J. Dairy Sci. 109:482–494
https://doi.org/10.3168/jds.2025-26755

How can production levels influence decision making on organic dairy farms in Brazil?

Amanda B. Sant'ana,[1] Fernanda S. Machado,[2] Fábio H. Diniz,[2] Maria F. A. Pires,[2] Polyana P. Rotta,[1] Emília F. Ribeiro,[1] and Alex L. Silva[1]*
[1]Department of Animal Science, Universidade Federal de Viçosa, Viçosa, Minas Gerais, Brazil, 36570-900
[2]Embrapa Dairy Cattle, Juiz de Fora, Minas Gerais, Brazil, 36038-330

ABSTRACT

The aim of this study was to characterize organic dairy systems in Brazil. It was hypothesized that the production level of the herd influences the productivity and marketing aspects of organic milk production systems. A descriptive analysis was carried out in which the variables were geographical location, herd size, animal production, feed used, health and reproduction management, organic inputs used, feed production management, and transportation of products. The characteristics of the systems were evaluated according to the level of production, with farmers divided into 3 groups, with the upper extract comprising farms with an average production of over 16 L/cow per day (HIG), the medium extract with a production between 10.5 and 16 L/cow per day (MED), and the lower extract with an average production of less than 10.5 L/cow per day (LO). The variables were subjected to binomial logistic regression and comparisons were made by odds ratio. The average area of the properties was 107 ha (minimum 3 ha and maximum 1,450 ha); the area for organic milk production was 44 ha (minimum 1 ha and maximum 550 ha). The average daily milk production was 645 L/d (minimum of 12 L/d and maximum of 5,000 L/d), with an average production of 13 L/cow per day (minimum of 4 L/cow per day and maximum of 25 L/cow per day). The herds had an average of 58 cows (minimum 2 cows and maximum 310 cows) and 40 lactating cows (minimum 2 and maximum 255 cows). The average annual production was 7,517 L/ha per year (minimum 21 L/ha per year and maximum 29,877 L/ha per year). The average number of family workers was 2 (minimum 2 and maximum 7); the average number of external workers was 3 (minimum 2 and maximum 16). The HIG and MED farms were found to be 90% less likely to produce cheese. In addition, HIG and MED farms were 10.7 and 6.6 times more likely to have Holstein × Jersey crosses in their herd, respectively. The MED farms were 80% less likely to have *Urochloa* spp. pastures, whereas HIG farms were 93.2% less likely to have *Urochloa* spp. pastures and 92% less likely to use chopped grass to supplement the herd. However, the odds of having *Megathyrsus maximus* pastures was 4.66 times greater for HIG. In addition, HIG farms were 4.5 times more likely to use any type of management software. The analysis of certified organic dairy farms revealed a concentration in the Southeast region of Brazil, where production is mainly focused on milk, whereas other regions have more diversified organic production. The HIG farms are more likely to use specialized cattle breeds, herd supplementation, pastures formed by higher-yielding forage species with greater nutritional value, and management software. These results emphasize the need for public policies that promote the adoption of technological and sustainable practices to increase the efficiency and productivity of the organic dairy sector.
Key words: bovines, organic milk, survey

INTRODUCTION

In recent decades, the profile of dairy consumers has changed, with a strong tendency to favor products of differentiated quality and a greater concern about the type of production, mainly due to issues related to environmental impact, health risks, and ethical considerations during the production process (Lima et al., 2020)

Organic products fit this profile, as food is produced while respecting the natural cycle of resource conservation (Piao et al., 2021). The global organic cultivation area increased by 26.6% between 2021 and 2022 (96.6 million ha), with a global market of €134.8 billion. With 996.44 ha and 24,205 organic producers and a market of €778 million, Brazil ranks 12th in terms of organically farmed area (Willer et al., 2024). According to a study by KPMG (2018), certified organic milk accounts for around 0.9% of all milk produced worldwide, with the market volume mainly concen-

Received April 13, 2025.
Accepted October 4, 2025.
*Corresponding author: alex.lopes@ufv.br

The list of standard abbreviations for JDS is available at adsa.org/jds-abbreviations-25. Nonstandard abbreviations are available in the Notes.

trated in countries such as the United States, Germany, and France (Kyrylov et al., 2018).

