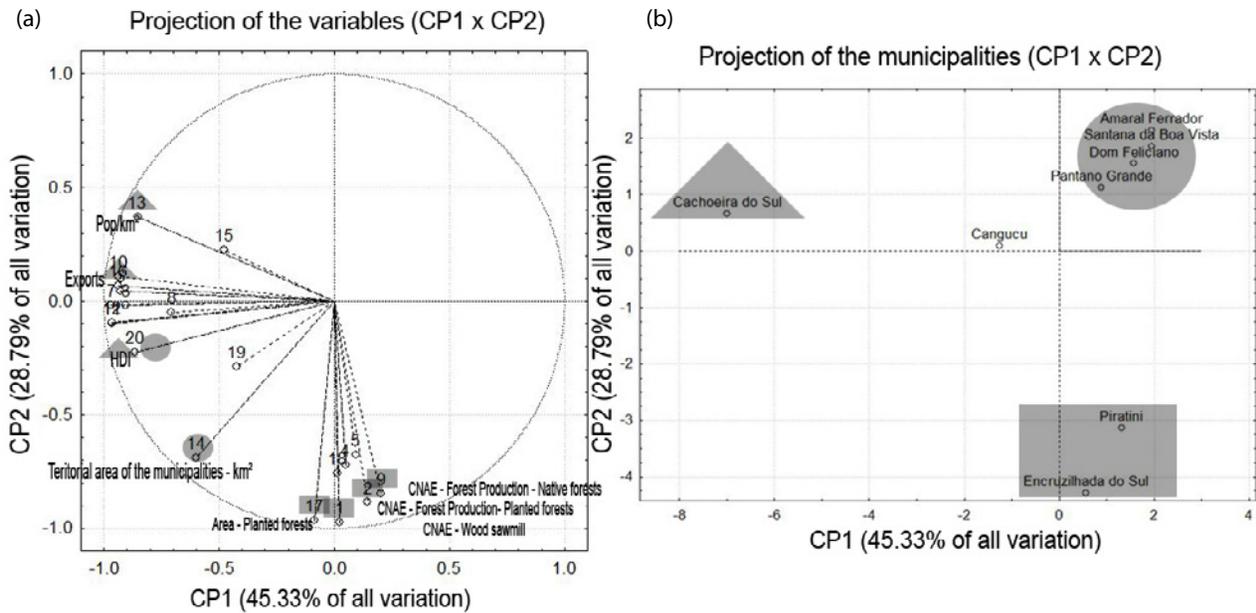


Figure 3. Principal component analysis, projection of the variables (a) and projection of the municipalities (b).

The analysis generated seven main components, and the first two represented 74.12% of the total variation of the variables obtained for the municipalities. The results found in the principal component analysis were, as expected, consistent with the groups formed by hierarchical grouping analysis. The detailing with respect to the indicators that make up each group is presented below.

3.1. Groups

3.1.1. Cachoeira do Sul

Represented only by the municipality of Cachoeira do Sul, it was highlighted by a more solid economic situation, reflecting, consequently, positive socioeconomic indicators. The most significant indicators for the consolidation of this group were the Total Exports U\$ FOB (2014), followed by the social indicators HDI (2010) and inhabitants per km² (2013). These collaborated in a more expressive way for the differentiation of this municipality when compared to all others, making it impossible to group it with them.

The Total Exports of U\$ FOB (2014) of the municipality of Cachoeira do Sul alone were 1272.02% (U\$ 23,044,147.00) higher than the sum of exports from all other municipalities of the study. This municipality presented the highest HDI – 2010, 0.742, much higher when compared to the second of the list among municipalities, 0.661 – Pantano Grande.

The third variable that significantly distinguished Cachoeira do Sul from the others was its population density of 22.3

inhabitants per km², 46.7% higher than the demographic density of the second place for this indicator: Canguçu, with 15.2 inhabitants/km².

This municipality also stood out in the number of companies and job creation, having 2,197 companies and 16,036 formal jobs (Brasil, 2015).

3.1.2. Low economic and social condition

The municipalities Amaral Ferrador, Santana da Boa Vista, Dom Feliciano and Pantano Grande, which formed the second group, were characterized by a strong opposition when compared to the “Cachoeira do Sul” group, mainly due to their HDI – 2010, which assumed the values of 0.624 for Amaral Ferrador, 0.661 for Pantano Grande, 0.633 for Santana da Boa Vista and 0.587 for Dom Feliciano.

The major exception to the economic indicators was Pantano Grande, which had the highest GDP per capita (R\$ 21,029.27) in the municipalities of the study. It also presented the highest value of total exports U\$ FOB – 2014 of its group and the second largest among all the groups, behind only Cachoeira do Sul. These numbers are explained due to the mining potential of the municipality, since the soil is rich in limestone, a soil corrective commonly used in the cultivation of soybeans and corn, among other crops grown in the state and in the country.

It was observed at group level that Pantano Grande also had the highest production of firewood (312,626,25 m³) and log (234,107.75 m³), considering the annual average in the

interval between the years 2006 and 2013 (Rio Grande do Sul, 2016). It was evident that this municipality stood out economically within its group due to mineral extraction, but, like the other municipalities that make up this group, the low territorial area in km², the low HDI (Figure 3) and the significant absence of companies of forestry-based sector kept the municipality within the cluster in question.

