

Production Circuits and the Participation of Family Farming in Brazilian Swine Farming

Circuitos produtivos e a participação da agricultura familiar na suinocultura brasileira

Gabriel dos Santos Ceretta¹; Alessandra Matte²; Ana Paula Schervinski Villwock³

- ¹ Federal Technological University of Paraná (UTFPR), Santa Helena Campus, Santa Helena/PR, Brazil. E-mail: gabrielceretta13@gmail.com
ORCID: <https://orcid.org/0000-0002-4067-1672>
- ² Federal Technological University of Paraná (UTFPR), Santa Helena Campus, Graduate Program in Agroecosystems (PPGIS), Santa Helena/PR, Brazil. Email: amatte@utfpr.edu.br
ORCID: <https://orcid.org/0000-0002-0502-6643>
- ³ Federal University of Sergipe (UFS), Department of Agronomic Engineering, Aracaju/SE, Brazil. E-mail: anavillwock@academico.ufs.br
ORCID: <https://orcid.org/0000-0002-9990-8590>

Abstract: The objective of this study is to analyze the productive dynamics and the participation of family farming in Brazilian pig farming, especially in light of local and global technological changes in recent years. The research is quantitative in nature, with the collection, processing, and analysis of secondary data from the 2006 and 2017 Agricultural Censuses regarding pig farming in Brazil. Regarding the analysis of the results, the quantitative data were treated using descriptive statistics adjusted for each variable studied. The results indicate the presence of pig farming throughout Brazil, with a strengthening, in recent years, of integrated production systems in the South and Southeast regions, and production focused on subsistence in the North and Northeast. The main conclusion is the relevance of pig farming for the reproduction of ways of life and its influence on international markets through exports, in addition to the need to rethink the current model, since the basis of the pig diet, corn, is exposed to climate and market fluctuations. It is also important to explore alternative markets, fostering this activity beyond conventional models. The Brazilian government needs to pay special attention and support to family farming, which is the main producer in the country. Although integration with agribusiness brings benefits, such as access to markets and stability, it also increases farmers' dependence, requiring public policies and industry actions that consider these vulnerabilities.

Keywords: Markets; Livestock; Integrated systems.

Resumo: O objetivo do estudo é analisar a dinâmica produtiva e a participação da agricultura familiar na suinocultura brasileira, especialmente diante das mudanças tecnológicas locais e globais dos últimos anos. A pesquisa é de caráter quantitativo, com levantamento, tratamento e análise de dados secundários dos Censos Agropecuários 2006 e 2017 em relação à suinocultura no Brasil. No que se refere à análise dos resultados, os dados quantitativos foram tratados por meio da estatística descritiva ajustadas a cada variável estudada. Os resultados apontam a presença da pecuária suína em todo o território brasileiro, com fortalecimento, em anos recentes, para sistemas integrados de produção nas regiões Sul e Sudeste, e uma produção voltada à subsistência no Norte e Nordeste. A principal conclusão é a relevância da suinocultura para a reprodução de modos de vida e sua influência nos mercados internacionais por meio da exportação, além da necessidade de repensar o modelo vigente, já que a base da dieta dos suínos, o milho, está exposta a oscilações climáticas e de mercado. Também é importante explorar mercados alternativos, fomentando essa atividade além dos modelos convencionais. O governo brasileiro precisa dar especial atenção e apoio à agricultura familiar, principal responsável pela produção no país. Embora a integração com a agroindústria traga benefícios, como acesso a mercados e estabilidade, ela também acentua a dependência dos agricultores, exigindo políticas públicas e ações da indústria que considerem essas vulnerabilidades.

Palavras-chave: Mercados; Pecuária; Sistemas integrados.

1. Introduction

A series of transformations in the pig production chain have marked the last few decades in Brazil, especially in the face of the growing process of specialization, incorporation of high degrees of technification, integration with industries and increased exports. Brazil is currently the 5th largest exporter and 3rd largest producer of pork in the world, according to data from the Food and Agriculture Organization of the United Nations (FAOSTAT, 2019). In line with this data, forecasts for animal protein consumption worldwide indicate that pork is in second place in the ranking, with production and consumption expected to grow over the next decade.

Recent research by the Brazilian Institute of Geography and Statistics (IBGE) found that of the 5,073,324 rural establishments identified in Brazil, 29% (1,471,270) of them are pig farms. This production activity is commonly carried out on small rural properties, characterized by production systems in which the predominant social category in management is family farmers (MIELE et al., 2011; LOPES et al., 2019). This productive activity is an important driver of socio-economic development in several states and municipalities in the country, which arouses interest in understanding its situation in the Brazilian and regional context.

In the international context, Preston (2022) presented important reflections on this activity, especially with regard to society's demand for the production of animal proteins using renewable resources and considering the welfare of animals in production systems, aiming for sustainable production practices. His review demonstrated the potential for generating pork protein in synergy with diets with a lower environmental impact, in line with what was also pointed out by Dias et al. (2021) in Brazil. Preston (2022) proposes that family farming can offer solutions for raising these animals, especially because of the way they are produced based on local environmental characteristics.