Although there are segments of the dairy industry in developed countries that have the potential to comply with organic production principles, milk production in developing countries generally takes place on a small scale and the activity is considered quite fragmented, with an undefined level of consistency (KPMG, 2018). In Brazil, there is a lack of accurate and reliable data on production, which makes it difficult to structure the supply chain and develop public policies and marketing strategies (Machado et al., 2021). This scenario makes the growth of organic dairy farming in Brazil rather slow compared with other countries. Brazil has 2 official sources of information: Brazilian Institute of Geography and Statistics (**IBGE**) data, collected as part of the agricultural census, and data from the National Registry of Organic Producers (**CNPO**), provided by the Brazilian Ministry of Agriculture and Livestock. These data were systematized by Embrapa and are available via the "Organic Milk Observatory" (https://leiteorganico.cnpgl.embrapa.br/).

According to the 2017 Agricultural Census (IBGE, 2019), Brazil had 64,690 farms practicing organic agriculture, accounting for approximately 1.4% of all certified organic farms globally (Willer et al., 2024). Out of these, 36,689 were exclusively dedicated to organic farming, 17,612 to organic livestock production, and 10,389 combined both activities. This number, however, reflects all establishments self-declared as organic and does not necessarily imply certification. In contrast, data from the CNPO reported only 15,856 certified organic production units in 2017, corresponding to 0.3% of all farms in the country (Vilela et al., 2019). The CNPO figures refer strictly to certified producers, which may explain the difference. According to data from Brasil (2021), the number of producers registered with the CNPO increased from 5,900 in 2012 to 17,700 in 2019 (Holmström et al., 2020), reaching 25,919 in 2024 (Brasil, 2025).

Despite this increase, a major obstacle to the development of the organic sector in Brazil is the lack of accurate data on indicators for the production, commercialization, and consumption of organic products (Lima et al., 2020). There are no official records of production indicators such as the number of animals in the herd, the number of lactating cows, the amount of milk produced, and so on. In addition, the lack of coordination between milk producers and organic input suppliers makes it difficult to develop commercial strategies for farmers and the processing industry (Machado et al., 2021).

The aim of this study was therefore to characterize the organic milk production systems in Brazil. It was hypothesized that the production level of the herd influences milk production efficiency, as well as marketing and the use of technology in organic systems.

MATERIALS AND METHODS

Based on data from the CNPO of the Brazilian Ministry of Agriculture and Livestock, a search was carried out for registered producers whose activities include the production of dairy cows in the period between August 2019 and August 2021.

The CNPO is mandatory and its database is maintained and updated by the conformity assessment organisms or state agricultural authorities, with production units labeled with the following information:

1) certification system (public or private certifier, participatory guarantee system [**PGS**], or social control organization [**OCS**]) and name of the unit;
2) federation unit and city;
3) farmer data (name, Social Security Number [**CPF**]/Corporate Taxpayer Identification Number [**CNPJ**], and contact);
4) scope (animal or plant [or both] primary production, processing of products of animal or plant origin [or both], extractivism, processing of inputs, and so on); and
5) description of the production activity.

The CNPO data were systematized to identify organic milk producers and to analyze the type of certification and activity (exclusively organic milk production or production of milk and other organic products on the same farm). In December 2019, 145 organic milk producers were registered with the CNPO, representing a total of 103 production units (farms) in Brazil, since some properties had more than one rural producer registered.

Survey Application

The research was previously submitted to the Human Research Ethics Committee of the Universidade Federal de Viçosa (Minas Gerais, Brazil) for evaluation and approved under protocol no. 5,664,620.

Based on the contacts provided by the CNPO, telephone interviews were conducted with 53 farmers in 2019 and information was obtained from 35 farmers via an online survey in 2020 and 31 farmers in 2021, with 5 farms in the conversion phase at the time of the survey. As some properties have more than one farmer registered on them, the farms were considered to be places of "primary production" of milk (i.e., large or small farms), excluding enterprises dedicated solely to milk processing not counted. The workforce was considered familiar when all farming activities were carried out exclusively by members of the farmer's family, without the involvement of any hired external workers.

