



# **Milk production in Rio Grande do Sul: specialization, concentration, and sources of growth (1999-2020)<sup>1</sup>**

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## **Abstract**

This article evaluated the structure of milk production in the state of Rio Grande do Sul, considering the specialization, concentration of milk production and, the sources of growth of this agricultural activity, in 1999-2020 period. For this, the Locational Quotient (LQ), the Locational Gini (LG) and the shift-share method were estimated. Results indicated the growth of specialization and concentration of production, with the Northwest region being the main dairy basin in the state and the micro-regions of Três Passos, Cerro Largo, Guaporé and Santa Rosa being the most specialized. Among the 35 microregions in Rio Grande do Sul, only 11 had LQ equal to or greater than two in the analyzed period, characterizing themselves as highly specialized. This specialization was associated with the increase in the spatial concentration of milk production, measured by the Locational Gini, given that the index increased from 0.39 in 1999 to 0.53 in 2020, demonstrating that, in measure, the most specialized regions have become the most productive, whether due to the favorable dynamics or due to the structural conditions. Furthermore, the advance of the activity occurred associated with the reduction of the herd in lactation and with the increase of productivity, technology and specialization.

**Keywords:** Milk production. Rio Grande do Sul. Specialization. Concentration. Sources of growth.

## **Caracterização da produção de leite no Rio Grande do Sul: especialização, concentração e fontes do crescimento (1999-2020)**

### **Resumo**

O objetivo desse artigo consistiu em avaliar a estrutura da produção de leite no estado do Rio Grande do Sul, considerando a especialização, a concentração da produção leiteira e as

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fontes de crescimento desta atividade agropecuária, no período 1999-2020. Para isso estimou-se o Quociente Locacional (QL), o Gini Locacional (GL) e o método shift-share. Os resultados indicam o crescimento da especialização e da concentração da produção, sendo a região Noroeste a principal bacia leiteira do estado e as microrregiões de Três Passos, Cerro Largo, Guaporé e Santa Rosa as mais especializadas. Destaca-se que dentre as 35 microrregiões gaúchas, apenas 11 apresentaram QL igual ou superior a dois no período analisado, caracterizando-se como altamente especializadas. Esta especialização ocorreu associada ao aumento da concentração espacial da produção de leite, medido pelo Gini Locacional, dado que o índice passou de 0,39 em 1999 para 0,53 em 2020, demonstrando que, em medida, as regiões mais especializadas se tornaram mais produtivas, seja pela dinâmica favorável como também pelas condições estruturais. Ademais, observou-se que o avanço da atividade ocorreu associada a redução do rebanho em lactação e ao aumento da produtividade, tecnologia e da especialização.

**Palavras-chave:** Produção de leite. Rio Grande do Sul. Especialização. Concentração. Fontes de crescimento.

### Caracterización de la producción de leche en Rio Grande do Sul: especialización, concentración y fuentes de crecimiento (1999-2020)

#### Resumen

El objetivo de este artículo fue evaluar la estructura de la producción de leche en el estado de Rio Grande do Sul, considerando la especialización y concentración de la producción de leche y las fuentes de crecimiento de esta actividad agrícola, en el período 1999-2020. Para ello se estimó el Cociente de Localización (CL), el Gini de Localización (GL) y el método shift-share. Los resultados indican el crecimiento de la especialización y concentración de la producción, siendo la región Noroeste la principal cuenca lechera del estado y las microrregiones de Três Passos, Cerro Largo, Guaporé y Santa Rosa las más especializadas. Se destaca que entre las 35 microrregiones de Rio Grande do Sul, sólo 11 tuvieron CL igual o superior a dos en el período analizado, caracterizándose como altamente especializadas. Esta especialización se dio asociada al aumento de la concentración espacial de la producción de leche, medida por el Gini Local, dado que el índice pasó de 0,39 en 1999 a 0,53 en 2020, demostrando que, en medida, las regiones más especializadas se han vuelto más productoras, ya sea por la dinámica favorable o por las condiciones estructurales. Además, se observó que el avance de la actividad estuvo asociado a la reducción del hato lactante y al aumento de la productividad, tecnología y especialización.

**Palabras clave:** Producción de leche. Rio Grande do Sul. Especialización. Concentración. Fuentes de crecimiento.

## 1 Introduction

In recent decades, commercial and economic integration between different countries and regions has brought numerous changes to the world economy, mainly in relation to production structures. It was no different with Brazilian dairy activity, which followed the same dynamics, with important structural and productive changes, moving from a production model with high government protection (VIEIRA, 2003), to a model with a high technological level, high genetic quality of the herd, modern conditions of food supplementation and productivity growth (BORGES et al., 2014).

However, with milk production, these changes did not occur linearly, when analyzed regionally, concentrated and heterogeneous, with predominance in the Southeast and South regions, both in terms of market (production, prices and consumption), and in terms of productivity (forms of production) (MORAES; BENDER FILHO, 2017). Due to the expansion of family farming, the activity develops in a less qualified way, with less improved genetic standards and with production being destined for the informal market (BORGES et al., 2014).

In this process, Rio Grande do Sul, which has long remained among the main milk producers in the country, has advanced in terms of participation in the last two decades, reaching in 2018, approximately 13% of the country's total raw milk production. In the same period, while Brazilian production grew annually at a rate of 2.98%, the state's production expanded at annual rates of 4.26% (IBGE, 2020). Contributing to this result were animal productivity, the highest in the country, at 3,240 liters, approximately 82% higher than the average productivity in Brazil, in addition to investments in technology, strict sanitary control and properties professional managements (ANUÁRIO LEITE, 2018). Indicators that corroborate the argument of Montoya and Finamore (2010), that the level of competitiveness of the Rio Grande do Sul dairy chain positions it as one of the most efficient in the country, with emphasis on its modern production process. Furthermore, Frizzo (2011) adds that the ecological and socioeconomic conditions of the state favor the construction of this highly competitive milk production system.

However, the milk production structure in Rio Grande do Sul is different between its microregions, both in relation to production and structure. Regarding the first aspect, production is predominantly concentrated in the Northwest region, which produces approximately 67% of the state's volume (IBGE, 2020). For the second, dairy activity is developed, to a large extent, on properties with smaller territorial extension; although, some large properties are identified, smaller ones predominate in the dairy production structure, according to Morais et al. (2012) and Brand et al. (2013).

According to Perobelli et al. (2018), this regional heterogeneity of production reflects the development of the production chain and its complementary activities. Thus, regional differences in the milk production process allow us to understand the dynamics of the sectoral chains of the production chain and its local development process. Aspects that underlie the discussion about how milk production is structured in the state of Rio Grande do Sul. From this, the main objective was to evaluate the structure of milk production in the state of Rio Grande do Sul, considering (i) the specialization and concentration of dairy production and (ii) the sources of growth of this agricultural activity, in the 1999-2020 period.

The state's growing results, associated with its quality reference status for the Brazilian milk market (ANUÁRIO LEITE, 2019), have generated a series of works, from different perspectives – production, quality and management – analyzing the relevance of the dairy sector in Rio Grande do Sul (NORO et al., 2006; ZANELLA et al., 2006; MONTOYA; FINAMORE, 2010; MARION FILHO; FAGUNDES, SCHUMACHER, 2011; MARION FILHO et al., 2015; MARION FILHO et al., 2016).

Otherwise, regarding the focus on spatial distribution and productivity there is still room for analysis. We stand out that, regarding the recent dynamics of dairy activity, there is little evidence, so the present study seeks to discuss of the dynamics and recent structure of this activity, highlighting how this process has influenced the local development of the regions.

