Tecnologia e produtividade, as cadeias produtivas brasileiras

Technology and productivity in Brazilian production chains

Wilson de Jesus Beserra de Almeida*
wilson.almeida@unialfa.com.br

Angelita Mendes Moreira Ramos *
wilson.almeida@unialfa.com.br

Antonio Hsiang **
wilson.almeida@unialfa.com.br

Centro Universitário Alves Faria, Goiânia, Brasil
Chihlee University of Technology of Taiwan, New Taipei, Taiwan

Resumo

A cadeia produtiva do leite é uma das mais importantes e complexas do agronegócio brasileiro. Este estudo foi desenvolvido com o objetivo de analisar a estrutura e a evolução da produção primária da cadeia leiteira no Brasil. A análise foi realizada contemplando o período compreendido entre os anos 2000 e 2020, tendo como base as informações disponibilizadas pelos órgãos oficiais (federal e estadual), especialmente através da Pesquisa da Pecuária Municipal (PPM/IBGE). No cenário nacional os dados mostram aumentos significativos de produção e produtividade com redução do efetivo de animais. O Brasil é o terceiro maior produtor mundial de leite de vaca, atingindo a marca de 30,1 bilhões de litros de leite em 2020. O estado de Minas Gerais lidera a produção nacional de leite, seguido pelo Rio Grande do Sul e Paraná.Quanto mais desenvolvida tecnologicamente a região maior é a produção e produtividade da cadeia de leite, isto ocorre provavelmente em muitas cadeias de produção.

Palavras-chave: setor produtivo primário, produtividade, novas tecnologias.

Abstract

The milk production chain is one of the most important and complex in Brazilian agribusiness. This study was developed with the objective of analyzing the structure and evolution of the primary production of the dairy chain in Brazil. The analysis was carried out covering the period between 2000 and 2020, based on information provided by official agencies (federal and state), especially through the Municipal Livestock Survey (PPM/IBGE). In the national scenario, the data show significant increases in production and productivity with a reduction in the number of animals. Brazil is the third largest producer of cow's milk in the world, reaching the mark of 30.1 billion liters of milk in 2020. The state of Minas Gerais leads the national production of milk, followed by Rio Grande do Sul and Paraná. The more technologically developed the region, the greater the production and productivity of the milk chain, this probably occurs in many production chains.

1. Introduction

Milk is one of the most important agricultural products globally, being among the five most traded products, both in volume and in value . It is consumed daily, in its most diverse forms, by billions of people. As a complex food that contains high concentrations of macro and micronutrients, milk is important for human nutrition and development.

Dairy farming plays a significant role in world economic development. According to the *Food and Agriculture Organization* (FAO), due to its geographical conditions, Brazil has great potential to consolidate its leadership in food production, increasingly meeting the growing food demand of the population. In order to meet this growing and demanding demand, it is necessary to increase production in a sustainable way, with an increase in productivity and competitiveness indices (FAO, 2019; VILELA, 2016).

The milk production chain is one of the most complex and has great socioeconomic relevance in the national and regional scenario, generating employment and income for the numerous agents involved in the process. Present in almost all Brazilian municipalities, dairy production involves about 1.2 million producers and 3.5 million people, being an important instrument for fixing people in the countryside. The structure of milk production in Brazil presents diversity and great heterogeneity in terms of technology, productivity, quality, costs, production scale and management capacity (VIEIRA FILHO AND FISHLOW, 2017; GASQUES et. al, 2019).

The global dairy sector has undergone important structural, economic, environmental and social changes in recent decades. The search for specialization caused growth in milk production and gains in quality and productivity for this sector. On the other hand, it caused a reduction in the number of producers, since the industries began to demand the supply of high quality products.

The main transformations that took place in the milk production chain took place from the 1990s onwards, with the end of price-fixing, less State intervention, commercial opening, technification of production and installations of large industries. Other important driving forces behind these changes occurred from the reorganization of the logistics system with bulk collection, environmental legislation, chain management practices such as the strengthening of retail chains, the increase in the quality requirements of raw materials and products, the growth in demand due to the increase in income, the greater competition for production factors in traditional and frontier areas of milk due to the advance of scale agriculture and social policies to support micro and small producers (LEITE E ZOCCAL, 2016).

The search for greater competitiveness has led the milk production chain to invest in improving milk quality and in the professionalization of the sector, incorporating new technologies such as: genetic improvement; automation of the milking process; animal nutrition; improvement of herd health and management techniques; and more recently reproductive biotechnologies and the use of artificial intelligence.

According to the Institute of Geography and Statistics (IBGE, 2021), milk production in Brazil grew from 14.5 billion in 1990 to 35.4 billion in 2020, a percentage increase of 144%. In the same period, there was a 15.2% drop in the number of milked cows and an increase in productivity of 759

(liters/cow/year), raising the national average to 2,192 (liters/cow/year). These numbers demonstrate that Brazil follows the world trend of decreasing producers, increasing the scale of production, reducing the dairy herd and increasing animal productivity.

Brazil is the third largest producer of cow's milk in the world, after the United States and India (FAO, 2021). Despite the growth in production, the implementation of new technologies and the specialization of a large number of milk producers, Brazil has a trade deficit. Most of the Brazilian milk production is destined for the domestic market, not presenting great representation in the international market.

According to the Municipal Livestock Survey (IBGE, 2021), the South and Southeast regions together accounted for 68.4% of the milk produced in 2020. The six Brazilian states with the highest production volume were responsible for 73% of the milk volume. Minas Gerais (27.3%) is the largest producer in the country, in second place, Paraná (13.1%), followed by Rio Grande do Sul (12.1%), Goiás (9%), Santa Catarina (8.9%) and São Paulo (4.6%).

The state of Goiás has the second largest herd of milked cows in the country, with approximately 1.9 billion heads, only behind Minas Gerais. Milk production is developed throughout the territory of Goiás, covering its 246 municipalities in a heterogeneous way. In 2020, the production of cow's milk was 3.2 billion liters, keeping the state in fourth position in the national ranking.

The dairy activity is carried out by 72,353 producers, with an average productivity of 1,702 liters/cow/year, far below the first three in the Brazilian ranking: Minas Gerais, Paraná and Rio Grande do Sul, with productivity of 3,105 liters/cow/year, 3,490 liters/cow/year and 3,695 liters/cow/year, respectively. According to the 2017 Agricultural Census, the primary productive sector comprises 59.1% of agricultural establishments in the strata with up to 50 heads; 29.5% in strata from 51 to 200 heads; 9.7% from 201 to 500 heads (IBGE, 2021; SEAGRO, 2021).

Despite the economic and social importance, the scenario of the milk production chain in Goiás is challenging, as it has been showing a declining production. In the period 2015-2020, the state showed a drop of 6.4% in milk production. In this context, this study aims to understand the milk production chain in Goiás, identifying, above all, the structure and evolution of primary milk production in the state.

In order to carry out this work, data were gathered and analyzed, aiming at a recent contextualization of the milk production chain in Brazil and especially in the state of Goiás. in the Municipal Livestock Survey (PPM), Quarterly Milk Survey and Agricultural Censuses; Milk Intelligence Center (CILeite) of EmbrapaGado de Leite; Food and Agriculture Organization of the United Nations (FAO); Ministry of Development, Industry and Foreign Trade (MDIC); Ministry of Agriculture, Livestock and Supply (MAPA); Mauro Borges Institute of Statistics and Socioeconomic Studies (IMB); and Secretary of State for Agriculture, Livestock and Supply (SEAPA).