In this sense, family farming has been finding ways to produce and market its products even in markets dominated by large multinationals (PLOEG, 2016; WILKINSON, 2016; CERDAN, 2023; MATTE et al., 2024). It is important to understand that family farming, as a political category, was established in the first half of the 1990s, especially for the development of policies that catered to a public that was marginalized, gaining legitimacy and having its complexity illustrated in countless studies in the following years, recognizing it as an important social category. However, its legal formalization before the state only occurred in 2006, with the sanctioning of Law No. 11.326, of July 24, which establishes the guidelines for the formulation of the National Policy for Family Farming and Rural Family Enterprises (BRASIL, 2006). In 2017, Decree No. 9.064 changed some of the guidelines in Art. 3, which are: I - owning, in any capacity, an area of up to four fiscal modules; II - using at least half of the family workforce in the production and income-generating process; III - earning at least half of the family income from economic activities in their establishment or enterprise; and IV - managing the establishment or enterprise strictly.

Efficiency in pig farming in family-run establishments enables more profitable production in the search for increased income and employment, better prices for pigs, as well as enabling self-consumption in agricultural establishments (DE PAULA et al., 2019). In the same vein, Chau, Lebailly and Trung (2017) point out that pig farming is an important source of income, especially for family forms of production, and also contributes to the production of animal protein to supply 78% of meat production in Vietnam's domestic market. Therefore, local production systems in a production chain can contribute to greater competitiveness for companies and territories and influence local development (POLESE, 1998), plus regional historical aspects (VEDANA; MORAES, 2018).

The dynamism of globalization regularly modifies the arrangement of economic activities in territories, making some more dynamic than others and, consequently, unequal in the accumulation of capital and social indicators (ALVES; FERRERA DE LIMA; PIFFER, 2009).

In general, rural areas, specifically family farmers, react differently to these changes, especially with regard to the way in which work is organized and decisions are made in rural establishments. With this in mind, the aim of this study was to analyze the productive dynamics and participation of family farming in pig farming in Brazil, with the aim of identifying changes in this productive sector over the last two decades. To this end, the text is organized into four sections, including this introduction. The second section presents the instruments that make up the study method. The third section presents and discusses the main results. Finally, the final considerations are drawn as conclusions from these analyses.

2. Methodology

The research was carried out by collecting secondary data from the Automatic Retrieval System (SIDRA) platform of the Brazilian Institute of Geography and Statistics (IBGE). The data selected includes the results of the Agricultural Census carried out in 2006 and 2017. Consulting this database allowed us to determine and use the following variables: the number

of agricultural establishments that raise, produce and sell pigs in Brazil, the value received for the product, and the amount produced, distinguished by region of the country and among family farmers, consisting of the variables analyzed. The data selected refers to the number of establishments and animals (pigs) for the different regions of Brazil, which were systematized in tables and graphs. Brazil is a country with a large territorial area, with twenty-six states and the federal district, which are grouped into five regions: North, South, Southeast, Midwest and Northeast.

It should be noted that the Agricultural Census changed the way family farming is categorized, since continuous areas in the same municipal unit are now counted as continuous areas. The figure of the producer without an area has also changed, with production belonging to the owner of the area, where applicable. These differences cannot be dealt with, so the data is compared based on the classification of family farmer defined in the institute's classification.

With regard to analyzing the results, the quantitative data was treated using descriptive statistics, which allow situations or events to be analyzed, making it possible to accurately show the angles and dimensions of the context studied (HERNÁNDEZ SAMPIERI *et al.*, 2013). Therefore, information related to pig production in Brazil and in the different regions was analyzed using frequency, average and growth rates. To analyze this data, a literature review was carried out to draw conclusions and understand the changes underway.

3. Result and discussions

Pig farming is one of the productive activities that underwent the most changes in the period from the 1960s to the 1990s, especially when, through the reproduction of technological packages, there was a marked commercialization and specialization of agriculture, with a significant process of vertical integration in the poultry and pork chains in Brazil (MIELE; WAQUIL, 2007; MIOR, 2010; LOPES *et al.*, 2019). However, this process has not been homogeneous across Brazil, so we find regions where pig production is characterized by specialization and integration with industries, while in other regions these animals are raised for subsistence and on a small scale.

When analyzing the data from the 2017 Agricultural Census, it can be seen that the relationship between the number of establishments and the number of pigs in the herd shows significant diversity in Brazil when observed by region (Graph 1). While the bulk of the herd is concentrated in the South, with around 53.6% of the animals distributed in 375,844 establishments (25.5% of the total), only 14.7% of the herd is in the North and Northeast, distributed in 716,275 rural establishments (48.6% of the total). This data points to the predominance of integrated systems in the south of Brazil and subsistence farming in the north and northeast of the country, confirming previous analyses by Miele *et al.* (2011), in which 92% of pig farms in the south are integrated with companies and agro-industrial cooperatives.