This article is divided into four more sections. The following section presents the bibliographical framework about dairy activity in the state of Rio Grande do Sul, as well as the main studies already developed on the topic. In the third section, the methodology applied is discussed, divided into approaches to spatial distribution and sources of growth in dairy production. The fourth presents and discusses the results. And finally, on the fifth the final considerations of the study are highlighted.

## **2 Milk production in Rio Grande do Sul: Characterization and Empirical Evidence**

According to Berro, Brandão and Breitenbach (2014), milk production has consolidated itself as an important activity in the income composition of small farmers, with a large presence in family farming. In this regard, Gobbi and Pessôa (2009) highlighted the strong influence of European colonizers in the development of the activity in Rio Grande do Sul, as well as in the diffusion and modernization of agriculture and organizational structures, such as cooperativism. Combined with these cultural factors, Fauth and Feix (2015) stand out that the region has characteristics that are conducive to the development of the activity.

In addition to being an important producer, the productive segment in the state is marked by the heterogeneity of the productive structure adapted to the different conditions reported between regions (SCHUMACHER, 2013). Given the relevance of the activity, a range of studies on dairy farming in Rio Grande do Sul can be found in the literature, being analyzed from different aspects, such as origin, evolution, spillover, environmental factors, development strategy and specific regions.

Silva Neto and Basso (2005) analyzed the role that milk production can play as a development strategy on Rio Grande do Sul. The activity is important for the maintenance of farmers in rural areas and produces direct, indirect and induced effects on the local economy due to the high potential for adding value that the activity provides. The authors pointed to a reorientation of policies to encourage activity and the promotion of production systems adapted to the conditions of family production, promoting fairer and more territorially balanced social development.

Environmental factors that affect the production and composition of milk in herds assisted by cooperatives in Rio Grande do Sul were studied by Noro et al. (2006), using a dairy control program. Results indicated that an increase in the volume of somatic cell counts (an important tool that indicates the health of dairy cows) is related to a reduction in milk production and composition. Furthermore, the quality of the forage provides greater production in winter, a season that favors the highest content of the analyzed components, such as protein, fat and lactose, characteristics that are decisive for milk quality.

Schumacher and Marion Filho (2013), analyzed dairy farming in Rio Grande do Sul in terms of expansion and overflow. Methodologically, the authors used econometric models to determine geometric growth rates and to evaluate the dependency relationship between milk-producing municipalities. Results indicated that milk production in the state is concentrated in the Northwest region, and the municipalities that showed overflow are located in the Northwest, Northeast and Central-Eastern mesoregions.

Marion Filho, Reichert and Schumacher (2014) analyzed the origin of cattle, areas of greatest concentration and the recent evolution of herds and dairy activity between 2000 and 2010. The authors highlighted that dairy activity in Rio Grande do Sul originates from the period of colonization, introduced by European immigrants and started to be carried out for commercial purposes in the 18th century. In relation to the dairy herd, the Northwest mesoregion proved to be the region with the highest growth, around 4.46% per year (2000-2010), and the most specialized region. Milk production and productivity in the state showed positive annual growth rates.

Furthermore, studies related to dairy farming in Rio Grande do Sul extend to the analysis of specific regions. Zanella et al. (2006), with the aim of characterizing the production and quality of milk in production systems in the South region and verifying the percentage of samples that fall within the limits determined by Normative Instruction 51 (IN51), monitored specialized dairy production units, semi-specialized and non-specialized. Results indicated that the greater specialization of the systems results in greater milk production and lower somatic cell counts. Furthermore, fat levels are influenced by breed, and casein and solids percentages are affected, especially, by the herd's nutrition. Finally, only 41.8% of the sample met the limits established by Normative Instruction 51 (ZANELLA et al., 2006).

Montoya and Finamore (2010) characterized milk producers in the Northeast region of Rio Grande do Sul and their relationships with the market involved. From field research, they found that, on average, producers in this region have been working in the activity for 15 years, have a low level of education and, in 70.83% of properties, it is the wives who perform milking, herd management and control of income and expenses. From an economic point of view, 78.28% of those interviewed consider that, among the agricultural activities they carry out, dairy farming is the most important. Finally, the main obstacles to further development of the sector are the price of milk and the lack of rural credit at compatible interest rates.

Brand et al. (2014), characterized the properties of the Northwest region of the state in relation to the herd and the structure and organization. For this, questionnaires were applied to different properties in the region. Among the results reported, the great variation in production characteristics between properties stands out. Regarding the size of properties, 80% of producers have less than 30 hectares and average milk production was 18.25 liters/cow/day.

Finally, Lucca and Arend (2019) analyzed dairy farming and the development of the Northwest region of Rio Grande do Sul. The changes that occurred in the milk production chain, related to modernization, showed a rapprochement between processing industries and milk producers. Based on bibliographical research, they reported that the new dynamics of the sector motivates agents involved in the dairy industry to adopt new techniques, which include handling, professionalization and

care in the management of the property, favoring advances in production and marketing, as a strategy to remain in the activity.

From the studies presented, it is clear that the topic has been explored empirically from different perspectives, such as the analysis of the origin and historical context of milk production, properties socioeconomic characteristics, and environmental and technical factors that influence the production system. and productivity. In the following section, the methodology used to achieve the proposed objective is presented.

### 3 Methodology

The present study evaluated the structure of milk production in the state of Rio Grande do Sul, from 1999 to 2020. To this end, dairy farming in the state and its 35 micro-regions was studied based on indicators, such as Locational Quotient (QL), Locational Gini (GL), through the shift-share method. These methods made it possible to measure specialization, concentration and sources of activity growth. Next, we discuss the indicators used and their measurement.

#### 3.1 Location Quotient

The Locational Quotient is a measure of relative regional specialization. Widely used in works on regional economics since the original contribution by Isard (1960). According to Haddad (1989), QL compares the participation of a certain region in a certain sector, with the participation of that same region in a reference economy. This comparison is made in terms of a base variable, and from this measure it is possible to know how specialized the region is in a given activity.

For Crocco et al. (2003), the Locational Quotient compare two sectoral-spatial structures, using a reference economy. To find out whether a given micro-region in Rio Grande do Sul is specialized in milk production, Equation in (1) was used, whose base variable is the value of production:

$$QL_t = \frac{VPL_{jt}/VPLRS_t}{VAA_{jt}/VAARS_t} \quad (1)$$

where  $QL_t$  indicates the Location Quotient in year  $t$ ;  $VPL_{jt}$  the value of milk production in microregion  $j$ , in year  $t$ ;  $VPLRS_t$  the value of milk production in Rio Grande do Sul, in year  $t$ ;  $VAA_{jt}$  the value of milk production in microregion  $j$ , in year  $t$ ;  $VAARS_t$  the value of agricultural activity in Rio Grande do Sul, in year  $t$ .

If  $QL \leq 1$ , microregion  $j$  is not specialized in dairy activity; if  $QL \geq 1$ , the microregion has significant importance in the state context of dairy farming; therefore, it is considered specialized. However, following Marion Filho and Oliveira (2011), a control variable,  $QL \geq 2$ , was used in order to highlight more important results. Therefore, in the analysis only the quotients of micro-regions that achieved a specialization equal to or greater than twice that calculated for the state are presented. The QL was calculated annually for the period between 1999 and 2020 for the 35 micro-regions of Rio Grande do Sul.

### 3.2 Gini Locacional

The Locational Gini (GL) measures the concentration of an activity in a given region. In this study, it measures the concentration of dairy activity in Rio Grande do Sul. Analytically, this coefficient varies from zero to unity, according to Suzigan et al. (2003), and the closer to the unit, the more concentrated the activity; conversely, if the activity is uniformly distributed, the coefficient will be zero.