2. The milk production chain in the international scenario

World milk production has been growing in recent decades, with a decrease in herds and an increase in productivity. In developed countries, dairy production tends to come from confined systems and with great incentives and subsidies to production (SORIO, 2018).

According to the Food and Agriculture Organization of the United Nations (FAO, 2019), the largest producers of cow's milk produced approximately 60% of the world's total milk. The United States occupies the first place in the world ranking, with a production of 98.7 million tons, representing 14.5% of global production, it also has the highest productivity per cow. Brazil is the third largest producer in the world, with a production volume of 33.8 billion liters of milk, obtained from a herd of 16.4 million milked cows, resulting in a productivity of 2,069 liters/cow/year. Table 1 presents the production of cow's milk, the number of milked cows and the productivity of the main producing countries.

Considering animal productivity as an indicator of the development of dairy activity, estimated in kilograms per cow/year, North Americans have the best dairy productivity in the world, with 10,463 kg/cow/year. United Kingdom, Germany and France show productivity above 7,000 kg/cow/year. The average productivity rate in Brazil has been showing steady growth over the years. The growth, in the period 2016-2018, was 20%, but still below the world average of 2,574 kg/cow/year.

Table 1: Milk production, milked cows and productivity among the world's top producers, 2016 to 2018

countries	Production (tons)			Flock (heads)			Productivity (kg/head)		
	2016	**2017**	**2018**	**2016**	**2017**	**2018**	**2016**	**2017**	**2018**
United States	96,366,267	97,761,519	98,690,477	9,312,400	9,368,500	9,432,100	10,348	10,435	10,463
India	78,098,880	83,633,570	89,833,590	49,128,270	50,905,190	52,841,810	1,590	1,643	1,700
Brazil *	**33,680,401**	**33,312,149**	**33,839,864**	**19,559,095**	**16,851,782**	**16,357,485**	**1,722**	**1977**	**2,069**
Germany	32,672,340	32,598,198	33,064,833	4,217,700	4,199,010	4,100,863	7,746	7,763	8,063
Russia	29,528,984	29,867,213	30,345,525	7,199,922	7,043,569	6,726,438	4,101	4,240	4,511
China	31,018,548	30,772,422	31,165,090	12,717,879	12,014,621	5,574,969	2,439	2,561	5,590
France	25,627,060	25,539,489	25,541,269	3,637,015	3,596,837	3,552,436	7,046	7,101	7,190
New Zealand	21,671,520	21,372,000	21,392,000	5,202,467	5,043,813	5,010,334	4,166	4,237	4,270
Turkey	16,786,263	18,762,319	20,036,877	5,431,714	5,969,046	6,377,907	3,090	3,143	3,142
Pakistan	15,529,000	16,115,000	16,722,000	12,625,000	13,101,000	13,595,000	1,230	1,230	1,230
United Kingdom	14,662,000	15,267,000	15,311,000	1,897,000	1,897,000	1,881,000	7,729	8,048	8,140
SUBTOTAL	**395,641,263**	**405,000,879**	**415,942,525**	**130,928,462**	**129,990,368**	**125,450,342**	**3,022**	**3,116**	**3,316**
Too much	269,955,273	272,669,806	266,079,991	145,645,383	145,394,116	139,507,988	1,854	1,875	1,907
TOTAL	**665,596,536**	**677,670,685**	**682,022,516**	**276,573,845**	**275,384,484**	**264,958,330**	**2,407**	**2,461**	**2,574**

Source: FAO / *IBGE - Municipal Livestock Research
Elaboration: Intelactus/Embrapa Milk Cattle

World milk production (81% cow's milk, 15% buffalo milk and 4% goat, sheep and camel milk combined) was approximately 906 million tonnes in 2020, up 2% from 2019, driven by by growth in all geographic regions except Africa, where production remained stable. The increase was greatest in Asia, followed by Europe, Oceania and Central America and the Caribbean (FAO, 2021).

In India, milk production reached 195 million tonnes, supported by continued growth in dairy herds, increased feed availability and improved pastures. In China, increased production on large-scale dairy farms and improved operational efficiency drove 7% growth in milk production. In Pakistan, the volume of milk grew by 3.2%, mainly due to the increase in herds. International dairy trade grew by 1.2%, driven mainly by increased imports from China (FAO, 2021).

Brazil, despite appearing in the first positions in the world ranking of milk production and presenting one of the largest herds of milked cows, when it comes to animal productivity, occupies the 84th position. Brazilian productivity is five times lower than that of the United States and Israel, the first in the world, countries that exceed 10,000 liters/cow/year (FAO, 2019). This result demonstrates that Brazil has high production, however, it has low production efficiency.

Worldwide, more than 600 million people live on dairy farms, with only 0.3% of farms having more than 100 cows, which demonstrates the importance of the activity for family and subsistence agriculture. Demand has grown mainly due to the increase in population and increase in per capita consumption, related to the improvement in income in emerging countries. Exports of dairy products are highly concentrated in the European Union, the United States and New Zealand, which supply 69% of the international market and have been increasing their share over the last few years. China, Germany, France, the Netherlands and Russia are some of the world's leading dairy importers (SÓRIO, 2018).

3. Characteristics of milk production in Brazil

The dairy activity in Brazil evolves continuously, following the world trend, which is of consistent growth in production and productivity, with a reduction in the number of dairy farms and an increase in the number of animals in the production systems.

According to the Municipal Livestock Survey (IBGE, 2021), in the last two decades, Brazilian milk production has increased 1.8 times, from 19.77 billion liters in 2000 to 35.45 billion in 2020, the highest production registered with an increase of 1.5% compared to 2019. After a decline in the period 2015-2017, production began to grow again from 2018. The herd of milked cows decreased by 9.6% in the period between the year 2000 and 2020, reaching 16.2 million heads. Productivity showed a continuous evolution, from 1,105 liters/cow/year in 2000 to 2,192 liters/cow/year in 2020, a variation of 98.4% in the period, as shown in Table 2.

Table 2: Milk production, herd of milked cows and animal productivity in Brazil

	2000	2005	2010	2015	2016	2017	2018	2019	2020

milk production (billions of liters)	19.77	24.62	30.72	34.61	33.68	33.31	33.91	34.92	35.45
milked cows (millions of heads)	17.89	20.63	22.93	21.11	19.56	16.85	16.35	16.31	16.17
Productivity (liters/cow/year)	1,105	1,194	1,340	1,639	1,722	1977	2,074	2,142	2,192

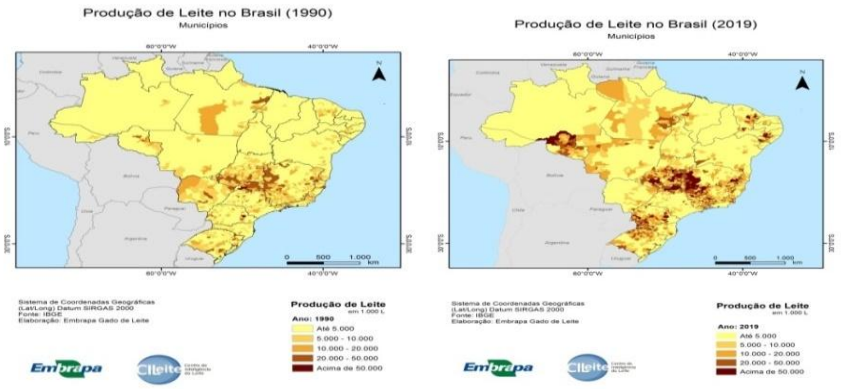
Source: IBGE - Municipal Livestock Survey, prepared by the authors

Productivity has grown continuously, although the pace has slowed in recent years, demonstrating the continuous technological progress of the Brazilian dairy sector. Productivity growth illustrates an intensification in production systems, genetic improvement, associated with advances in the management and management of the activity.