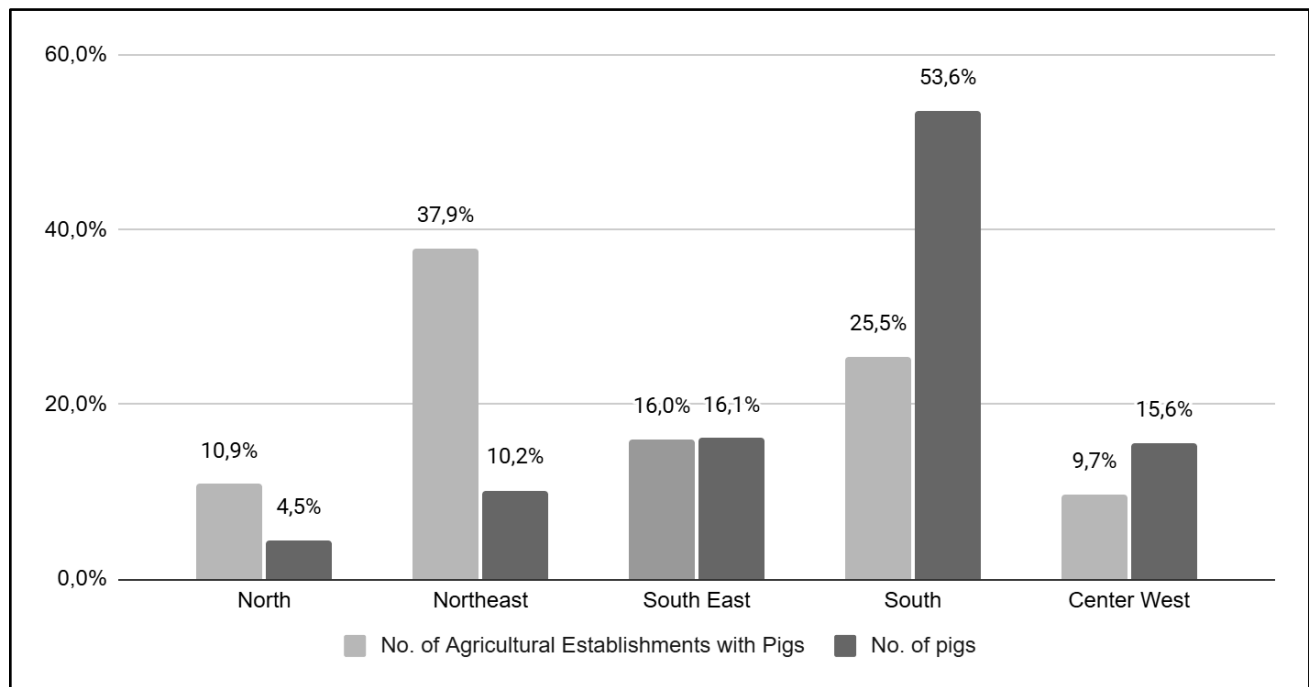


Figure 1 – Distribution of the number of rural establishments with pigs and the number of pigs in the different regions in Brazil, 2017.

Source: Prepared by the authors based on IBGE (2019).

In recent decades, pig farming has been on the rise in Brazil, with a 26% increase in the number of pigs in the period from 2006 to 2017 (Table 1). However, there was a decrease in the percentage of the activity carried out by family farmers from 2006 to 2017, from 85% to 79%, respectively. Despite the increase in pig production in the country, family farming has been losing its share of production over the years.

In the South and Southeast, there has been an increase in the number of animals, 26% and 21% respectively, while there has been a reduction in the number of rural establishments dedicated to the activity. This can be explained by the concentration of production for commercial purposes, indicating intensification and specialization of the activity, along with a reduction in farming for self-consumption and, consequently, an increase in demand for pork. In other words, the reduction in the number of establishments occurs in the regions with the largest number of animals, characterized by the concentration of production for commercial purposes.

This dynamic is similar to that found by Ouma et al (2014) in Uganda, where in the classification of pig producers into clusters, one of the profiles is characterized by intensive associative producers. The main characteristic of this group in that country is similar to the Brazilian reality, which includes integration with cooperatives and companies that operate in the form of integration.

The Northeast of Brazil maintained practically the same pig production and number of establishments with pigs from 2006 to 2017. The North, on the other hand, saw the biggest increase in the number of establishments with pigs (35%), followed by the Midwest (19%), also expanding the number of pigs by 10% and 67%, respectively. This suggests that there has been an increase in intensification and specialization of the activity in the Central-West region, as the percentage of pig numbers has increased threefold in relation to the number of establishments raising these animals, which is not the case in the North.

Table 1 – Characterization and oscillation of the number of animals, the number of rural establishments raising pigs and the proportion of these that are characterized as family farming for Brazil and regions, 2006 and 2017.