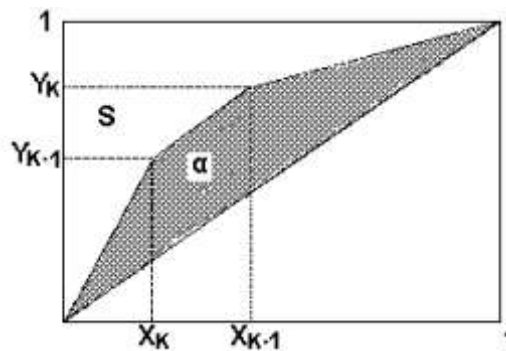
According to Puga (2003) and Suzigan et al. (2003), to calculate the GL it is necessary to order the ratios in decreasing order ( $VPL_{jt}/VPLRS_{jt}$ ). Subsequently, the so-called location curve is constructed with the variables X and Y, which are defined as follows:

Y: indicates the accumulated proportion between the value of milk production in microregion j in relation to the value of milk production in Rio Grande do Sul.

X: represents the accumulated proportion of the ratio between a microregion and the total number of them in the state.

Figure 1 shows, on the horizontal axis, the accumulated proportion of X and, on the vertical axis, the accumulated proportion of Y. The 45-degree diagonal drawn at the origin of the axes is called the “line of perfect equality” and assumes that the variables displayed on this line have the same value. The location curve positioned above and to the left of this diagonal is formed by the points of the accumulated proportions of the variables X and Y. The distance between these curves indicates the magnitude of the spatial concentration.

Figure 1: concentration area



Source: Marion Filho e Oliveira (2011).

The next step in calculating the GL consists of determining the concentration area represented by  $\alpha$  in Figure 1. It is obtained by residue, and firstly, the total area above  $\alpha$ , represented by (S), is calculated. according to Equation (2):

$$S = \sum_{k=1}^n (Y_k - Y_{k-1}) \left( \frac{X_k - X_{k-1}}{2} \right) \quad (2)$$

where n represents the number of microregions ( $k=1, 2, 3, \dots, 35$ ).

Subsequently,  $\alpha$  is calculated, according to Equation (3):

$$\alpha = 0,5 - S \quad (3)$$

Therefore, GL is defined as the ratio between the concentration area and half the area of Figure 1 (which corresponds to 0.5), according to Equation (4):

$$GL = \frac{\alpha}{0,5} = 2\alpha \quad (4)$$

The GL was calculated annually, between 1999 and 2020, for milk production

### 3.3 Shift-Share Method

This method is traditionally used in agricultural studies, generally to decompose growth rates in agricultural production. Following this line, this method is used to decompose the growth of dairy farming, based on the method used by Raiol et al. (2009), Bastos and Viggiano (2012), Moura, Santos and Bulhões (2015), Pinto and Perobelli (2016) and by Moura and Santos (2017).

Shift-Share assumes that the variation in milk production ( $\Delta Q$ ) is due to changes in the size of the herd (extensive growth) and changes in the productivity of the herd (intensive growth). The variation in milk production between two periods can be represented by Equation in (5):

$$\Delta Q = Q_t - Q_0 \quad (5)$$

where  $Q_0$  represents milk production in the initial year (year 0) and  $Q_t$  represents milk production in the final year (year t), for a given period. In this research, the period extends from 1999 to 2020.

Using data relating to the quantity of milk produced ( $Q$ ), in liters, and the number of cows milked ( $VO$ ) for a given year, it is possible to calculate the herd productivity ( $PDT$ ). Therefore, milk production in year t can be represented by:

$$Q_0 = VO_0 \times PDT_0 \quad (6)$$

$$Q_t = VO_t \times PDT_t \quad (7)$$

a variação entre os dois períodos é dada por:

$$\Delta Q = (VO_t \times PDT_t) - (VO_0 \times PDT_0) \quad (8)$$

If there is a variation in milk production resulting exclusively from a variation in the number of cows milked, production in year t will be:

$$Q^{vo} = VO_t \times PDT_0 \quad (9)$$

This gives rise to the herd expansion effect (EER), the variation in milk production is due to the increase in herd size (extensive growth), which corresponds to:

$$EER = Q^{vo} - Q_0 \quad (10)$$

$$EER = (VO_t \times PDT_0) - (VO_0 \times PDT_0) \quad (11)$$

The productivity effect (EPT) reflects the increase in production resulting exclusively from the increase in productivity. It is obtained by residue, subtracting from the variation in milk production observed in year t, the variation in production resulting exclusively from the variation in the number of cows milked:

$$EPT = Q_t - Q^{vo} \quad (12)$$

$$EPT = (VO_t \times PDT_t) - (VO_t \times PDT_0) \quad (13)$$

It is worth mentioning that  $Q_0$  and  $Q_t$  are observed values, while  $Q^{vo}$  is an unobserved value, or is hypothetical, imputed, estimated.



The effects of herd expansion (EER) and productivity (EPT), expressed in absolute terms, must correspond to the total variation observed in milk production:

$$(Q_t - Q_0) = EER + EPT \quad (14)$$

In the description and analysis of the results, the values of the calculated effects are presented in average annual growth rates, therefore; expressed as a percentage. Thus, dividing both sides of equation (14) by  $Q_t - Q_0$  and multiplying both sides by:

$$r = \left( \sqrt[p]{\frac{Q_t}{Q_0}} - 1 \right) \times 100 \quad (15)$$

with  $r$  being the average annual growth rate of milk production, in percentage, and  $p$  being the root index, which corresponds to the length of the analysis period, we obtained:

$$r = \frac{(Q^{v_0} - Q_0)}{(Q_t - Q_0)} r + \left( \frac{(Q_t - Q^{v_0})}{(Q_t - Q_0)} \right) r \quad (16)$$

where the first term on the right represents EER, and the second term represents EPT, both expressed as a percentage.

### 3.4 Data Source

Data regarding the value of milk production and the number of cows milked for the microregions and for the state of Rio Grande do Sul were collected in the Sidra database, from Instituto Brasileiro de Economia e Estatística (IBGE, 2023). And the data referring to the value added by agriculture in micro-regions and in the state were collected at the Fundação de Economia e Estatística (FEE, 2020).

## 4 Analysis and discussion of results

In this section, we discussed the results regarding the dynamics of dairy activity in Rio Grande do Sul. To this end, firstly, in section 4.1, evidence is presented on the specialization of dairy production, using the Locational Quotient. In section 4.2, spatial concentration is discussed, using the Locational Gini. And finally, in section 4.3, the quotients estimated using the shift-share method are presented, such as production, herd expansion and productivity effect.

### 4.1 Specialization of dairy production in the microregions of Rio Grande do Sul

The analysis of dairy activity in Rio Grande begins with the presentation of the Locational Quotient results (Table 1), which show the highly specialized microregions, with  $QL \geq 2$ , in at least one of the years for which the QLs were calculated.

Table 1 – Evolution of QL in the microregions of Rio Grande do Sul specialized in milk production, between 1999 and 2020.