Over the 3 yr in which the study was conducted, 119 responses were received, covering 90 farms out of 103.

Table 1. Descriptive statistics for characterization of certified Brazilian organic dairy farms

	Descriptive statistics					
Predictor	N[1]	Mean	Median	Minimum	Maximum	SD
Area (ha)						
Total	84	107	50	3	1,450	188.6
Organic dairy farming	82	44	25	1	550	70.6
Productivity						
Total milk (L/d)	82	645	415	12	5,000	864.4
Milk yield (L/cow per day)	82	13	14	4	25	5.1
Milk production (L/ha per year)	800	7,517	6,387	21	29,877	6,437.3
Herd (n)						
Total	84	58	45	2	310	55.9
Cows in lactation	84	40	28	2	255	43.2
Cows in lactation/total cows (%)	84	66	70	15	100	19.9
Workforce (n)						
Familiar	81	2	2	0	7	1.6
External	77	3	2	0	16	3.4

[1]N = number of properties.

Of these, 6 farms were excluded because they produce buffalo (*Bubalus bubalis*) milk rather than cow (*Bos taurus taurus* and *Bos taurus indicus*) milk, giving a total of 84 farms, which represents 81.5% of the total organic dairy farms. The survey collected various information to characterize the organic dairy farm: geographical location, herd size, daily milk production, feed used, health and reproduction management, inputs used, management of feed production for the herd, and product transport (Supplemental File S1, see Notes).

Statistical Analyses

For the statistical analysis, the consistency of the data was checked. This included duplicate responses and checking for biological sense between related variables reported by farmers, and inconsistent data were excluded from the results. A descriptive analysis of the dataset was then carried out (Table 1). The variables were geographical location, herd size, animal production, feed used, health and reproduction management, organic inputs used, production management of feed for the herd, and transportation of products.

To evaluate the characteristics of the systems according to the production level (L/cow per day), the farms were grouped into terciles, using the 33.33rd and 66.66th percentiles as cut-off points. The top tercile (**HIG**) included 28 farms with an average production of over 16 L/cow per day, the medium tercile (**MED**) included 29 farms with a production between 10.5 and 16 L/cow per day, and the bottom tercile (**LO**) included 27 farms with an average production of less than 10.5 L/cow per day (Figure 1). For farms allowing calves to be present during milking, calves were prevented from suckling on milk recording days, ensuring that recorded milk yield reflected actual production. Calves remained in contact only to stimulate milk let-down, so terciles were based solely on recorded milk yield, maintaining data consistency and preventing classification bias.

Subsequently, the variables of interest were subjected to binomial logistic regression, followed by the estimation of the odds ratio for the production levels using the logit link function available in the glm function of R (version 4.5.1; R Core Team, 2025), with a significance threshold of $P < 0.05$. The contrasts tested were HIG versus LO (base group), MED versus LO (base group), and HIG versus MED (base group).

RESULTS AND DISCUSSION

Organic Milk Production Units in Brazil

A total of 84 organic dairy farms were identified in this study, spread across 11 states and the Federal District (Figure 2). The present study also analyzed the number of certified organic dairy farms by region in Brazil (Figure 3A). We found that the majority of certified farms are located in the Southeast region, which accounts for approximately 75% of the total. In contrast, the South region represents around 19%, whereas the remaining 6% are distributed across the Northeast and Midwest regions.

As observed, the Southeast region of Brazil stands out with a high number of certified organic dairy farms, which is due to the investments made by private companies (Nestlé and Danone) in the production of organic milk powder between 2018 and 2020 (Machado et al., 2021). During this period, both companies launched organic products on the market, encouraging the entry of new producers and the modernization of certified farms (Lima et al., 2020). Danone collected organic milk from 8 suppliers in Minas Gerais and São Paulo (both located in the southeast). Nestlé had around 40 producers in its