Brazil and Major Regions	2006			2017			Oscillation Rate	
	Number of Animals	No. of Estbl.	% FF*	Number of Animals	No. of Estbl.	% FA*	Number of Animals	No. of Estbl.
North	1.598.928	117.641	83%	1758.908	159.402	81%	10%	35%
Northeast	3.940.454	551.940	90%	4.004.615	556.873	79%	2%	1%
Southeast	5.232.493	253.804	79%	6.343.331	235.775	76%	21%	-7%
South	16.750.420	451.870	88%	21.101.886	375.844	85%	26%	-17%
Center West	3.667.056	120.856	69%	6.137.452	143.376	69%	67%	19%
Brazil	31.189.351	1.496.111	85%	39.346.192	1.471.270	79%	26%	-2%

*%AF: Family Farming, calculation made based on the total number of establishments with pigs.

Source: Prepared by the authors based on the Agricultural Census, IBGE (2006; 2019).

It is worth noting that the data analyzed is in line with Gastardelo and Melz (2014), who state that in Brazil, the greatest concentration of pig farming is in the southern states, but with growth towards the Midwest, due to the large production of inputs. In an analysis of the activity over time, Miele et al. (2011) point out that the growth of pig farming in Brazil is significant when compared to the world average or even to its main competitors, explained especially by the organizational influence in this chain, such as the incorporation of technological advances.

In Brazil, 51.3% of pig production is concentrated in establishments with an area of 0.1 to 50 hectares (IBGE, 2019), possibly associated with other livestock and agricultural practices (BARROS 2021, DENTZ, SPÍNDOLA, 2019). The data also shows that of the total number of rural establishments with pig farms, 80.6% come from family farming (IBGE, 2019), reinforcing what previous studies have already pointed out: the majority participation of this category in pig farming.

According to Buainain, Sabbato and Guanzioli (2004), family farming is extremely diverse with its essence directly linked to regional customs, professional experiences, access to financial, social and human capital resources. Therefore, based on the secondary data collected above, the starting point was to relate the number of properties practicing pig farming to the distribution of livestock, since the most effective way to work with this data was to divide it into groups of strata of total area, in order to identify which category is at the forefront of this practice (Table 2).

As the table shows, the majority of pig farms have an area of less than 50 hectares, with 89.5% of pig producers in the South, 87% in the Northeast, 81.1% in the Southeast, and 56.5% and 60.6% in the North and Midwest, respectively. There are also figures that show a reality beyond this pattern: in the Northeast, 48.3% of the establishments that raise pigs have an area of less than five hectares, which may indicate that the practice is for subsistence, since the slaughter and industrial processing plants in this chain are concentrated in the southern region of the country.

Table 2 – Distribution in relative values of pig farms for the different regions of Brazil, 2017.

Size Group	North	Northeast	Southeast	South	Center West
From 0 to less than 5 ha	14,9%	48,3%	25,0%	20,0%	10,4%
From 5 to less than 10 ha	6,2%	11,9%	15,4%	18,4%	8,8%
From 10 to less than 20 ha	9,1%	12,2%	19,2%	27,8%	14,3%
From 20 to less than 50 ha	26,3%	14,6%	21,5%	23,3%	27,1%
From 50 to less than 100 ha	18,9%	6,3%	9,5%	6,1%	14,6%
From 100 to less than 200 ha	11,9%	2,9%	4,9%	2,2%	9,0%
From 200 to more than 10,000 ha	5,4%	2,4%	1,7%	0,7%	8,2%
Producer without area	0,5%	1,8%	0,004%	0,1%	0,1%

Source: Prepared by the authors based on IBGE (2019).

The number of pigs per stratum of major region was presented earlier, with a large share of the southern states, which curiously have the lowest distribution of animals on properties larger than 50 hectares, but their leadership is not based solely on the presence of slaughtering and processing plants, there are historical factors that have led to this position.

In addition to local geography dictating access to markets and socio-economic integration, a characteristic present among the largest companies in this segment is the focus on processed products for the domestic market, while in exports efforts are focused on food safety issues demanded by the international market. For Hickmann (2014) and Miele (2007), the good performance of this agro-industrial chain is linked to the increase in production scale, specialization, technification and new trends in the slaughtering and processing sector.

As stated above, the largest portion of the pig herd is allocated to properties with an area of less than 50 hectares, and the table below shows how this information relates to financial turnover and the proportion of animals sold.

Table 3 – Value of pig sales expressed in thousand (Real), percentage share by stratum and incidence by rural establishment size group, Brazil 2017.

Size Group	Percentages	Value in thousand R\$ (Real)
From 0 to less than 5 ha	9,9%	1.136.970
From 5 to less than 10 ha	7,0%	800.998
From 10 to less than 20 ha	13,6%	1.563.199
From 20 to less than 50 ha	20,8%	2.396.600
From 50 to less than 100 ha	12,2%	1.405.157
From 100 to less than 200 ha	9,3%	1.064.772
From 200 to less than 500 ha	11,4%	1.312.541
From 500 to less than 1.000 ha	7,2%	832.126
From 1.000 to less than 2.500 ha	4,3%	498.756
From 2.500 to less than 10.000 ha	3,7%	428.640
From 10.000 ha and more	0,4%	49.385
Producer without area	0,1%	14.031

Source: Prepared by the authors based on IBGE (2019).