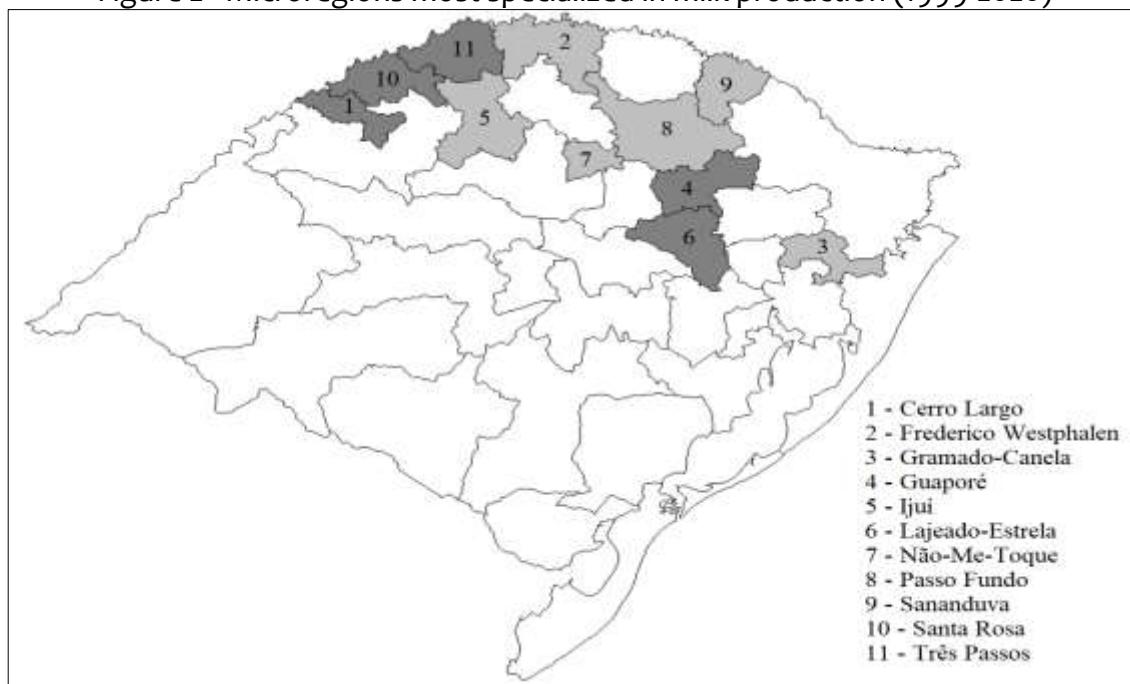
Microrregion	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
	Cerro Largo	2,19	2,24	2,25	2,96	2,46	3,11	2,55	2,62	2,31	2,52
Frederico Westphalen	1,18	1,06	1,18	1,42	1,24	1,34	1,32	1,28	1,46	1,64	1,72
Gramado-Canela	1,55	1,50	1,77	2,18	2,63	0,93	1,50	1,65	1,96	1,63	1,38
Guaporé	1,42	1,31	1,50	1,60	2,08	1,97	1,64	1,63	1,91	1,95	1,86
Ijuí	1,67	1,80	1,71	1,76	1,18	1,57	2,81	2,02	1,40	1,58	1,50
Lajeado-Estrela	2,35	2,10	2,01	1,44	1,92	1,85	1,40	1,74	1,68	1,93	1,87
Não-Me-Toque	2,14	2,35	2,11	1,99	1,63	1,74	2,23	2,30	1,78	1,54	1,59
Passo Fundo	1,50	1,54	1,65	1,69	1,57	1,85	2,72	2,12	2,01	2,22	2,25
Sananduva	1,29	1,06	0,92	1,19	1,14	1,57	2,17	1,61	2,04	1,62	1,82
Santa Rosa	2,55	2,53	2,63	2,54	2,18	3,30	3,69	3,18	2,27	2,72	2,81
Três Passos	2,41	2,08	2,49	2,68	2,41	2,69	2,90	2,82	2,18	2,58	2,69
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Cerro Largo	2,20	1,98	2,48	2,05	2,22	2,43	2,33	2,75	2,77	2,67	2,65
Frederico Westphalen	1,45	1,32	1,64	1,65	1,81	1,89	1,77	2,10	2,30	2,07	1,82
Gramado-Canela	1,37	1,52	1,25	1,43	1,28	1,28	1,19	1,20	1,24	0,84	0,76
Guaporé	2,16	2,01	1,97	1,98	1,97	2,20	2,33	2,51	2,67	2,86	2,61
Ijuí	1,67	1,70	2,42	1,46	1,80	1,59	1,42	1,77	1,51	1,7	1,72
Lajeado-Estrela	1,83	1,96	2,00	2,15	2,01	2,19	2,43	2,36	2,72	2,29	2,13
Não-Me-Toque	1,75	1,47	1,64	1,30	1,69	1,56	1,52	1,63	1,36	1,55	1,95
Passo Fundo	2,34	2,08	2,04	1,98	2,12	2,14	2,18	1,70	1,59	1,9	1,96
Sananduva	1,46	1,95	1,69	2,04	1,94	1,97	1,82	2,07	1,62	1,68	1,64
Santa Rosa	2,78	2,45	2,97	2,59	2,66	2,78	2,50	2,49	2,45	2,56	2,22
Três Passos	2,39	2,42	2,75	2,51	2,43	2,37	2,50	2,92	3,00	2,54	2,16

Source: Research results based on data from IBGE (2023) and FEE (2020).

Note:  $QL \geq 2$  highlighted in gray indicates the microregions most specialized in milk production.

The growing milk production in Rio Grande do Sul, in the period 1999-2020, did not occur homogeneously, which has been modifying the geographic map of activity in the state (Figure 2). The Cerro Largo microregion became the most specialized in production, being accompanied, in decreasing order of importance, by the Guaporé, Santa Rosa, Três Passos and Lajeado-Estrela microregions. Conversely, Gramado-Canela and Não-Me-Toque are no longer highly specialized, with decreasing rates from 2003 and 2006, respectively.

Figure 2 - Microregions most specialized in milk production (1999-2020)



Source: Research results based on data from IBGE (2023) and FEE (2020).

Note: Shaded locations represent microregions specialized in any of the years between 1999 and 2020. Darker shading indicates the five microregions specialized in 2020.

It is clear that, over the years, there has been a reduction in micro-regions specializing in milk production, with only five remaining in 2020, corroborating the tendency to concentrate production. These results corroborate those reported by Marion Filho, Fagundes and Schumacher (2011), Marion Filho et al. (2015), Telles et al. (2018) and Barden et al. (2020). This concentration of specialized micro-regions in the Northwest region has been the result of local dynamics, largely, of integrated action between processing industries and milk producers, which amplifies the effects of the production model based on specialization and modernization as a strategy, strengthening the producer's permanence in the activity. Conversely, in regions of low specialization, as explained by Marion Filho, Fagundes and Schumacher (2011), milk production constitutes a strategy to supplement income for other activities.

The only microregions that presented  $QL \geq 2$  in all years analyzed were Santa Rosa and Três Passos, both with significant participation in state milk production and average productivity, of 4,344 liters/cow/year and 3,856 liters/cow/year in 2020, respectively. , higher than the state's productivity of 3,771 liters/cow/year. These microregions included municipalities that are most relevant to state dairy production, such as Santo Cristo, which produced the largest volume of milk in the period studied,

Crissiumal, Três de Maio, Santa Rosa and Cândido Godói, which also stood out for their high production.

These results corroborated those found by Schumacher (2013), who analyzed milk production in the municipalities of Rio Grande do Sul and identified the presence of four clusters. The first of them covered the two aforementioned micro-regions (Santa Rosa and Três Passos), and beyond them the Cerro Largo micro-region, also located in the Northwest mesoregion, which is considered the main dairy basin in the state. The third is located in the Northeast mesoregion, especially in municipalities belonging to the Guaporé microregion, and the fourth involves 17 municipalities in the Lajeado – Estrela microregion.

In terms of total production, the largest volume produced in the period 1999-2020 is reported in the micro-region of Passo Fundo, with a dairy herd that approaches 80,000 heads and productivity of 5,344 liters/cow/year, and a 10% share of state production, in 2020. In addition, there are four municipalities among the 20 with the highest production in the state, with Marau being the main municipality. The others are: Casca, Passo Fundo and Vila Maria.

Among the other highly specialized microregions, Ijuí and Sananduva stand out for their high productivity (4,724 liters/cow/year and 3,606 liters/cow/year, respectively, in 2020). The microregion of Frederico Westphalen stands out for the high number of cows milked, exceeding 90,000 heads, in 2020, which resulted in significant production in the state context. Dairy farming in Rio Grande do Sul has evolved to higher levels of specialization in a greater number of micro-regions, especially since 2015.