According to projections from 2020/21 to 2030/31, carried out by the Ministry of Agriculture, Livestock and Supply - MAPA, milk production in Brazil is expected to grow at an annual rate between 1.9% and 3.1%. The growth in production and supply will be mainly based on improvements in the management of dairy farms and increased animal productivity (BRASIL, 2021).

The Brazilian milk production is distributed throughout the country, observing aspects of grouping. The occurrence of *clusters* can provide subsidies for the adequate planning of actions and the formulation of public policies aimed at the development of the entire production chain. According to the map presented in Figure 1, it is possible to verify the concentration and evolution of milk production over the last three decades.

Figure 1 : Map of geographic distribution and density of milk production in Brazil, in 1990 and 2019.



Source: Embrapa Milk Cattle

The milk production chain is distributed throughout Brazil, however, with marked differences between the producing regions. Of the 35.45 billion liters of milk produced in 2020, the Southeast region, with a share of 34.3% and an increase of 1.9% over the previous year, led the national production of cow's milk for the second consecutive year. The Midwest showed a drop of 10.3% in the volume

produced in the period 2015-2020. The largest growth was in the Northeast region, with a 25% increase in production (Table 3).

Table 3 : Cow's milk production in Brazilian regions, 2015 to 2020

Region	annual milk production (billions of liters)						Var. (%) 2020-2015	Var. (%) 2020-2019
	2015	2016	2017	2018	2019	2020		
North	1.83	1.88	2.18	2.29	2.24	2.13	16.1%	-4.9%
North East	3.96	3.88	3.98	4.49	4.85	4.94	25.0%	1.9%
Midwest	4.60	3.97	3.97	4.09	4.14	4.13	-10.3%	-0.2%
Southeast	11.90	11.50	11.40	11.45	11.95	12.17	2.3%	1.9%
South	12.32	12.45	11.78	11.60	11.74	12.07	-2.1%	2.8%
Brazil	**34.61**	**33.68**	**33.31**	**33.91**	**34.92**	**35.45**	**2.4%**	**1.5%**

Source: IBGE - Municipal Livestock Survey, prepared by the authors

The South region ranked second, accounting for 34% of the total, producing 12.1 billion liters of milk. The Northeast Region was in third place, with a growth of 1.9% in its production, totaling 4.9 billion liters of milk. Milk production in Brazil is concentrated in the South and Southeast regions, which together accounted for 68.4% of the milk produced in 2020.

Table 4 shows milk production and productivity in Brazil in 2019 and 2020. Minas Gerais continues to occupy the first place in the ranking, with 27.3% of national production, followed by the states of Paraná (13.1%), Rio Grande do Sul (12.1%), Goiás (9%), Santa Catarina (8.9%) and São Paulo (4.6%). In absolute terms, the biggest increase in production occurred in Paraná, with an additional 289 million liters compared to 2019.

Table 4 : Milk production and productivity in the main producing states - 2019 and 2020

States	milk production (millions of liters)			Productivity (liters/cow/year)		
	2019	2020	Variation	2019	2020	Var. (%)
Minas Gerais	9,448	9,692	2.6%	3,012	3,105	3.1%
Paraná	4,350	4,639	6.6%	3,320	3,490	5.1%
Rio Grande do Sul	4,349	4,290	-1.4%	3,619	3,695	2.1%
Goiás	3,165	3,189	0.8%	1,683	1,702	1.1%
Santa Catarina	3,040	3,137	3.2%	3,817	3,716	-2.6%
São Paulo	1,653	1,645	-0.5%	1,606	1,630	1.5%

Source: IBGE - Municipal Livestock Survey, prepared by the authors

All states in the South region had a productivity above 3,400 liters/cow/year. In the national ranking, Santa Catarina, with 3,716 liters/cow/year, appears in first place, followed by Rio Grande do Sul (3,695), Paraná (3,490) and Minas Gerais (3,105). The states of Goiás and São Paulo, despite the increase in recent years, show productivity below the national average of 2,192 liters/cow/year. The

biggest increase in productivity occurred in Paraná, with a significant 170 liters per cow/year and a percentage change of 5.1% in the 2019-2020 period.

The main factors that explain the growth in milk productivity in recent decades were: (a) technological changes in the sector, with an increase in the productivity of production factors due to the adoption of new technologies; (b) reduction in the number of producers, with a concentration on large producers, who take advantage of demand opportunities for those who produce a greater volume of milk, with superior quality; (c) search for animals of superior generic value, with specialized herds for milk production; and (d) greater demand in relation to milk quality and food safety, leading producers to improve management and technical efficiency .

The Brazilian production of milk under inspection (municipal, state or federal) acquired by dairies has shown steady growth over the last two decades. It grew by an average of 5.3% per year, from 12.1 billion liters in 2000 to 25.5 billion liters in 2020. While total milk production increased by 79.3% in the period between 2001 and 2020, inspected milk grew by 110.8%, causing a reduction in informality in the productive sector. At the beginning of the analyzed period (year 2000) informal milk represented 38.7% of total production, in 2020 this share dropped to 28%, an indication of professionalization and modernization of the entire milk production chain in Brazil. Table 5 shows the evolution of inspected milk production and the share of informal milk.

Table 5 :Total milk production, formal and informal production in Brazil from 1997 to 2008

Year	Total production (million liters)	Formal milk		Informal Milk	
		Production (million liters)	%	Production (million liters)	%
2000	19,767	12,108	61.3%	7,659	38.7%
2005	24,621	16,284	66.1%	8,337	33.9%
2010	30,715	20,976	68.3%	9,739	31.7%
2015	34,610	24,061	69.5%	10,549	30.5%
2020	35,445	25,525	72.0%	9,920	28.0%

Source: IBGE - Quarterly Milk Survey, and prepared by the authors

In the period between 2016 and 2020, the Northeast region showed the highest growth in inspected milk production (11.5%), while in the South (3.7%), Southeast (1.4%) and Midwest (1%) there was a less expressive increase. Production is even more concentrated in the South and Southeast regions, which together represent 77.1% of the milk inspected, following the total production, and showing the concentration of the largest dairy industries in the country. The Midwest with 12.2%, Northeast with 6.7% and North with 4% complete the volume of industrialized milk in Brazil, as shown in Table 6.