The data in the third table reinforces the majority of farms with an area of less than 50 hectares, since they account for 51.3% of the revenue generated by the sale of pigs. The figures also point to the low popularity of the practice on properties with an area of more than 500 hectares, which may explain the low competitiveness of the activity compared to other more profitable practices. It is worth noting that agricultural establishments with areas between zero and 10 hectares had a low share of the total, compared to other strata of area. This can be explained by the fact that these establishments are located in the north and northeast, far from the industrial centers in the south of the country.

According to the annual report of the Brazilian Animal Protein Association (ABPA), Brazil produced around three million tons of pork in 2019, generating approximately one and a half billion dollars in revenue. Curiously, Brazil's pork consumption is incompatible with its position as a producer, with only 13% of annual per capita consumption going to this protein, an extremely low figure compared to other countries such as Vietnam, China and Germany, which consume up to 60% of this protein (GASTARDELO; MELZ, 2014).

Given these figures, there is a constant variation in the commercial price of this protein by region in Brazil. The table below shows an average between the number of heads sold and the amount paid, subdivided into regional strata.

Table 4 – Average price paid for pigs in Brazil and the different regions of the country.

	Number of pigs sold in rural establishments	Value of pig sales in rural establishments (Thousand Reais)	Average price paid	
North	668.940	167.135	R\$	4,00
Northeast	2.617.392	708.619	R\$	3,69
Sputheast	10.445.262	2.971.120	R\$	3,52
South	42.362.907	5.843.909	R\$	7,25
Center West	10.895.583	1.811.113	R\$	6,02
Brazil	66.990.084	11.501.896	R\$	5,82

Source: Prepared by the authors based on IBGE (2019).

It can be seen that the northern and northeastern regions of the country sell fewer animals, and consequently generate less revenue than the other regions, reinforcing the prerogative that in these places the practice of pig farming is carried out largely for self-consumption. It is worth noting that the Southeast, which has a smaller number of animals, raised a substantial amount of money compared to the Midwest. Finally, the South has the highest average payment per animal in the country at R\$7.25, and is responsible for 63% of the number of pigs sold in agricultural establishments and 50% of the value of pigs sold in agricultural establishments.

The pork agro-industrial production chain is structured through a set of articulated and sequential processes, subdivided into three macro segments: primary material production, industrialization and marketing. Categorized as a commodity, coming from an agro-industrial chain, pork has its final price directly influenced by other production chains, especially in the first segment, in which the animal goes through the fattening process, with emphasis on the composition of the feed, based on corn, soybean meal, meat meal, wheat bran, mineral and vitamin compounds. According to Fávero (2003), corn alone can account for up to 40% of the cost of producing live pigs, and added to the other inputs, the diet can account for 70 to 80% of the cost of production. The same is found by Portes et al. (2019) in their analysis of the costs of the pig production chain in southern Brazil, especially when demonstrating that variations in the prices of soybean meal and corn significantly influence the activity.

The breeding process branches out and can be conducted in up to four types of farms: full cycle farms (CC), piglet production units (UPL), finishing units (UT) and certified pig breeding farms (GRSC) where the process is certified and monitored in order to maintain a quality standard and contain the spread of diseases in the national herd, with the final product of this stage going to slaughterhouses or meatpackers (MENEGUETTI, 2000; MIELE; WAQUIL, 2006; ROCHA, 2006).

The second link in the chain is slaughter and processing by meatpacking plants. According to Melz et al. (2012), from this stage onwards, the extent to which the meat can be marketed depends directly on the inspection level of the slaughterhouse, classified into three categories: federal inspection system (SIF), state inspection system (SIE) and municipal inspection system (SIM), from which pork can only be exported if it is slaughtered in a slaughterhouse with federal slaughter quality certification (SIF). The final stage is distribution and marketing, carried out by commercial centers whose responsibility it is to intermediate the sale to the final recipient.

However, it should be pointed out that the pig production chain, like any other, has its problems, whether it's exploitative contracts between companies that integrate producers, the bureaucracy involved in certifying slaughter and processing facilities, or even the poor infrastructure of the country's road network. Bedin (2013) criticizes the way in which value is added to production. The author mentions that producers issue invoices at cost price to their distributors, who live in port municipalities. The bill is then issued at the sale price, withholding part of the revenue for the place where the transport will take place, excluding the municipality of origin, withholding the revenue generated by the activity carried out there, hindering its development. The author cites BRF as an example, which has registered two large meatpacking plants in two cities in Santa Catarina - Concórdia and Herval d'Oeste - both of which are non-exporting locations.

Corroborating this analysis, in the last Agricultural Census (IBGE, 2019), 1,471,270 rural establishments with pigs were tabulated, of which 67.12% reported not selling animals, which indicates production for self-consumption and informal trade. In this sense, the intrinsic relationship between family pig farming and cooperatives and trade associations

can offer benefits to producers, as it allows them to be more competitive in the market and in the purchase of inputs, for example. Table 5 shows the total number of agricultural establishments tabulated, the number of members or non-members of trade associations, expressed in absolute numbers and percentages.