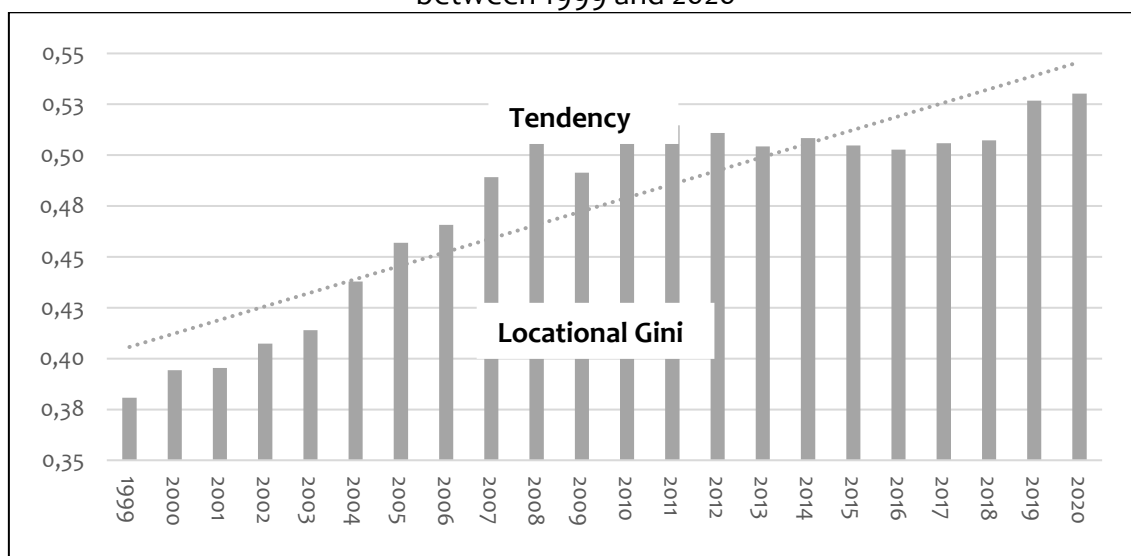
It is worth mentioning that the microregion of Não-Me-Toque, the one with the highest productivity in the state, approximately 5,655 liters/cow/year in 2020, is no longer highly specialized due to the low number of milked cows. In the Gramado-Canela microregion, highlighted in 2002 and 2003, in addition to a low number of milked cows, low productivity also contributed to reducing milk production; and consequently, the microregion is no longer highly specialized. This reduction is in line with those reported by Almeida et al. (2022), which noted the distance of dairy basins from large urban centers, both due to economic and productive factors, and were directed to the Northwest region of the state (FEIX et al., 2022).

Given the evidence about the change in the panorama of milk production in the state, especially in terms of specialization, the following section evaluated the evolution of the spatial concentration of the activity in the state.

#### 4.2 Spatial concentration of dairy production in Rio Grande do Sul

The spatial concentration of milk production in Rio Grande do Sul was calculated from the Locational Gini (GL), for 1999 to 2020. The highest GL (0.53) and the largest concentration area ( $\alpha$ ) were found for the year 2020, while the lowest GL (0.38) and the smallest area recorded were for the year 1999. Figure 3 shows the evolution of the spatial concentration of dairy farming.

Figure 3 – Evolution of the Locational Gini of milk production in Rio Grande do Sul, between 1999 and 2020



Source: Research results based on data from IBGE (2023) and FEE (2020).

The results demonstrated a constant index growth, analyzing the year 2020 in relation to 1999, an increase of 39% in concentration is observed, considering that the index goes from 0.38 in the first year to 0.53 in the last . This greater concentration of dairy production follows the specialization process seen in the main micro-regions, which have been increasing their level of specialization in recent years, thus becoming more productive.

According to Marion Filho and Oliveira (2011), the dynamics of product generation are contributing to increasing the concentration of production. This increase in concentration is the result of the favorable dynamics of some regions and the decline in dairy production in others, such as the Metropolitan and Central regions, which have an economic structure based on industrial production and services.

The increase in spatial concentration may be the result of public policies and private initiatives implemented with the aim of improving milk quality and productivity. However, according to Moura and Santos (2017), this process should not be considered necessarily harmful to the development of the activity, especially if the concentration is not significant enough to compromise the presence of the activity in some region.

Regarding this, Almeida (2005) argues that livestock farming has spatial effects, which develop from the interaction between neighbors. In the case of milk production, these effects occur in the form of clusters, reinforced by the dependence on natural resources that are concentrated in certain geographic spaces and local productive characteristics.

Along the same lines, Marion Filho, Fagundes and Schumacher (2011) highlighted that there is a spatial dependence between municipalities, while those with high or low production values are close to neighbors under the same condition. These results are corroborated by productivity, quantity produced, average rainfall, capital and pasture area, which showed an important correlation with the gross value

of production, which affects the availability of pasture, acquisition of inputs, number of cows and the technologies used in the production process.

In a similar analysis, Perobelli et al. (2018) reported, for municipalities in Minas Gerais, that variables such as the adoption of technologies in milk production have a significant effect on the growth of local production, as well as the expansion of concentration of milk production, and that this growth occurred in regions with greater capacity installed.

The evidence of specialization and concentration of dairy activity in the state encourages a deeper understanding of this dynamic, with a discussion of production growth factors.

### 4.3 Growth of dairy farming in Rio Grande do Sul

In the period 1999-2020, Brazil presented an average growth rate in milk production of 2.84% per year, which corresponds to a total growth of 85% in the period as a whole (Table 2). The growth in milk production in the country during this period resulted from gains in productivity (EPT = 3.12% per year), since the herd expansion effect (EER), which complements the variation in milk production, was negative in 0.28%, indicating a decrease in the number of cows milked. As argued by Vilela et al. (2017), the dairy herd has shown a reduction since 2013, going from 23.2 million milked cows to 21.7 million in 2017. Reinforcing the thesis that the growth in national supply has been due to gains in terms of productivity.

In the state of Rio Grande do Sul, dairy farming showed an average growth of 3.55% per year, corresponding to an increase of 115% over the period. Results demonstrated that the average annual growth rate of milk production in the state was 0.71 percentage points higher than the average annual performance of national dairy farming, equivalent to a 30% greater expansion (Table 2). The EPT productivity effect of 3.52% per year was greater than the EER effect of 0.03% per year, corresponding to 99% of the expansion of state milk production in 1999-2020, which can be attributed to the growth in dairy productivity, the remaining is due to the growth in the number of cows milked.

This marginal contribution to herd productivity is related to the reduction in milked cows. Situation that Feix et al. (2022) justify the context of low growth in national demand, increased competition with other MERCOSUR countries, growth in production costs and instability in prices paid to producers, from 2015 onwards, which caused dairy farming in Rio Grande do Sul to undergo a process of “natural selection” that caused a drop in the number of milk producers and milked cows.