Table 6 : Milk production under inspection in Brazil, by regions and main producing states (in millions of liters)

States	2016	2017	2018	2019	2020	Var. (%) 2020/19	Var (%). yy 2016/2020	part (%) 2020
North	1,091	1,127	1,049	1,018	1,009	-0.9%	-1.9%	4.0%
North East	1,173	1,250	1,407	1,554	1,714	10.3%	11.5%	6.7%
Southeast	9,477	9,717	9,635	9,843	9,995	1.5%	1.4%	39.2%
South	8,432	9,119	9,204	9,324	9,682	3.8%	3.7%	37.9%
Midwest	2,995	3,121	3,164	3,266	3,116	-4.6%	1.0%	12.2%
Brazil	**23,170**	**24,334**	**24,458**	**25,012**	**25,526**	**2.1%**	**2.5%**	**100%**

Source: IBGE - Quarterly Milk Survey , prepared by the authors.

The six main Brazilian states in milk production were responsible for 84.1% of the volume of milk purchased by the dairy under inspection. In absolute values, the highest increase in formal production occurred in Minas Gerais, with an additional 224 million liters. Paraná (5.2%) presented the highest percentage growth in 2020, when compared to the previous year, followed by Santa Catarina (4.5%), while the states of Goiás (-5.2%) and São Paulo (- 2.1%) registered a decline in annual production (Table 7).

Table 7 : Milk production under inspection in the main producing states - 2019 and 2020

States	2019		2020		Var. (%) 2020-2019
	Production (million liters)	**%**	**Production** (million liters)	**%**	
Minas Gerais	6,285	25.1%	6,510	25.5%	3.6%
Paraná	3,308	13.2%	3,480	13.6%	5.2%
Rio Grande do Sul	3,255	13.0%	3,317	13.0%	1.9%
Santa Catarina	2,761	11.0%	2,884,	11.3%	4.5%
São Paulo	2,786	11.1%	2,728	10.7%	-2.1%
Goiás	2,636	10 ,5%	2,500	9.8%	-5.2%
Brazil	**25,012**		**25,526**		**2.1%**

Source: IBGE - Quarterly Milk Survey, prepared by the authors.

Dairy farming is practiced throughout the national territory, with producers at various organizational and technological levels, ranging from family farming, small cooperatives to properties with a high technological level. There is great heterogeneity in the productive sector, with variations: in the size of the enterprise; the type and level of intensification of the production system; in the producer's profile; in the productivity levels of production factors; in the form and structure of market and input access (VIANA and RINALD, 2010).

The dairy activity in Brazil has been undergoing profound transformations, with the departure of producers who are unable to maintain themselves in the activity increasingly common. Comparing the 2017 and 2006 Census data, the dynamics of the Brazilian milk production structure shows the

concentration of production on larger-scale properties and the reduction in the number of smaller-scale producers.

In the period 2006-2017, almost 180 thousand establishments left the dairy activity. This movement of producers leaving did not happen in a linear fashion. While more than 240 thousand establishments with production of less than 50 liters/day abandoned the dairy activity, establishments with production above 500 liters per day and between 200 and 500 liters per day significantly increased production, with growth of 166% and 79% respectively, according to data presented in Table 8.

Table 8 : Production strata and establishments with milk production in Brazil, 2006 and 2017

Stratum (L/day/establishment)	establishments		Variation 2017-2006	
	2006	2017	(No.)	(%)
less than 50	1,076,169	833,903	-242,266	-23%
From 50 to less than 200	230,639	250,639	20,000	9%
From 200 to less than 500	35,209	63,113	27,904	79%
above 500	8,792	23,411	14,619	166%
Total	**1,350,809**	**1,171,066**	**-179,743**	**-13%**

Source: IBGE – Agricultural Census 2006 and 2017, prepared by the authors

Information from Milkpoint (2021), in its survey of the 100 largest milk producers , showed that the average daily production of the Top 100 grew by 252.3% between the period from 2001 to 2020, reaching, in this last survey, a daily average of 23,057 liters , average annual growth of 12.6%. In the same period, total milk production grew 3.6% per year and the formal volume, 4.6% per year. These data are indicative of a movement towards productive concentration and scale gains, and technology has been essential for this increase in production .

4. Primary productive sector of the dairy chain of Goiás

Goiás is the seventh Brazilian state in territorial extension, located in the Center-West region of the country, occupying an area of 340,242,854 km², having a strategic geographic position. It is limited to the north with the state of Tocantins, to the south with Minas Gerais and Mato Grosso do Sul, to the east with Bahia and Minas Gerais and to the west with Mato Grosso. The state of Goiás has 246 municipalities and an estimated population of 7.2 million inhabitants (IBGE, 2021; IMB, 2021).

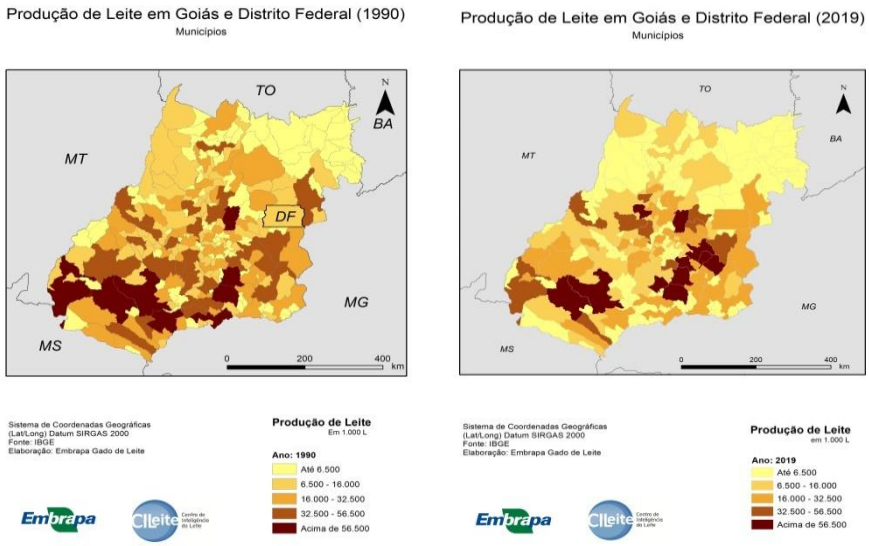
With a GDP of 208.7 billion, in 2019, and participating in 2.8% of the national GDP, the state of Goiás occupies the ninth place in the national ranking. Despite growing industrialization, agriculture remains one of the most important economic activities in the state, as it drives growth and exports. Goiás stands out in the national production, occupying the first place in the production of sorghum and tomato; second place in the production of sugarcane and sunflower; and the third in soybeans and corn. The

cattle herd is the second largest in the country with approximately 22.8 million head. Pig and poultry farming are also consolidated, mainly in Southwest Goiás(SEAGRO, 2021).

With a production of 3.2 billion liters of cow's milk, resulting from a herd of approximately 1.9 million milked cows, Goiás is the fourth state in the national ranking, behind only Minas Gerais, Paraná and Rio Grande do Sul. The South Goiano (45.2%) and Centro Goiano (32.6%) regions are responsible for 77.8% of the state's milk production.

Despite the economic and social importance, the scenario of the milk production chain in Goiás is challenging, as the activity has been showing a declining production, especially in recent years. The dairy activity is present in the 246 municipalities of Goiás and presents expressive numbers. There are approximately 72 thousand producers; 220 thousand direct and indirect jobs; GVP of R$ 4.9 billion and more than 2 billion liters of industrialized milk. Figure 2 shows milk production in the 1990s and 2019, showing the evolution and concentration of milk production in the state.