Table 5 – Number of rural establishments, whether or not associated with cooperatives and/or class entities, expressed in absolute number and percentage.

Brazil and Major Regions	Association of the producer to the cooperative and/or class entity						
	Total	Associated	%	Not associated	%	Cooperative	%
North	580.613	489.567	84%	91.046	16%	20.309	4%
Northeast	2.322.719	1.965.202	85%	357.517	15%	33.592	2%
Southeast	969.415	766.795	79%	202.620	21%	165.630	22%
South	853.314	631.285	74%	222.029	26%	313.763	50%
Center West	347.263	288.960	83%	58.303	17%	46.144	16%
Brazil	5.073.324	4.432.970	82%	931.515	18%	579.438	14%

Source: Prepared by the authors based on IBGE (2019).

The data demonstrates a significant relationship between rural areas and social organization entities, whether among residents, trade unions, or associations. However, this engagement does not always translate into improvements in quality of life and productivity within these establishments, as exemplified by the pig farming production chain, where more than half of the producers operate solely for subsistence.

The role of cooperativism in agro-industrial production chains is undeniable; however, the percentage of members has proven low in regions far from processing and slaughter centers, reaching only 2% in the Northeast, where the highest rates of production for personal consumption occur. In contrast, the South stands out, with the number of cooperative members reaching 50%, reflecting the integration between producers and industries in the sector.

According to Hickmann (2014), it is essential to identify the weakest links in the production chain to find its main obstacles and bottlenecks, aiming to develop this chain and, consequently, improve the living conditions of rural producers. The author emphasizes the role of public and private actions to enhance competitiveness in light of the changes that have occurred in recent years. This distinct scenario among the country's regions is directly related to the organization that coordinates the markets. While cooperatives dominate the agricultural market in the South, food industries take precedence in other regions of Brazil, as seen in the production chain in the state of Goiás (PEIXINHO; SILVA; SOUZA, 2021).

It is important to consider that the data analyzed regarding the pig farming chain in this article has undergone significant changes in recent years, mainly due to two factors. The first is the rapid spread of African swine fever (ASF), which impacted China and spread across the Asian continent. The second is the COVID-19 pandemic, which affected global agro-food markets.

The ASF significantly influenced the number of agricultural establishments with pigs, particularly driven by agricultural cooperatives and food industries, leading to growth in this activity within integrated systems. For instance, the number of breeding sows in Paraná, the largest producer in the country, increased by 4.5% from 2018 to 2020 (IBGE, 2020). At that time, the scenario was prosperous for the activity, attracting family producers who adopted it through financing, encouraged by a booming Chinese and Asian market and the need to meet growing demand driven by the culling of animals to control ASF. However, little was discussed or warned to producers that this market would have a limited duration, given that the sanitary void would eventually end and animal populations would be replenished in those countries.

In addition to the expected production recovery, the temporary closure of some international markets due to the pandemic, combined with uncontrolled exports of Brazilian corn and the subsequent rise in domestic corn prices, has placed the Brazilian pig farming market in a period of unpredictable and underestimated risks. However, these risks primarily threaten one particular link in this chain—not cooperatives or industries, but mainly rural producers, who have loans to repay based on projections in a scenario of increased prices for animal deliveries, which have not materialized in the general context.

Integrated family farming, which is part of many of these productive contexts, presents its own benefits and challenges. Among the positive aspects is the opportunity for income and employment for the family unit, especially in an agro-food market showing signs of increased global consumption of this protein (Matte et al., 2024). However, challenges such as dependence on centralized decision-making, the requirement for adopting new technologies in production systems, the need for investment from producers, low bargaining power among farmers, lack of control over the price of the final

product, promotion of monocultures, and economic and social pressures on producers can further exacerbate this situation. It is crucial that public policies and industry initiatives take these vulnerabilities into account, providing adequate support to balance this relationship (PAULILO, 1990).

These additional elements, briefly explored, deserve attention in research on the market and production of pig farming. In particular, we emphasize the importance of focusing on rural producers and their strategies in light of the recovery of production in Asia, as well as what the industry will do to support this activity.

4. Finals considerations

The results show the diverse distribution of pig farming in Brazil. It can be seen that the largest number of establishments raising pigs is located in the Northeast, while the South is responsible for the largest production, since the production system of this chain in the region is based on integration with industries and cooperatives, while in the Northeast it is based on self-consumption.

It is hoped that this work will contribute to researchers and those interested in studies related to pig farming, insofar as it provides a brief overview of the distribution of this activity in the country and potential locations for promoting it. The pig industry has experienced significant growth in recent years, evidenced by the increase in the concentration of production and the growing international demand for the protein.