Table 2 – Average annual growth rates in milk production, decomposed into herd expansion effect and productivity effect in the period 1999-2020

Item	Microrregion	r	EER	EPT
1	Brasil	2,84	-0,28	3,12
2	Rio Grande do Sul	3,55	0,03	3,52
3	Cachoeira do Sul	0,37	-1,22	1,58
4	Camaquã	-1,11	-2,23	1,12
5	Campanha Central	4,38	0,28	4,10
6	Campanha Meridional	2,50	2,68	-0,18
7	Campanha Ocidental	0,26	-1,67	1,93
8	Carazinho	5,73	2,43	3,29
9	Caxias do Sul	0,96	-1,83	2,79
10	Cerro Largo	4,28	0,54	3,74
11	Cruz Alta	3,77	0,81	2,96
12	Erechim	4,76	0,82	3,94
13	Frederico Westphalen	5,76	1,37	4,38
14	Gramado-Canela	-2,13	-3,42	1,29
15	Guaporé	7,40	1,20	6,21
16	Ijuí	4,05	0,77	3,27
17	Jaguarão	-3,97	-5,22	1,25
18	Lajeado-Estrela	3,25	0,68	2,57
19	Litoral Lagunar	-1,23	-2,98	1,75
20	Montenegro	0,87	-1,56	2,43
21	Não-Me-Toque	1,61	-0,69	2,31
22	Osório	-5,03	-5,86	0,83
23	Passo Fundo	5,20	0,93	4,27
24	Pelotas	0,92	-1,77	2,69
25	Porto Alegre	1,79	0,91	0,89
26	Restinga Seca	0,18	-2,65	2,83
27	Sananduva	5,78	1,27	4,51
28	Santa Cruz do Sul	1,41	-1,01	2,41
29	Santa Maria	-2,26	-3,79	1,53
30	Santa Rosa	3,40	0,16	3,24
31	Santiago	4,05	-0,25	4,30
32	Santo Ângelo	3,34	-0,05	3,39
33	São Jerônimo	-1,44	0,87	-2,31
34	Serras de Sudeste	-0,29	-2,27	1,98
35	Soledade	2,97	0,11	2,85
36	Três Passos	4,51	0,67	3,84
37	Vacaria	0,88	-2,80	3,67

Source: elaborated by the authors based on IBGE (2023)

Furthermore, it is clear that of the 35 micro-regions in Rio Grande do Sul, 23% showed a decline in milk production. They are: Camaquã, Gramado-Canela, Jaguarão, Litoral Lagunar, Osório, Santa Maria, São Jerônimo and Serras de Sudeste. Among these micro-regions, only São Jerônimo showed a reduction in productivity, the other seven achieved productivity gains; however, these gains were not enough to

overcome the effect of the herd reduction. It is worth mentioning that most of these microregions are not specialized in dairy production. In 2020, the eight microregions together contributed 2.39% of state production, despite representing 22.85% of the number of microregions in the state.

In relation to productivity, only two micro-regions showed a decline, they are: Campanha Meridional and São Jerônimo. In the Southern Campaign there was a retraction of (-0.18% p.a.); however, the increase in the herd (milked cows), which was 2.68% p.a., compensated for the loss in productivity, and caused the microregion to present a average annual growth rate of milk production of (2.50% p.a.). Table 2 illustrated that, in São Jerônimo, the drop in productivity was greater (-2.31% p.a.) and was not compensated by the increase in the herd (0.87% p.a.), which resulted in a drop in milk production of (-1.44% p.a.). It is worth mentioning that 18 micro-regions showed a decrease in the herd, with the most significant drop being in Osório (EER = - 5.86% p.a.). This micro-region also saw the biggest drop in milk production in the state, of -5.03% per year.

Among the 27 micro-regions of the state (77%) that showed growth in milk production in the period 1999-2020, twelve recorded average annual rates higher than the state average. They are: Central Campaign, Carazinho, Cerro Largo, Cruz Alta, Erechim, Frederico Westphalen, Guaporé, Ijuí, Passo Fundo, Sananduva, Santiago and Três Passos. There is regional heterogeneity in dairy production in Rio Grande do Sul, the micro-regions with performance above the state average are located especially in the Northwest mesoregion, except for Guaporé (Northeast), Campanha Central (Southwest) and Santiago (Western Center)..

The micro-region of Guaporé stand out with the highest average annual growth rate in milk production (7.40% p.a.), with EPT of 6.21% per year, the highest among the 35 micro-regions, and EER of 1.20% per year. In 2020, the Guaporé microregion was the sixth largest milk producer in the state, behind Passo Fundo, Três Passos, Frederico Westphalen, Lajeado-Estrela and Ijuí.

In general, productivity gains can be largely attributed to the adoption of technologies, as mentioned by Alves, Souza and Rocha (2012) and Feix et al. (2022). Over the last 40 years, technological innovations have been gradually incorporated into rural properties. Highlighting aspects related to herd genetics, intensive pasture management, nutritional and health control, mechanization of processes, among others (FISCHER et al. 2011; VILELA et al., 2017). Despite this, Brazilian productivity, when compared to the main world producers, is still considered low (FISCHER et al. 2011).

Furthermore, it appears that the continuity of the activity has become a major challenge for producers, resulting in a tendency to reduce establishments (VILELA et al., 2017). Conversely, it must be considered that the country has several favorable characteristics for the growth of the activity, such as: the largest arable area in the world, extensive pasture area, water availability, conditions related to soil and climate, among others ( GOMES, 2009).

In summary, Rio Grande do Sul stands out in the national milk production, and in the period analyzed, the state presented an average growth in production above the national average, with an important part of this result resulting from the increase in herd productivity. Despite this, some micro-regions (23% of them) showed a decline in production. Another characteristic of the activity is the expansion of concentration



and specialization of production in certain regions, which presented production growth rates above the national average (12 micro-regions), with emphasis on the Northwest region.

This direction of dairy production to the Northwest mesoregion, as argued by Feix et al. (2022), has been encouraged by investments from companies and cooperatives in the sector. Along the same lines, Medeiros et al. (2023) highlighted that the quality of performance between processing industries and producers provides more appropriate conditions for managing the production and marketing process, contributing both to achieving prices and profits and to the growth of the milk producing establishment. Management processes that occur associated with the temperate climate, water availability, small properties, family labor, and access to subsidized credit from the National Program for Strengthening Family Agriculture (PRONAF), which constitute important factors for this dynamic.

## 5 Final Considerations

The expressive results of dairy activity in recent years have raised debates about the structure and its production system. In line with this, the present study evaluated the specialization, concentration and sources of growth in dairy farming in Rio Grande do Sul, in the period 1999-2020. The results for both specialization and concentration showed growth in the state, with the Northwest region being the main dairy basin and the micro-regions of Três Passos, Cerro Largo, Guaporé and Santa Rosa being the most specialized.

In terms of specialization and concentration, of the 35 micro-regions in Rio Grande do Sul, only 11 presented a Location Quotient equal to or greater than two during the period analyzed, making it possible to characterize the micro-regions of: Cerro Largo, Frederico Westphalen, Gramado-Canela, Guaporé, Ijuí as highly specialized. , Lajeado-Estrela, Não-Me-Toque, Passo Fundo, Sananduva, Santa Rosa and Três Passos. This specialization occurred associated with the increase in the spatial concentration of milk production, measured by the Locational Gini, given that the index went from 0.39 in 1999 to 0.53 in 2020, demonstrating that the more specialized regions became more productive, either through favorable dynamics as well as structural conditions.

Furthermore, the evidence corroborated the dynamics of significant growth in dairy farming in Rio Grande do Sul, including an average annual expansion higher than the national average, with the micro-regions of Osório and Serras do Sudeste being those that showed the largest and smallest contraction, respectively. Both in micro-regions and in the state, productivity gains (intensive growth) contributed relatively more to the expansion of production than the growth in the number of cows milked (extensive growth). A result that confirmed that the advancement of activity occurred associated with the reduction of the lactating herd and the increase in technology and specialization.

Although, the results demonstrated characteristics relevant to the dynamics of dairy activity, some limitations must be considered, especially regarding the measures applied, which are relative. Therefore, greater specialization may be the result of a reduction in the added value of agriculture or an increase in the value of milk production. And concentration can change if the relative prices paid to the

producer change, without changing the volume produced. Therefore, it is suggested for future studies to use other methodologies, such as spatial econometrics, with the objective of comparison, to verify whether there is a spillover effect between micro-regions.