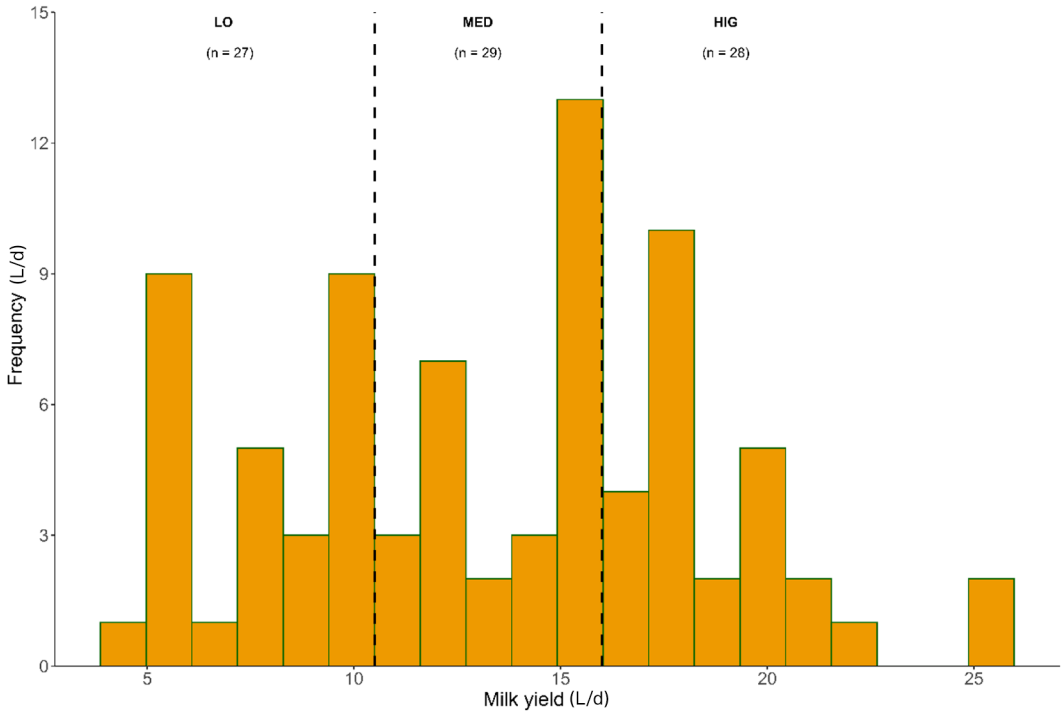

Figure 1. Frequency distribution of daily milk production categorized by production level. LO = low production level; MED = medium production level; HIG = high production level.

organic milk project, with a daily collection of around 35,000 L of milk in São Paulo (Machado et al., 2021).

The distribution of organic dairy farms in the Brazilian states reflects the diversity of production practices observed. São Paulo is the state with the highest number of certified farms (53.6%), followed by Minas Gerais, Paraná, Rio de Janeiro, and Santa Catarina. Interestingly, this distribution reflects the production patterns observed on these farms. Whereas 53% of all certified farms in Brazil focus exclusively on the production of milk or milk and dairy products, the remaining 47% have a more diversified production approach that includes various other organic products such as fruits, vegetables, grains, and others. The geographical distribution of certified farms therefore not only illustrates the regional differences but also reflects the broader spectrum of production diversity within the organic dairy sector in Brazil.

This diversified approach of production predominates in most regions of Brazil (Figure 3B). In contrast, farms producing only organic milk and milk and other nondairy organic products predominate in the Southeast (Figure 3B). In the state of São Paulo, 36 farms are dedicated exclusively to the production of organic milk and 9 farms have a diversified production approach. We also found that 6 farms in Minas Gerais and 4 farms in Rio de Janeiro produce only organic milk. The greater number of farms dedicated exclusively to the production of milk and dairy products in the Southeast can be attributed in part to the significant investment in the organic system by large dairy companies mentioned earlier.

Although there has been growth in organic milk production over the years, reflecting a global expansion trend, the pace of this growth in Brazil has been rather moderate. The entry of large companies into the dairy sector and their investments in the collection of organic milk in Brazil have thus contributed to the growth and structuring of the organic milk production chain. This impact is particularly noticeable in the Southeast region, where the sector grew between 2018 and 2021 (Silvano, 2018; Machado et al., 2021).