Figure 2 : Map of geographic distribution and density of milk production, by municipalities, in Goiás, 1990 and 2019



Source: Embrapa Milk Cattle

According to the Municipal Livestock Survey (PPM/IBGE) in the period from 2000 to 2020, milk production in Goiás grew by 2.16% per year, while national production grew by 3.78% per year. Considering only the period 2015-2020, the state fell by 6.4%, significantly contributing to the 10.3% decline in the Midwest region (Table 9).

Table 9 : Cow's milk production (in millions of liters) in the regions of Brazil, Midwest and the state of Goiás, period 2000-2020

Year	2000	2005	2010	2015	2020	Var. (%) 2000-2020	Var. (%) 2015-2020
Brazil	19,767	24,621	30,715	34,610	35,445	79.3%	2.4%
Midwest	3,080	3,778	4,450	4,604	4,132	34.2%	-10.3%
Goiás	2,194	2,649	3,194	3,406	3,189	45.4%	-6.4%

Source: IBGE - Municipal Livestock Survey, prepared by the authors

Milk production is present throughout the territory of Goiás. Data from the 2017 Agricultural Census indicate that Brazil has approximately 1.2 million agricultural establishments that produce cow's milk. In Goiás, there are 72,353 dairy properties, of which 69.3% are family farming and 30.7% are employers, indicating the predominance of small and medium producers. This percentage is below the Brazilian average, which is 81.2% of family establishments.

It appears that 78.8% of dairy farms in Brazil have up to 50 heads, while Goiás have only 59.1%. The state has 29.5% of establishments in the stratum of 50 to 200 heads, and 9.7% in the stratum of 200 to 500 heads, almost double the national average (Table 10)

Table 10 : Number of agricultural establishments that produced cow's milk in Brazil and in the state of Goiás - 2017

Bovine head groups	BRAZIL			GOIÁS		
	Total	Family farming - no	Family farming - yes	Total	Family farming - no	Family farming - yes
Total	**1,176,295**	**221,135**	**955,160**	**72,353**	**22,297**	**50,056**
from 1 to 2	49,356	7,582	41,774	548	138	410
from 3 to 5	128,281	18,096	110,185	2,189	523	1,666
from 6 to 10	205,534	25,632	179,902	5,635	1,172	4,463
From 11 to 20	238,020	26,791	211,229	11,028	1,888	9,140
From 21 to 50	306,134	39,884	266,250	23,361	3,479	19,882
From 51 to 100	131,109	32,324	98,785	13,314	3,275	10,039
From 101 to 200	63,301	29,832	33,469	8,055	4,316	3,739
From 201 to 500	33,865	25,400	8,465	5,304	4,741	563
From 501 to 1000	9,499	9,083	416	1,745	1,738	7
From 1001 and more	5,761	5,733	28	984	982	two
No bovine heads	5,435	778	4,657	190	45	145

Source: IBGE, Agricultural Census/2017.

Milk production in Goiás was practically stagnant in the last decade, with production of 3.2 billion liters per year. Milk production grew by 18% in the period between 2010 and 2013, followed by a

decline in the period from 2014 to 2017, recovering the accumulated loss from the year 2018, reaching in 2020 at the same level as in 2010.

The dairy herd also fell (-24.4%), from 2.48 million head in 2010 to 1.87 million in 2020. As for animal productivity expressed in liters/cow/year, there was an increase of 32, 2% in the period, reaching 1,702 liters/cow/year, still well below the national average of 2,192 liters/cow/year (Table 11).

Table 11: Milk production, herd of milked cows and animal productivity in Goiás

Year	milk production		milked cows		Productivity	
	(thousand liters)	tx. Growth	(heads)	tx. Growth	(liters/cow/year)	tx. Growth
2010	3,193,731	100	2,479,869	100	1,288	100
2011	3,482,041	109.0	2,615,611	105.5	1,331	103.4
2012	3,546,329	111.0	2,692,841	108.6	1,317	102.3
2013	3,776,803	118.3	2,723,594	109.8	1,387	107.7
2014	3,659,191	114.6	2,638,373	106.4	1,387	107.7
2015	3,405,513	106.6	2,518,931	101.6	1,352	105.0
2016	2,933,441	91.8	2,237,872	90.2	1,311	101.8
2017	2,989,833	93.6	1,984,981	80.0	1,506	117.0
2018	3,084,080	96.6	1,930,594	77.9	1,597	124.0
2019	3,164,963	99.1	1,881,021	75.9	1,683	130.6
2020	3,188,868	99.8	1,873,669	75.6	1,702	132.2

Source: IBGE - Municipal Livestock Survey, prepared by the authors

The state of Goiás is territorially divided into five mesoregions: Centro Goiano and Sul Goiano with 82 municipalities each; the East of Goiás with 32 municipalities, followed by the North of Goiás with 27 municipalities and the Northwest of Goiás with 23 municipalities, thus encompassing the 246 municipalities of Goiás, all with establishments with milk production.

Analyzing milk production by mesoregion, it can be seen that there was a retraction in production in South Goiás (-14.7%), North Goiás (-4.2%) and Northwest Goiás (-16.4) contributing to the decline of 6.4% in the total production of the state, even considering the growth of production in the Center (3.8%) and East Goiano (14.3%) mesoregions, as shown in Table 12.

Table 12: Milk production in the Goiás mesoregions, Goiás and Brazil, 2000-2020

Mesoregion, Goiás, Brazil	Milk production (thousand liters)					Var. (%) 2000/20	Var. (%) 2019/20	part (%) 2020
	2000	2005	2010	2015	2020			
Goiás Center	676,078	734,699	808,549	1,000,323	1,038,700	53.6%	3.8%	32.6%
eastern Goiás	142,693	218,625	244,468	306,458	350,363	145.5%	14.3%	11.0%

Northwest Goiás	184,120	249,689	278,325	265,306	221,802	20.5%	-16.4%	7.0%
North Goiás	140,266	187,077	206,936	141,152	135,239	-3.6%	-4.2%	4.2%
South Goiás	1,050,642	1,258,509	1,655,453	1,692,274	1,442,764	37.3%	-14.7%	45.2%
GOIÁS	**2,193,799**	**2,648,599**	**3,193,731**	**3,405,513**	**3,188,868**	**45.4%**	**-6.4%**	**100.0%**
BRAZIL	**19,767,206**	**24,620,859**	**30,715,460**	**34,609,588**	**35,445,059**	**79.3%**	**2.4%**	

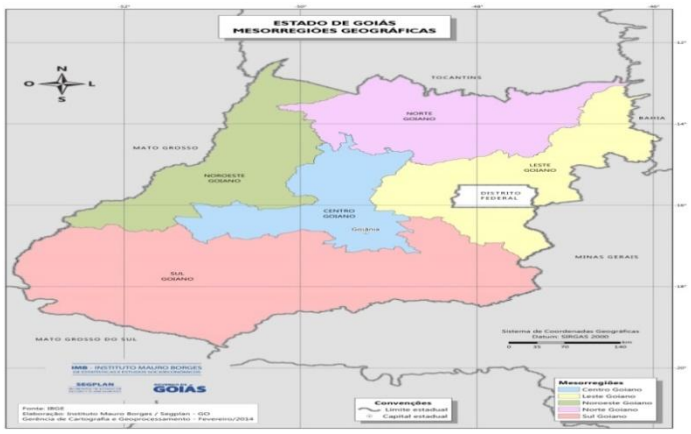
Source: IBGE - Municipal Livestock Survey, prepared by the authors

Sul Goiano produced 1.4 billion liters of milk in 2020, representing 45.2% of state production, with emphasis on the municipalities of Orizona, Piracanjuba, Jataí, Rio Verde, Silvânia, Pontalina and Vianópolis, seven among the ten largest producers in the state of Goiás.