## REFERENCES

ALMEIDA, E. S. Função de Produção Agropecuária Espacial. In: CONGRESSO BRASILEIRO DE ECONOMIA E ADMINISTRAÇÃO RURAL (SOBER). 43. **Anais [...]**. Ribeirão Preto, 2005.

ALMEIDA, M. et al. Pecuária Leiteira do Rio Grande do Sul: uma análise espacial da produtividade a partir da década de 1980. **Colóquio – Revista do Desenvolvimento Regional**, Taquara, v. 19, n. 1, p. 123-147, jan./mar. 2022.

ALVES, E. R. A.; SOUZA, G. da S.; ROCHA, D. de P. Lucratividade da agricultura. **Revista de Política Agrícola**, ano 21, n. 2, p. 45-63, abr./jun. 2012.

BARDEN, J. E. et al. The specialization of milk production in the Vale do Taquari/RS region. **Revista Brasileira de Gestão e Desenvolvimento Regional**, Taubaté, v. 16, n. 1, p. 339-353, jan./abr. 2020.

BASTOS, S. Q. de A.; VIGGIANO, L. C. de F. Fontes de crescimento da pecuária leiteira: uma análise para o Estado de Minas Gerais. In: SEMINÁRIO SOBRE A ECONOMIA MINEIRA, 15., 2012, Diamantina. **Anais [...]** Diamantina: Cedeplar, 2012.

BERRO, R.; BRANDÃO, J. B.; BREITENBACH, R. Sistema local de produção de leite em Itaqui, Rio Grande do Sul: caracterização e diferenciação dos estabelecimentos formais. In: ENCONTRO DE ECONOMIA GAÚCHA. 7. **Anais [...]**. Porto Alegre: PUC – RS, 2014. Disponível em: <<https://www.fee.rs.gov.br/wp-content/uploads/2014/05/201405237eeg-mesa5-producaoiteitaqui.pdf>>. Acesso em: 21 mai. 2020.

BORGES, M. S.; CASTRO, M. C. D.; GUEDES, C. S. M.; ALIMONDA, H. A. Modernização, Trabalho e Produtividade na Pequena Produção Leiteira na Argentina e no Brasil. **Revista ADM.MADE**, v. 18, n. 1, p. 12-31, jan/abr. 2014.

BRAND, S. I.; MUMBACH, G. L.; DIEL, M. I.; PORTELA, V. O.; SCHNEIDER, F. J. A.; SILVA, D. R. Dados preliminares sobre características de propriedades de bovinocultura leiteira da região Noroeste do RS. **Revista Interdisciplinar de Ensino, Pesquisa e Extensão**, v. 2 n. 1, 2013.

CROCCO, M. A.; GALINARI, R.; SANTOS, F.; LEMOS, M. B.; SIMÕES, R. **Metodologia de identificação de arranjos produtivos locais potenciais**. Belo Horizonte: Ed. Da UFMG/Cedeplar, 2003. 28 p. (Texto para discussão, 212).

FAUTH, E. M.; FEIX, R. D. Aglomeração produtiva de laticínios nos Coredes Fronteira Noroeste e Celeiro. Porto Alegre: FEE, 2015. Disponível em: <https://www.fee.rs.gov.br/wp-content/uploads/2016/06/201606068-laticinios-fronteira-noroeste-e-celeiro-relatorio1.pdf>. Acesso em: 22 mai. 2020.

FEIX, R. D.; LEUSIN JÚNIOR, S.; BORGES, B. K.; PESSOA, M. L. **Painel do agronegócio do Rio Grande do Sul - 2022**. Porto Alegre: SPGG, 2022. Disponível em: <https://dee.rs.gov.br/painel-agro>. Acesso em: 26 mai. 2023.

FISCHER, A. *et al.* Produção e produtividade de leite do Oeste catarinense. **Revista De Administração, Contabilidade e Economia - RACE**, v. 10, n. 2, p. 337-362, 2011.

FRIZZO, L. N. **Os desafios da produção de leite e as consequências sobre o desenvolvimento regional: o caso da normativa 51**. 2011. 101f. Dissertação (Programa de Pós-Graduação em Desenvolvimento) – Universidade Regional do Noroeste do Estado do Rio Grande do Sul, Ijuí, 2011.

FUNDAÇÃO DE ECONOMIA E ESTATÍSTICA SIEGFRIED EMANUEL HEUSER -FEE. Indicadores. 2020. Disponível em: <<https://www.fee.rs.gov.br/>>. Acesso em: 26 mai. 2023.

GOBBI, W. A. De O.; PESSÔA, V. L. S. A pecuária leiteira e a agricultura familiar em Ituiutaba (MG): as transformações na comunidade da canoa. **Geo UERJ**, v. 1, n. 19, p. 79-110, 2009.

GOMES, E. J. Dados do Censo Agropecuário confirmam concentração da atividade leiteira no Brasil. **Deser**, Curitiba, n. 166, nov. 2009. Disponível em: <<http://www.deser.org.br/adm/ver.asp?id=22>>. Acesso em: 15 maio 2020.

HADDAD, P. R. Medidas de localização e de especialização. In: HADDAD, P. R. (Org.). **Economia regional: teorias e métodos de análise**. Fortaleza: BNB/Etene, 1989. p. 225-247.

IBGE. **Sistema IBGE de recuperação automática - SIDRA**. Disponível em: <<http://www.sidra.ibge.gov.br/>>. Acesso em: 26 mai. 2023.

INSTITUTO BRASILEIRO DE GEOGRAFIA E ESTATÍSTICA (IBGE). **Pesquisa Pecuária Municipal**. 2020. Disponível em: <https://www.ibge.gov.br/estatisticas/economicas/agricultura-e-pecuaria/9107-producao-da-pecuaria-municipal.html?edicao=17941&t=series-historicas>. Acesso em: 21 mai. 2020.

ISARD, W. **Methods of regional analysis**. Cambridge, Massachusetts: The MIT Press, 1960.

LUCCA, E. J.; AREND, S. C. A pecuária leiteira e o desenvolvimento da Região Noroeste do Rio Grande do Sul. **Revista Brasileira de Desenvolvimento Regional**, v. 7, n. 3, p. 107-142, 2019.

MARION FILHO, P. J.; FAGUNDES, J. O.; SCHUMACHER, G. A produção de leite no Rio Grande do Sul: produtividade, especialização e concentração (1990 – 2009). **Revista de Economia e Agronegócio**, v. 9, n. 2, p. 233-252, 2011.

MARION FILHO, P. J.; MOURA, A. C.; BRITES, M.; LORONZONI, R. K. Concentração regional e especialização na produção de leite do Rio Grande do Sul (1990 – 2010). **Revista Brasileira de Gestão e Desenvolvimento Regional**, v. 11, n. 1, p. 224 – 242, jan./ abr. 2015.

MARION FILHO, P. J.; MOURA, A. C.; BRITES, M.; LORONZONI, R. K. Especialização na produção de leite e concentração no Rio Grande do Sul. **Revista de Administração e Negócios da Amazônia**, v. 8, n. 1, p. 22-38, jan/abr. 2016.

MARION FILHO, P. J.; OLIVEIRA, L. F. V. de. A especialização e a concentração da produção de leite nas microrregiões do Rio Grande do Sul (1990 – 2007). **Ensaios FEE**, Porto Alegre, v. 31, Número Especial, p. 635- 647, jun. 2011.