Regarding the use of organic milk production, the survey revealed that 74.7% of producers market their milk as organic, either by selling it directly at outdoor fairs or by selling it to industries or cooperatives. In contrast, 25.3% stated that they sell it as conventional due to a lack of alternatives. Of the producers who sold organic milk as conventional milk, 38% discontinued organic milk production. These results point to several challenges faced by organic producers, including issues related to market demand, access to organic markets, logistical constraints, and production costs. The lack of demand or access to organic markets in certain regions may result in producers opting to sell their milk as conventional milk to secure a stable source of income.

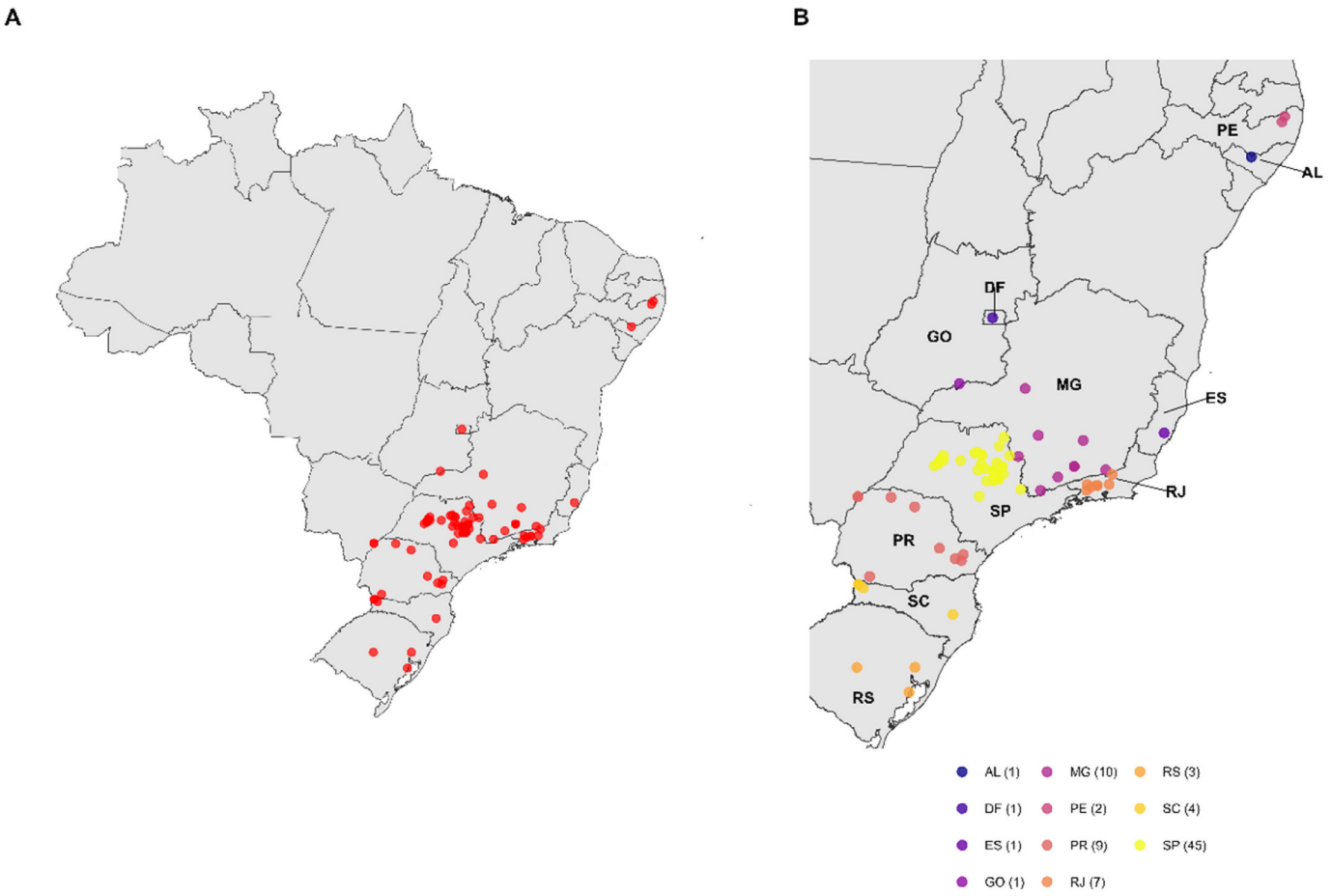

Figure 2. Distribution of organic dairy farms across the federal states in Brazil (A), with a zoomed-in view highlighting the main production regions (B). SP = São Paulo; MG = Minas Gerais; PR = Paraná; RJ = Rio de Janeiro; SC = Santa Catarina; RS = Rio Grande do Sul; PE = Pernambuco; AL = Alagoas; ES = Espírito Santo; DF = Distrito Federal; GO = Goiás.

The analysis of the production of dairy products and other organic products using logistic regression revealed a significant difference in cheese production ($P = 0.01$). The MED and HIG farms were 89% less likely to produce cheese than LO farms, with an odds ratio 95% CI of 0.03 to 0.31 (Figure 4A and 4B). This scenario can be attributed to the fact that most MED and HIG farms operate at a scale that enables the transportation of a large proportion of fresh milk to milk processing plants (Figure 4C).

Alternatively, no significant differences were found in the production of butter, yogurt, or other organic milk derivatives ($P > 0.05$), indicating that the economic viability of producing these products was similar across different production levels. It is worth noting that organic milk derivatives fetch a higher price compared with conventional dairy products (KPMG, 2018), which provides an additional incentive to produce these higher value-added products.

No significant differences were found in the production of organic products such as vegetables, cereals, and others ($P > 0.05$). Therefore, regardless of the production level on the farm, the probability of producing one of these products remains the same (Figure 4D, 4E, and 4F).

Certification Systems for Organic Milk Production in Brazil

Brazilian legislation establishes 3 types of organic certification: audit certification, participatory certification, and social control within direct sales (Brasil, 2025). Audit certification is conducted by accredited public or private bodies that issue certificates after verifying compliance with organic standards through independent audits. Participatory certification involves a collective system of evaluation among producers, technicians, and consumers, typically used by small-scale farmers and recognized by the government. Social control within direct sales applies to family farmers who sell directly to consumers and are monitored through organized groups registered with government oversight, without the need for formal certification.