Centro Goiano produced 32.6%, highlighting the municipalities of Bela Vista de Goiás and Itapuranga. The Center and East of Goiás were the only two mesoregions that showed growth in milk production in 2020, up 14.3% and 3.8% respectively.

Figure 3 shows the geographic distribution and quantity produced (thousand liters) in the five mesoregions of Goiás, in 2020.

Figure 3 : Milk production (thousand liters) in the Goiás mesoregions - 2020



Source: IMB, 2021

The fifteen main milk producing municipalities in Goiás (Top 15 in 2020) showed an increase in the volume of milk produced in the last two decades. Considering only the period between 2015 and 2020, there was an average growth of 1.23% per year. The municipality of Orizona, the largest producer in Goiás, showed a growth of 25.6% in relation to the period 2019-2020 and an average growth of 13.7% per year when compared to the entire period of analysis. Table 13 compares information in the fifteen main municipalities of Goiás in the years 2000, 2005, 2010 and 2020 with regard to total milk production.

Table 13 : Milk production (thousand liters) in the fifteen main milk producing municipalities in Goiás - 2000-2020

Counties	Milk production (thousand liters)					Var.(%)	Var.(%)	part
	2000	2005	2010	2015	2020	2000/20	2019/20	2020
Arizona	29,150	44,151	75,000	90,000	113,000	287.7%	25.6%	3.5%
Piracanjuba	68,258	92,734	114,313	105,805	95,100	39.3%	-10.1%	3.0%
jatai	45,448	53,000	119,256	98,000	88,700	95.2%	-9.5%	2.8%
Bela Vista de Goiás	29,700	30,665	31,330	71,500	77,839	162.1%	8.9%	2.4%
green River	55,750	64,000	78,800	90,000	72,122	29.4%	-19.9%	2.3%
sylvania	26,651	37,114	46,500	49,000	64,500	142.0%	31.6%	2.0%
Pirenopolis	25,700	32,000	32,000	36,000	64,324	150.3%	78.7%	2.0%
Pontalina	29,764	26,407	35,832	70,020	63,600	113.7%	-9.2%	2.0%
Itapuranga	34,500	23,760	27,060	33,273	62,090	80.0%	86.6%	1.9%
Vianopolis	10,071	16,826	18,900	40,500	61,325	508.9%	51.4%	1.9%
hillocks	55,487	70,883	112,007	75,800	60,700	9.4%	-19.9%	1.9%
Lucia	13,000	46,620	68,590	72,000	57,568	342.8%	-20.0%	1.8%
itaberai	24,070	25,056	27,000	32,500	48,911	103.2%	50.5%	1.5%
hydroland	19,000	15,804	16,841	42,123	47,812	151.6%	13.5%	1.5%
Caçu	24,990	25,600	25,380	46,000	45,467	81.9%	-1.2%	1.4%
GOIÁS	**2,193,799**	**2,648,599**	**3,193,731**	**3,405,513**	**3,188,868**	**45.4%**	**-6.4%**	**100.0%**
BRAZIL	**19,767,206**	**24,620,859**	**30,715,460**	**34,609,588**	**35,445,059**	**79.3%**	**2.4%**	

Source: IBGE - Municipal Livestock Survey, prepared by the authors

Considering only the period 2019-2020, the best results in milk production were obtained by the municipalities of Itapuranga with an increase of 86.6%, followed by Pirenópolis (78.7%), Vianópolis (51.4%) and Itaberaí(50.5%). The municipalities of Luziânia, Morrinhos and Rio Verde presented a 20% drop in milk production. Piracanjuba and Jataí fell by 10% and 9.5% respectively.

The ten largest milk producers in Goiás in 2020, account for 23.9% of state production. They are, according to the state ranking: Orizona, Piracanjuba, Jataí, Bela Vista de Goiás, Rio Verde, Silvânia, Pirenópolis, Pontalina, Itapuranga and Vianópolis.

In the surveys of the 100 largest milk producers, carried out in the last five years by Milkpoint (2016 to 2021), the average participation of 10 properties in Goiás, all with an average production above 10 thousand liters / day. In the Top 100 survey carried out in 2021, two farms had production above 30,000 liters/day; two with production between 20,000 and 30,000 liters/day; three properties with production between 15,000 and 20,000 liters/day; and three between 10,000 and 15,000 liters/day. These numbers solidify the understanding of the concentration of production that occurs throughout the milk chain.

The downward trend in the number of animals occurred in the national scenario as a whole, as well as in the analyzed municipalities. The biggest drops in the herd of milked cows occurred in Silvânia

(33.8%), Bela Vista de Goiás (30.1%), Itaberaí (29.9%) and Orizona (26.9%). In general, there was a decrease of 26.4% in the dairy herd of Goiás in the year 2020, according to data presented in Table 14.

Table 14 : Number of milked cows (heads) in the fifteen main milk producing municipalities in Goiás - 2000-2020

Counties	Herd of milked cows (heads)					Var.(%) 2000/20	Var.(%) 2019/20	part 2020
	2000	2005	2010	2015	2020			
Arizona	16,000	30,950	50,000	54,700	40,000	150.0%	-26.9%	2.1%
Piracanjuba	49,312	63,036	77,500	45,293	36,350	-26.3%	-19.7%	1.9%
jatai	34,120	38,000	47,040	44,545	47,200	38.3%	6.0%	2.5%
Bela Vista de Goiás	22,000	22,700	23,060	36,000	25,150	14.3%	-30.1%	1.3%
green River	40,000	36,000	43,700	48,000	38,100	-4.8%	-20.6%	2.0%
sylvania	20,500	27,130	30,300	32,500	21,500	4.9%	-33.8%	1.1%
Pirenopolis	23,800	25,000	25,000	26,650	22,491	-5.5%	-15.6%	1.2%
Pontalina	24,680	23,384	29,000	30,000	24,500	-0.7%	-18.3%	1.3%
Itapuranga	25,000	24,000	24,600	29,800	24,220	-3.1%	-18.7%	1.3%
Vianopolis	8,000	12,300	15,500	22,000	18,900	136.3%	-14.1%	1.0%
hillocks	49,880	70,203	90,500	34,620	31,800	-36.2%	-8.1%	1.7%
Lucia	31,000	32,000	36,100	38,000	36,206	16.8%	-4.7%	1.9%
itaberai	29,000	32,200	33,000	39,800	27,915	-3.7%	-29.9%	1.5%
hydroland	12,700	10,980	11,700	30,792	35,980	183.3%	16.8%	1.9%
Caçu	14,700	15,100	14,100	23,200	24,720	68.2%	6.6%	1.3%
GOIÁS	**2,006,038**	**2,334,558**	**2,479,869**	**2,544,301**	**1,873,669**	**-6.6%**	**-26.4%**	**100.0%**
BRAZIL	**17,885,019**	**20,625,925**	**22,924,914**	**21,110,916**	**16,167,625**	**-9.6%**	**-23.4%**	

Source: IBGE - Municipal Livestock Survey, prepared by the authors

Considering the period between 2000 and 2020, the average productivity in Goiás, went from 1,094 liters/cow/year to 1,702 liters/cow/year, an increase of 55.6% in the analyzed period, a very low index compared to the main producing states, in addition to being below the national average, which is 2,192 liters/cow/day. The highest yields in the state of Goiás were observed in the municipalities of Vianópolis, Bela Vista de Goiás, Silvânia and Orizona, with 3,245 liters/cow/year, 3,095, 3,000 and 2,825, respectively.