Still, the municipality of Santana da Boa Vista was the exception of this group regarding the production of forest raw material, collaborating only 0.43% of the production of firewood and 0.07% of the production of logs, contrasting significantly in this aspect, since the average annual production of the group was of 558,245.40 m³ of firewood and 346,671.75 m³ of logs (accounting period between 2006 and 2013) (Rio Grande do Sul, 2016).

3.1.3. Industrial cluster

The municipalities of Encruzilhada do Sul and Piratini were characterized by a strong forest base that considerably influenced the municipal economy, creating a significant number of jobs and cluster of companies for the CNAE/class Forest Production – Planted Forest; CNAE/class Forest Production Support Activities and CNAE/class of transformation of logs into boards. These two municipalities and three CNAE/class amassed 1155 direct jobs (75.20% of all municipalities) referring to 68 companies accounted (59.65% of all companies).

In addition to these economic indicators, the planted forest area is the largest in the region (Brasil, 2016), consequently, firewood production data (m³) was the most representative in comparison to all municipalities in the current study, where the average annual production, considering the period between 2006 and 2013, represented 46.84% of the same period for all municipalities (Rio Grande do Sul, 2016).

3.1.4. Canguçu

Canguçu had characteristics common to all other groups, but its main highlight for the productive arrangement was

the supply of raw material due to the presence of planted forests (Brasil, 2016), besides having in its industrial constitution 12 companies and 196 jobs that are forestry-based (Brasil, 2015). However, the municipality presented weak social and geopolitical conditions, such as low HDI and low territorial area in km², and did not present a significant association through hierarchical grouping analysis with the municipalities of Encruzilhada do Sul and Piratini (“Industrial Cluster”), although it is important to the region’s forestry-based sector.

3.2. Typology of industrial clusters

Considering the CNAE/classes Forest Production – Planted Forest, Forest Production Support Activities, the transformation of logs into boards, and the three indicators of industrial clusters, the characterization of the typology of the Forestry-Based Productive Arrangement of the “Serra do Sudeste” for each group of municipalities was carried out (Table 2), according to the grouping provided by hierarchical grouping analysis.

The municipalities of Encruzilhada do Sul and Piratini, the “Industrial Cluster” group, were classed as a Regional-Sector Development Nucleus, making this group of municipalities important at regional and sectoral levels, that is, besides being of significant importance for the economic development of the region, were also essential for the sector, considering the state of Rio Grande do Sul. “Canguçu” and “Weak economic and social condition” groups were characterized as Local Development Vectors, due to its high importance for the region, but reduced importance for the sector at State level.

Finally, the “Cachoeira do Sul” group did not obtain enough parameters to be characterized according to the cluster typology methodology. Alternatively, the unit analysis of the indicators of cluster LQ, P and E allowed to diagnose the presence of a forestry-based sector in the municipality, considering the presence of companies and jobs, but did not present sufficient relative participation to fit this sector as a main actor in the municipality’s economy.

Table 2. Classification of the typology of the local productive arrangements from the groups.

Groups – hierarchical grouping analysis	Indicators			Typology of the local productive arrangement
	LQ	P	E	
Weak economic and social condition	5.47	0.74%	16.0	Local Development Vector
Cachoeira do Sul	1.15	0.59%	18.0	Does not fit the typology
Canguçu	8.27	1.41%	12.0	Local Development Vector
Industrial Clusters	39.67	8.33%	68.0	Regional-Sector Development Nucleus

LQ: locational quotient; P: relative participation of the economic class in the region in relation to the total participation in the state; E: minimum number of establishments.

3.3. Geographical limitation

Based on the results found, it is evident that the geographical limitation of the forestry-based Local Production Arrangement of “Serra do Sudeste” depends on municipalities that are forestry-based and, in addition, have in their economic scenario companies capable of benefiting from this raw material. The municipalities that satisfied these premises were Cachoeira do Sul, Encruzilhada do Sul, Piratini, Canguçu, Pantano Grande, Dom Feliciano and Amaral Ferrador, excluding the municipality of Santana da Boa Vista.

The following are the most relevant factors for the inclusion of the groups and municipalities in the local productive arrangement, in descending order of contribution to the local productive arrangement:

- Group “Industrial Cluster” – the municipalities of Encruzilhada do Sul and Piratini, mainly due to the forestry base and industrial cluster of the forestry sector (68 companies and 1115 direct jobs).
- Groups “Canguçu” and “Cachoeira do Sul” –for its forestry base, but also by the significant representation of Canguçu in the number of companies and jobs for the forestry sector considered in the research (12 and 196, respectively).
- Group “Weak economic and social condition” – the municipalities of Pantano Grande, Dom Feliciano and Amaral Ferrador were included. The municipality of Santana da Boa Vista was excluded from the limitation because it did not present relevant economic and social indicators for the regional economic apparatus of the forestry-based sector.

4. CONCLUSIONS

This study verified that there is a Forestry-Based Production Arrangement in the region of “Serra do Sudeste” bounded by the municipalities of Cachoeira do Sul, Pantano Grande, Dom Feliciano and Amaral Ferrador, with emphasis on the municipalities of Encruzilhada do Sul, Piratini and Canguçu, for their highlights in relation to the other municipalities regarding the amount of companies and jobs for the economic activities of the productive arrangement.

In addition, it is emphasized the possibility and importance of replicating the methodology presented here in other regions considering different scales in relation to the one that was used in this study. It is important that future authors

be observant of the peculiarities of each region and scale of analysis, so that they are assertive in the choice of indicators that will help in the construction of the portrait of the object of study to reach its objectives, thus providing information to subsidize the structuring, organization, planning and management of the forestry sector as a whole.

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