Given the country's vast territorial area, there is room for different production systems. However, the scenario illustrated here reinforces the need for studies to consider alternative or traditional food sources for this activity, since the main component of these animals' diet is corn, whose production is directly related to climatic conditions. There is potential to explore markets for pork products other than the conventional one, since self-consumption is very present in the country's rural areas.

In this sense, both the state and the private sector have a responsibility to develop public policies and actions that can mitigate the fragility of the integrated production system. It is essential that these initiatives seek to balance economic interests with strengthening farmers' autonomy, promoting greater resilience and sustainability in the sector.

Acknowledgments

We would like to thank the National Council for Scientific and Technological Development - CNPq, Process No. 423392/2021-2, for funding this research.

References

- ASSOCIAÇÃO BRASILEIRA DE PROTEÍNA ANIMAL – ABPA. *Relatório Anual 2020*. São Paulo: ABPA, 2020.
- BARROS, J.B. *Caracterização da cadeia produtiva de suínos no Estado de Goiás*. 2021. Dissertação (mestrado) - Universidade Federal de Santa Catarina, Centro Tecnológico, Programa de Pós-Graduação em Engenharia de Produção, Florianópolis, 2021. URI: <https://repositorio.ufsc.br/handle/123456789/229215>
- BATALHA, M. O.; SILVA, A. L. Gerenciamento de sistemas agroindustriais: definições, especificidades e correntes metodológicas. In: BATALHA, M. O. (Ed.). *Gestão Agroindustrial*: GEPAI: Grupo de estudos e pesquisas agroindustriais. v. 1. 3 ed. São Paulo: Atlas, 2007. p. 1-62.
- BEDIN, M. *Dejetos para o oeste, riqueza para Itajaí*. Suinocultura Industrial, Publicado em 10 de dezembro de 2013. Disponível em: <https://www.suinoculturaiindustrial.com.br/imprensa/dejetos-para-o-oeste-riqueza-para-itajai-por-marcos-bedin/20131210-085341-p360>
- BRASIL. Casa Civil. *Lei Nº 11.326, de 24 de julho de 2006*. Estabelece as diretrizes para a formulação da Política Nacional da Agricultura Familiar e Empreendimentos Familiares Rurais. Brasília, 2006. URL: http://www.planalto.gov.br/ccivil_03/_ato2004-2006/2006/lei/111326.htm
- CERDAN, C. From Agro-industrial Specialisation to a Plurality of Models in Southern Brazil. In: Gasselin, P. et al. (eds) *Coexistence and Confrontation of Agricultural and Food Models*. Springer, Dordrecht, 2023. https://doi.org/10.1007/978-94-024-2178-1_1

- CHAU, LTM; LEBAILLY, P; TRUNG, TQ. Enhancing farmers' market power and income in the pig value chain; a case study in Bac Giang province, Vietnam. *Livestock Research for Rural Development*, v. 29, n. 12, 2017. URL: <http://www.lrrd.org/lrrd29/12/ltrmc29221.html>
- DE PAULA, G.; PEROSA, J. M. Y.; RECHZIEGEL, W.; BUENO, O. DE C. Suinocultores da agricultura familiar do município de Marechal Cândido Rondon (PR). *Revista ADMPG*, v. 4, n. 2, 17 jul. 2019. URL: <http://admpg.com.br/revista2011/v2/artigos/artigo%20%20suinocultores%20da%20agricultura.pdf>
- DENTZ; E.V.; ESPÍNDOLA, C.J. Dinâmica produtiva da pecuária na mesorregião oeste catarinense: especialização e diversificação da produção no período de 2000 a 2017. *GEOSUL*, v. 34, n. 71, 2019. DOI: <https://doi.org/10.5007/1982-5153.2019v34n71p175>
- DIAS, E.F. et al. Macauba (*Acrocomia aculeata*) pulp meal as alternative raw material for growing-pigs. *Livestock Science*, v 252, October 2021. DOI: <https://doi.org/10.1016/j.livsci.2021.104675>
- FAOSTAT. *Countries by commodity*. Rankings, meat pork. FAO, 2019.
- FÁVERO, J. A. (Org.). *Sistemas de produção: Produção Suínos*. Brasília: Embrapa Suínos e Aves, 2003.
- GASTARDELO, T.A.R.; MELZ, L.J. A suinocultura industrial no mundo e no brasil worldwide and brazilian swine breeding. *Revista UNEMAT de Contabilidade*, Cáceres, MT, v. 3, n. 6, Jul./Dez. 2014. DOI: <https://doi.org/10.30681/ruc.v3i6.266>
- HERNÁNDEZ SAMPIERI, R. et al. *Metodologia de pesquisa*. Porto Alegre: Penso, 2013.
- HICKMANN, Felipe Mathias Weber. Perfil, desempenho e perspectivas de propriedades suinícolas do município de Mato Leitão-RS. 2014. In: Salão de Iniciação Científica da UFRGS, 26., 2014, *Anais...*, Porto Alegre: UFRGS, out. 2014. URL: <https://lume.ufrgs.br/handle/10183/112764?locale-attribute=en>
- INSTITUTO BRASILEIRO DE GEOGRAFIA E ESTATÍSTICA – IBGE. *Censo Agropecuário 2017*. Rio de Janeiro: IBGE, 2019.
- INSTITUTO BRASILEIRO DE GEOGRAFIA E ESTATÍSTICA – IBGE. *Censo Agropecuário 2006*. Rio de Janeiro: IBGE, 2009.
- INSTITUTO BRASILEIRO DE GEOGRAFIA E ESTATÍSTICA – IBGE. *Pesquisa da Pecuária Municipal – PPM*. Tabela do efetivo dos rebanhos, por tipo de rebanho, segundo a Unidade da Federação, suas Mesorregiões, Microrregiões e Municípios: Grandes Regiões e as Unidades da Federação. Rio de Janeiro: IBGE, 2020. Disponível em: <https://www.ibge.gov.br/estatisticas/economicas/agricultura-e-pecuaria/9107-producao-da-pecuaria-municipal.html?edicao=25474&t=resultados>. Acesso em 8 jun. 2022.
- LOPES, A. A. et al. O desenvolvimento da suinocultura na Região do Médio Alto Uruguai do estado do Rio Grande do Sul. *Ver. Livre Sust. Emp.*, v. 4, n. 5, p. 122-139, set./out. 2019
- MATTE, A., et al. Mudanças alimentares no consumo de proteína animal durante a pandemia de Covid-19 na Região Sul Brasil. *Redes*, v. 29, n. 1, 2024. <https://doi.org/10.17058/redes.v29i1.17909>
- MIELE, M. et al. O desenvolvimento da suinocultura brasileira nos últimos 35 anos. In: SOUZA, J. C. P. V. B. et al. (Ed.). *Sonho, desafio e tecnologia: 35 anos de contribuições da Embrapa Suínos e Aves*. Concórdia: Embrapa Suínos e Aves, 2011. p. 85-102. URL: <https://www.embrapa.br/busca-de-publicacoes/-/publicacao/907870/o-desenvolvimento-da-suinocultura-brasileira-nos-ultimos-35-anos>
- MIELE, M.; WAQUIL, P. D. Estrutura e Dinâmica dos Contratos na Suinocultura de Santa Catarina: Um Estudo de Casos Múltiplos. *Est. Econo.*, SP, v. 37, n. 4, p. 817-847, out. 2007. DOI: <https://doi.org/10.1590/S0101-41612007000400005>