Table 15 compares information in the fifteen main municipalities of Goiás in the years 2000, 2005, 2010 and 2020 with regard to animal productivity, expressed in liters/cow/year.

Table 15 : Animal productivity (liters/cow/year) in the fifteen main milk producing municipalities in Goiás - 2000-2020

Counties	Productivity (liters/cow/year)					Var.(%) 2000/20	Var.(%) 2019/20
	2000	2005	2010	2015	2020		
Arizona	1,822	1,427	1,500	1,645	2,825	55.1%	71.7%
Piracanjuba	1,384	1,471	1,475	2,336	2,616	89.0%	12.0%
jatai	1,332	1,395	2,535	2,200	1,879	41.1%	-14.6%
Bela Vista de Goiás	1,350	1,351	1,359	1,986	3,095	129.3%	55.8%
green River	1,394	1,778	1,803	1,875	1,893	35.8%	1.0%
sylvania	1,300	1,368	1,535	1,508	3,000	130.8%	99.0%
Pirenopolis	1,080	1,280	1,280	1,351	2,860	164.9%	111.7%
Pontalina	1,206	1,129	1,236	2,334	2,596	115.3%	11.2%
Itapuranga	1,380	990	1,100	1,117	2,564	85.8%	129.6%
Vianopolis	1,259	1,368	1,219	1,841	3,245	157.7%	76.3%
hillocks	1,112	1,010	1,238	2,189	1,909	71.6%	-12.8%
Lucia	419	1,457	1,900	1,895	1,590	279.2%	-16.1%
itaberai	830	778	818	817	1,752	111.1%	114.6%
hydroland	1,496	1,439	1,439	1,368	1,329	-11.2%	-2.9%
Caçu	1,700	1,695	1,800	1,983	1,839	8.2%	-7.2%
GOIÁS	**1,094**	**1,135**	**1,288**	**1,338**	**1,702**	**55.6%**	**27.2%**
BRAZIL	**1,105**	**1,194**	**1,340**	**1,639**	**2,192**	**98.4%**	**33.7%**

Source: IBGE - Municipal Livestock Survey, prepared by the authors

To promote improvements in production systems, and consequently in the entire primary productive sector of the dairy chain, it is necessary to incorporate new technologies and professionalize the sector.

Final considerations

The dairy activity is developed in all Brazilian regions, with a significant impact on the economy of several states. The analysis of data on the evolution of milk production in Brazil, and especially in Goiás, in the period between 2000 and 2020, based on information provided by official agencies (federal and state), especially by the Brazilian Institute of Geography and Statistics (IBGE), by EMBRAPA Gado de Leite and by the Mauro Borges Institute of Statistics and Socioeconomic Studies (IMB), allows us to infer some considerations in the national and state scenario.

In the national scenario, there were significant increases in production and productivity, with a reduction in the number of agricultural establishments producing milk and the number of animals, except in the North region, where there was an increase in the number of milked cows. The country reached a production of 35.4 billion liters of milk, an increase of 79.3%, even with a 9.6% reduction in the dairy herd.

The production of milk under inspection (municipal, state or federal) more than doubled in the analyzed period, while informal milk decreased from 38.7% in 2000 to 28% in 2020, increasing the competitiveness of the entire milk production chain.

When analyzing the Brazilian regions, the Northeast stood out with an increase of 25% in the period between 2015 and 2020, an increase of almost one billion liters of cow's milk in the total volume

produced. In the Midwest, there was a drop of 10.3% in the same period, mainly due to the drop in production in the state of Goiás. The South, despite showing a drop of 2.1% in the volume produced, continues to stand out especially in terms of productivity of its dairy herd, much higher than the national average. The Southeast, despite showing a decline in production in the period from 2016 to 2018, managed to reverse the situation, closing the year 2020 as the largest producing region in the country, thanks to the good performance of the state of Minas Gerais, first in the national ranking. This scenario can be explained by the professionalization of the sector, especially by the adoption of technologies in animal genetic improvement, nutrition, handling, management, among other factors.

The state of Goiás, even occupying the fourth position in the national ranking of milk production, has been showing a drop in production in recent years, despite being a state dedicated to agribusiness. Dairy cattle farming is present in all 246 municipalities in Goiás, presenting great economic and social importance for the state, involving approximately 72 thousand producers and 200 thousand direct and indirect jobs. In 2020, milk production in Goiás was 3.2 billion liters, practically the same volume produced in 2010, thus showing the stagnation of the dairy sector in the last decade and the discouragement of its producers.

The South of Goiás, responsible for 45.2% of the state volume of milk produced, showed a drop of 14.7% in 2020. Regarding the municipalities of Goiás, Orizona continues to lead the state ranking, reaching the mark of 113 million liters, more than tripling milk production in the last two decades.

Regarding the increase in milk production, in the period between 2000 and 2020, the municipalities of Vianópolis (508.9%), Luziânia (342.8%) and Orizona (287.7%) stand out. Analyzing the data from the last year, Itapuranga (86.6%) and Pirenópolis (78.7%) were the municipalities that presented the highest growth in milk production. The municipalities of Rio Verde, Morrinhos and Luziânia showed a 20% drop in the volume produced in 2020, followed by the municipalities of Piracanjuba and Jataí, a decrease of 10.1% and 9.5% respectively.

Finally, a more in-depth analysis of animal productivity in Goiás is necessary. In 2000, productivity was 10.6% below the national average, reaching 4% in 2010, showing a period of investment and evolution of dairy activity in the state, from then on, the scenario drastically reversed. In the last year analyzed, the difference reached the mark of 490 liters/cow/year, 28.8% below the national average of 2,192 liters/cow/year. This scenario is very worrying, as it reminds us of the idea of inefficient use of productive resources, lack of investment in new technologies, and public programs and policies (credit, technological and managerial innovations, genetic improvement, animal health, safety and quality of milk, etc.) aiming at the development of the primary productive sector of the milk chain in Goiás.