MARION FILHO, P.J.; REICHERT, H.; SHUMACHER, G. A Pecuária No Rio Grande Do Sul: A Origem, A Evolução Recente Dos Rebanhos E A Produção De Leite. In: ENCONTRO DE ECONOMIA GAÚCHA. 7. **Anais [...]**. Porto Alegre: PUC – RS, 2014. Disponível em: <[http://cdn.fee.tche.br/eeg/6/mesa13/A\\_Pecuaria\\_no\\_RS-A\\_origem\\_Evolucao\\_Recente\\_dos\\_Rebanhos\\_e\\_a\\_Producao\\_de\\_Leite.pdf](http://cdn.fee.tche.br/eeg/6/mesa13/A_Pecuaria_no_RS-A_origem_Evolucao_Recente_dos_Rebanhos_e_a_Producao_de_Leite.pdf)>. Acesso em: 19 mai. 2020.

MEDEIROS, A. P., MELZ, L. J., FAVARETTO, J., BENDER FILHO, R. Qualidade no relacionamento entre indústrias e produtores de leite: análise da mesorregião noroeste do Rio Grande do Sul. **Revista de Economia e Sociologia Rural**, v. 61, n. 2, e248266. <https://doi.org/10.1590/1806-9479.2021.248266>

MINISTÉRIO DA AGRICULTURA E PECUÁRIA. **Nota nº 01-2023/CGPOP/DAEP/SPA/MAP**. 16 de Janeiro de 2023. Brasília. Disponível em: <[NotaCGPOP202301VBP16.01.23.pdf \(www.gov.br\)](http://www.gov.br/NotaCGPOP202301VBP16.01.23.pdf)>. Acesso em: 19 mai. 2023.

MONTOYA, M. A.; FINAMORE, E. B. Características dos produtores de leite do RS: uma análise a partir do Corede Nordeste. **Indicadores Econômicos FEE**, Porto Alegre, v. 37, n. 4, p. 213-224, 2010.

MORAES, B. M. M.; BENDER FILHO, R. Mercado brasileiro de lácteos: análise do impacto de políticas de estímulo à produção. **Revista de Economia e Sociologia Rural**, v. 55, n. 4, p. 783-800, out/dez 2017.

MORAIS, M. S.; SOUSA, R. A. T. M; COSTA, R. B.; DORVAL, A.; TIMOFEICZYK JÚNIOR, R. Impacto ambiental em assentamentos da reforma agrária no Mato Grosso. **Floresta**, Curitiba, v. 42, n. 3, p. 597-598, out. 2012.

MOURA, A. P. F.; SANTOS, C. V. Distribuição espacial e fontes de crescimento da pecuária leiteira paranaense. **Revista de Política Agrícola**, v. 26, n. 2, p. 5-19, 2017.

MOURA, A. P. F.; SANTOS, C. V.; BULHÕES, R. Fontes de crescimento da pecuária leiteira paranaense no período 1995-2010: uma análise por mesorregiões à luz do método *shift-share*. **Ciências Sociais em Perspectiva**, v. 14, n. 27, p. 65-87, 2015.

NORO, G.; GONZÁLEZ, F. H. D.; CAMPOS, R.; DURR, J. W. Fatores ambientais que afetam a produção e a composição do leite em rebanhos assistidos por cooperativas no Rio Grande do Sul. **Revista Brasileira de Zootecnia**, v. 35, n. 3, p. 1129-1135. 2006.

PEROBELLI, F. S.; ARAÚJO JUNIOR, I. F. de; CASTRO, L. S. de. As dimensões espaciais da cadeia produtiva do leite em Minas Gerais. **Nova Economia**, v. 28, p. 297-337, 2018.

PINTO, D. G.; PEROBELLI, F. S. Determinantes do crescimento da pecuária de leite em Minas Gerais uma análise para o período de 2005 a 2014. **Reflexões Econômicas**, v. 1, n. 2, p. 44-67, out/mar 2016.

PUGA, F. P. **Alternativas de apoio a MPMES localizadas em arranjos produtivos locais**. Rio de Janeiro: BNDES, 2003. 30 p. (Texto para discussão, 99).

RAIOL, L. C. B.; SANTOS, M. A. S.; REBELLO, F. K. Fontes de crescimento da pecuária leiteira no nordeste paraense no período de 1990 a 2007. In: CONGRESSO DA SOCIEDADE BRASILEIRA DE ECONOMIA E SOCIOLOGIA RURAL, 47., 2009, Porto Alegre. **Anais...** Brasília, DF: Sober, 2009.

SCHUMACHER, Gabriela. **Produção de leite no Rio Grande do Sul: a distribuição espacial e a relação de dependência entre os municípios**. 2013. 103f. Dissertação (Programa de Pós-Graduação em Administração) – Universidade Federal de Santa Maria, Santa Maria, 2013. Disponível em: <<https://repositorio.ufsm.br/handle/1/4637>>. Acesso em: 20 mai. 2020.

SCHUMACHER, G.; MARION FILHO, J. P. A expansão da pecuária no Rio Grande do Sul e o transbordamento na produção de leite (2000 a 2010). **Gestão e Regionalidade**, v. 29, n. 87, p. 32-46, set/dez. 2013.

SILVA NETO, B.; BASSO, D. A produção de leite como estratégia para o desenvolvimento do Rio Grande do Sul. **Desenvolvimento em Questão**, v. 3, n. 5, p. 53-72, jan/jun. 2005.

SUZIGAN, W.; FURTADO, J.; GARCIA, R.; SAMPAIO, S. E. K. Coeficientes de Gini Locacionais – GL: aplicação à indústria de calçados do Estado de São Paulo. **Nova Economia**, v. 13, n. 2, p. 39-60, jul./dez. 2003.

TELLES, Tiago Santos et al. Microrregiões especializadas na produção de leite no sul do Brasil. In: CONGRESSO DA SOCIEDADE BRASILEIRA DE ECONOMIA, ADMINISTRAÇÃO E SOCIOLOGIA RURAL, 56., 2018, Campinas. **Anais [...]**. Campinas, SP: SOBER, 2018. Disponível em: [https://www.researchgate.net/profile/Amanda-Schuntzemberger/publication/330216559\\_MICRORREGIOES\\_ESPECIALIZADAS\\_NA\\_PRODUCAO\\_DE\\_LEITE\\_NO\\_SUL\\_DO\\_BRASIL/links/5c3492c592851c22a363c4c9/MICRORREGIOES-ESPECIALIZADAS-NA-PRODUCAO-DE-LEITE-NO-SUL-DO-BRASIL.pdf](https://www.researchgate.net/profile/Amanda-Schuntzemberger/publication/330216559_MICRORREGIOES_ESPECIALIZADAS_NA_PRODUCAO_DE_LEITE_NO_SUL_DO_BRASIL/links/5c3492c592851c22a363c4c9/MICRORREGIOES-ESPECIALIZADAS-NA-PRODUCAO-DE-LEITE-NO-SUL-DO-BRASIL.pdf). Acesso em: 02 jun. 2023.

TRICHES, E. **Importância da atividade leiteira na agricultura familiar e uma análise na Propriedade Ghion – Marau-RS**. 2011. 63 p. Trabalho de Conclusão (Graduação em Desenvolvimento Rural) – Universidade Federal do Rio Grande do Sul, Porto Alegre, 2011.

VIEIRA, A. **A abertura da economia brasileira e os aspectos práticos e operacionais da exportação**. 2003. Dissertação (Programa de Pós-Graduação em Economia) – Universidade Federal do Rio Grande do Sul, Porto Alegre, 2003.

VILELA, D. et al. A evolução do leite no Brasil em cinco décadas. **Revista de Política Agrícola**, v. 26, n. 1, p. 5-24, 2017.

ZANELA, M. B.; FISCHER, V.; RIBEIRO, M. E. R.; STUMPF JUNIOR, W.; ZANELA, C.; MARQUES, L. T.; MARTINS, P. R. G. Qualidade do leite em sistemas de produção na região Sul do Rio Grande do Sul. **Pesquisa Agropecuária Brasileira**, Brasília, v. 41, n. 1, p. 153-159, jan. 2006.

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