- MIOR, L. C. Agricultura Familiar, agroindústrias e desenvolvimento territorial. In: VIERA, P. F. et al. (Org.). *Desenvolvimento Territorial no Brasil: subsídios para uma política de fomento*. Florianópolis: APED, 2010. p. 235-258.
- OUMA, E. et al. Characterization of smallholder pig production systems in Uganda: constraints and opportunities for engaging with market systems. *Livestock Research for Rural Development*, 26 (3), 2014. URL: <http://www.lrrd.org/lrrd26/3/ouma26056.htm>
- PAULILO, M.I.S. *Produtor e agroindústria: consensos e dissensos: o caso de Santa Catarina*. Editora da UFSC, 1990.
- PLOEG, J. D. *Camponeses e a arte da agricultura*. Porto Alegre: Editora da UFRGS, 2016.
- POLÊSE, M. *Economia Regional e Urbana: a lógica espacial das transformações econômicas*. Coimbra: APDR, 1998.
- PORTES, J.V. et al. Análise dos custos da cadeia produtiva de suínos no Sul do Brasil. *Custos e @gronegocio*, v. 15, Edição Especial, p. 18-41, Abr 2019. Link: <http://www.custoseagronegocioonline.com.br/especialv15/OK%20%20cadeia.pdf>
- PRESTON, T.R. Reducing the carbon foot print of pig production in the tropics with local feed and breed resources. *Livestock Research for Rural Development*, 34 (1), 2022. URL: <https://lrrd.cipav.org.co/lrrd34/1/3401Prest.html>
- SCHNEIDER, S. Situando o desenvolvimento rural no Brasil: o contexto e as questões em debate. *Revista de Economia Política*, São Paulo, v. 30, n. 3, jul./set. 2010. DOI: <https://doi.org/10.1590/S0101-31572010000300009>
- VEDANA, R; MORAES, M.L. Agricultura familiar na região sudoeste do Paraná: caracterização a partir dos dados do censo agropecuário de 2006. *Braz. J. of Develop.*, Curitiba, v. 4, n. 5, Edição Especial, p. 2408-2432, ago. 2018. URL: <https://brazilianjournals.com/index.php/BRJD/article/view/261>
- PEIXINHO, D.M.; SILVA, W.F.; SOUZA, M.S. Panorama atual da cadeia carne-grãos da avicultura e da suinocultura em Goiás. In: BERNARDES, J.A. *O setor carne-grãos no Centro-oeste: circuitos produtivos, dinâmicas territoriais e contradições*. Rio de Janeiro: Lamparina, 2021. p. 65-94.