Referências

BRASIL, Ministério da Agricultura, Pecuária e Abastecimento – MAPA. Projeções do Agronegócio: Brasil 2020/21 a 2030/31 – Projeções de Longo Prazo. Brasília. MAPA, 2021. Disponível em:

https://www.gov.br/agricultura/pt-br/assuntos/politica-agricola/todas-publicacoes-de-politica-agricola/projecoes-do-agronegocio

EMBRAPA GADO DE LEITE. Centro de Inteligência do Leite – CILeite. **Boletim Indicadores Leite e Derivados. Ano 13, nº 126 – Janeiro/2022**. Coordenação: Glauco Rodrigues Carvalho et. al. Disponível em: **https://www.cileite.com.br/ind_leite_derivados_jan_2022**

EMBRAPA GADO DE LEITE. Centro de Inteligência do Leite – CILeite. **Boletim Indicadores Leite e Derivados. Ano 12, nº 120 – Outubro/2021 – Edição Especial**. Coordenação: Glauco Rodrigues Carvalho et. al. Disponível em: **https://www.cileite.com.br/ind_leite_derivados_out_2021**

EMBRAPA GADO DE LEITE. Centro de Inteligência do Leite – CILeite. **Boletim Indicadores Leite e Derivados. Ano 12, nº 121 – Outubro/2021 – Edição Especial**. Coordenação: Glauco Rodrigues Carvalho et. al. Disponível em: **https://www.cileite.com.br/ind_leite_derivados_out_2021_2**

EMBRAPA GADO DE LEITE. Centro de Inteligência do Leite – CILeite. **Boletim Indicadores Leite e Derivados. Ano 12, nº 113 – Março/2021 – Edição Especial.** Coordenação: Glauco Rodrigues Carvalho et. al. Disponível em: **https://www.cileite.com.br/ind_leite_derivados_mar_2_2021**

EMBRAPA GADO DE LEITE. **Indicadores: Leite e Derivados. Ano 11, n. 100, Março/2020**. Coordenação: Glauco Rodrigues Carvalho et. al. Juiz de Fora, 2020. Disponível em: **https://ainfo.cnptia.embrapa.br/digital/bitstream/item/211789/1/Indicadores-leite-mar-2020.pdf**

FOOD AND AGRICULTURE ORGANIZATION – FAO. FAOSTAT. **Livestock Primary**. Rome, Italy, 2019. Disponível em: **https://www.fao.org/faostat/en/#data/QL**.

FOOD AND AGRICULTURE ORGANIZATION – FAO. **Overview of global dairy market developments in 2020**. Dairy Market Review, April 2021. Rome. Disponívelem: **https://www.fao.org/3/cb4230en/cb4230en.pdf**

GASQUES, J.G.; VIEIRA FILHO, J. E. R.; BASTOS, E.T. **Produtividade da agricultura brasileira: crescimento e inovação**. In: Geopolítica do alimento: o Brasil como fonte estratégica de alimento para a humanidade. Brasília, DF: EMBRAPA, 2019. Disponível em:

https://www.embrapa.br/busca-de-publicacoes/-/publicacao/1114767/geopolitica-do-alimento-o-brasil-como-fonte-estrategica-de-alimentos-para-a-humanidade

INSTITUTO BRASILEIRO DE GEOGRAFIA E ESTATÍSTICA – IBGE. **Censo Agropecuário 2017**. Disponível em: **https://sidra.ibge.gov.br/pesquisa/censo-agropecuario/censo-agropecuario-2017**.

INSTITUTO BRASILEIRO DE GEOGRAFIA E ESTATÍSTICA – IBGE. **Censo Agropecuário 2006**. Disponível em: **https://sidra.ibge.gov.br/pesquisa/censo-agropecuario/censo-agropecuario-2017**.

INSTITUTO BRASILEIRO DE GEOGRAFIA E ESTATÍSTICA – IBGE**. Pesquisa Pecuária Municipal**. Disponível em: **https://sidra.ibge.gov.br/pesquisa/ppm/**

INSTITUTO BRASILEIRO DE GEOGRAFIA E ESTATÍSTICA – IBGE**. Pesquisa Trimestral do Leite**. Disponível em: **https://sidra.ibge.gov.br/pesquisa/leite/tabelas**

INSTITUTO BRASILEIRO DE GEOGRAFIA E ESTATÍSTICA – IBGE**. Panorama do Estado de Goiás**. Disponível em: **https://cidades.ibge.gov.br/brasil/go/panorama**

INSTITUTO MAURO BORGES DE ESTATÍSTICAS E ESTUDOS SOCIOECONÔMICOS – IMB. Estatística de Goiás. Disponível em: **https://www.imb.go.gov.br/**

LEITE, F. L. B.; ZOCCAL, R. **Cenários para o agronegócio e as implicações para a cadeia produtiva do leite no Brasil**. In: Pecuária de leite no Brasil: cenários e avanços tecnológicos. Brasília,

DF: EMBRAPA, 2016. Disponível em: **https://ainfo.cnptia.embrapa.br/digital/bitstream/item/164236/1/Pecuaria-de-leite-no-Brasil.pdf**

MILKPOINT. Levantamento Top 100 2021: os 100 maiores produtores de leite do Brasil. Milkpoint, Piracicaba/SP. Março de 2021. Disponível em: **https://www.milkpoint.com.br/top100/2021/**

MILKPOINT. Levantamento Top 100 2020: os 100 maiores produtores de leite do Brasil. Milkpoint, Piracicaba/SP. Março de 2021. Disponível em: **https://www.milkpoint.com.br/top100-2020-lp/**

MILKPOINT. Levantamento Top 100 2019: os 100 maiores produtores de leite do Brasil. Milkpoint, Piracicaba/SP. Março de 2021. Disponível em: **https://www.milkpoint.com.br/top100/top100-2019.pdf**

OECD-FAO.**Agricultural Outlook 2021-2030**. Roma: OECD Publishing, Paris: Food and Agriculture Organization of the United Nations, 2021. Disponívelem:

https://www.fao.org/documents/card/en/c/cb5332en

PEREIRA, C. V.; NUNES, S. P. **A estrutura da cadeia produtiva do leite no sudoeste do Paraná**. In: Anais do 59º Congresso da Sociedade Brasileira de Economia, Administração e Sociologia Rural (SOBER) & 6º Encontro Brasileiro de Pesquisadores em Cooperativismo (EBPC). Anais...Brasília(DF) UnB, 2021. Disponível em: <https//www.even3.com.br/anais/soberebpc2021/342705

SECRETARIA DE ESTADO DE AGRICULTURA, PECUÁRIA E ABASTECIMENTO – SEAGRO. **Radiografia do Agro em Goiás 2021**. **https://www.agricultura.go.gov.br/informativos/radiografia-do-agro.html**

SORIO, A. **Cadeia agroindustrial do Leite no Brasil: diagnóstico dos fatores limitantes à competitividade**. Brasília, DF: Ministério da Indústria, Comércio Exterior e Serviços – MDIC, 2018.

http://www.unesco.org/new/fileadmin/MULTIMEDIA/FIELD/Brasilia/pdf/brz_sc_cadeia_produtiva_leite_MICS_por_2018.pdf

VIANA, G.; RINALDI, R. N. **Principais fatores que influenciam o desempenho da cadeia produtiva de leite – um estudo com os produtores de leite do município de laranjeiras do sul-PR**. Organizações Rurais & Agroindustriais, [S. l.], v. 12, n. 2, 2011. Disponível em: **http://revista.dae.ufla.br/index.php/ora/article/view/26**

VILELA, D. **Desafios e oportunidades para a pecuária de leite no Brasil**. In: Pecuária de leite no Brasil: cenários e avanços tecnológicos. Brasília, DF: EMBRAPA, 2016. Disponível em: **https://ainfo.cnptia.embrapa.br/digital/bitstream/item/164236/1/Pecuaria-de-leite-no-Brasil.pdf**

VIERA FILHO, J. R.R; FISHLOW, A. **A agricultura e indústria no Brasil: inovação e competitividade**. Brasília, DF: IPEA, 2017.

Recebido em: 13-02-2023
Aceito em: 15-03-2023

Endereço para correspondência:

Nome Wilson de Jesus Beserra de Almeida
Email wilson.almeida@unialfa.com.br