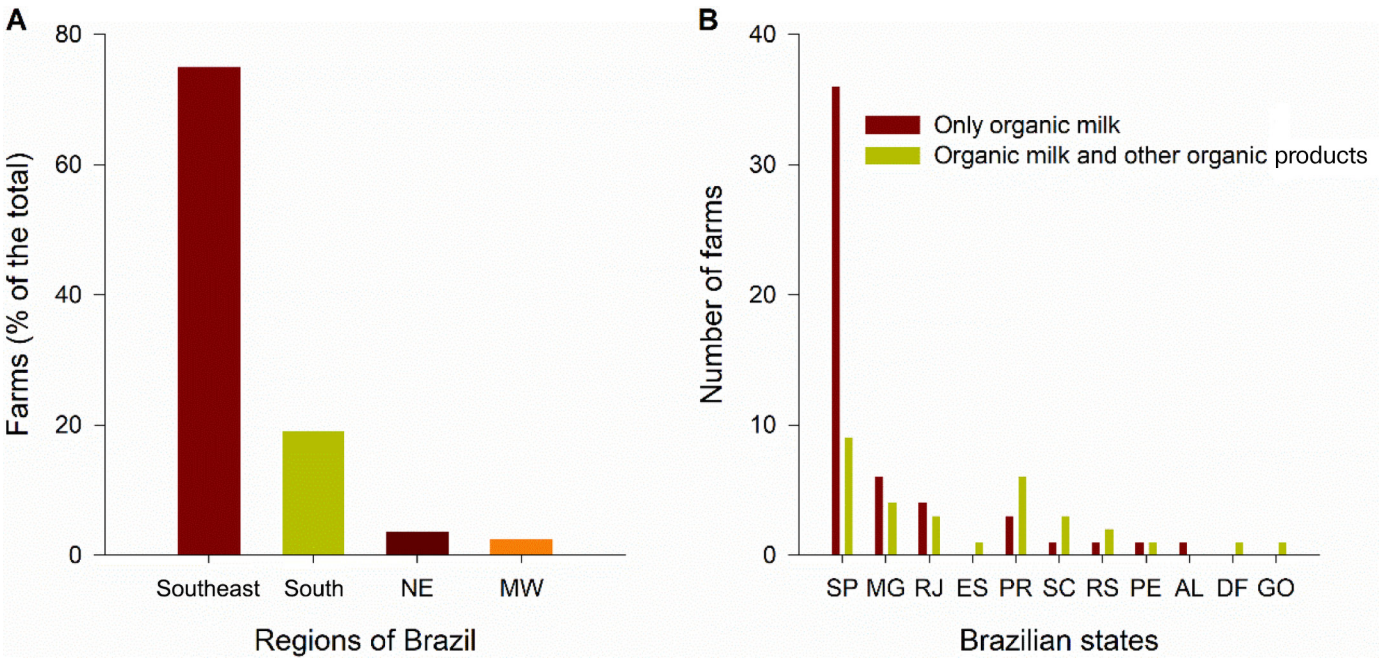

Figure 3. Distribution of organic milk production units by Brazilian region (A) and production of organic milk or milk and other organic products by Brazilian state (B). NE = Northeast; MW = Midwest; SP = São Paulo; MG = Minas Gerais; RJ = Rio de Janeiro; ES = Espírito Santo; PR = Paraná; SC = Santa Catarina; RS = Rio Grande do Sul; PE = Pernambuco; AL = Alagoas; DF = Distrito Federal; GO = Goiás.

In Brazil, the most important organic certification bodies recognized by audits include the Biodynamic Institute Certifications, Ecocert Brasil, and Institute of Technology of Paraná (TECPAR). This study found that the majority of organic farms in Brazil obtain certification through audits conducted by the certification companies, covering 71.4% of registered farms (Table 2). In the southeast of the country, this certification method is particularly widespread in the states of São Paulo and Minas Gerais.

Certification can also take place through a PGS, in which the members themselves (e.g., producers, processors, and traders) guarantee the organic quality of their products and which is based on trust, social networks, and knowledge sharing (IFOAM, 2018). Some of the most important organic certification bodies recognized as PGS in Brazil are the Ecovida Association of Participatory Certification, the Association of Organic Farmers of the State of Rio de Janeiro, the Brota Cerrado of Serra da Canastra Association of Participatory Certification, and the Natural Agriculture Association of Campinas.

The PGS-certified dairy farmers account for 26.2% of the total number of certifications in Brazil and are very present in the southern region and the state of Rio de Janeiro (Figure 2), as these are pioneer locations for nongovernmental organizations such as the Association of Organic Farmers of the State of Rio de Janeiro and the Ecovida Association of Participatory Certification in the south of the country (Vilela et al., 2019). In addition, both southern Brazil and the state of Rio de Janeiro have a diverse supply of agricultural products, which can encourage demand for organic certification. The PGS certification can be an attractive option for farmers who produce a variety of organic crops and are looking for a more accessible and participatory certification system.

The OCS is a way to involve producers who only need to consider selling their products directly to consumers. According to Candiotto (2018), one of the requirements of these programs is that 30% of the food purchased must come from family farms, with producers of certified organic food receiving an additional 30% over and above the amount paid for conventional food, making them important mechanisms for strengthening and expanding organic agriculture. With only 2.4% of all certifications, the OCS (e.g., Association of Agroecological Farmers of Bom Jardim) is only present in the Northeast region, in the state of Pernambuco, with 2 certified organic farms (Table 2). The Northeast region of Brazil, known for its strong tradition of family farming, is more affected by OCS due to several factors. The OCS emphasizes the involvement of the local community in the certification process, which is consistent with areas where there is strong community organization and a growing interest in organic production. In addition, in some regions of the Northeast, there is broader access to resources and support for the development of local organic initiatives, which further favors the presence of the OCS.

Table 2. Number of organic dairy farms per Brazilian state, stratified by type of certification

State	Type of certification[1]		
	Certifier	PGS	OCS
São Paulo	44	1	
Minas Gerais	9	1	
Rio de Janeiro		7	
Espírito Santo	1		
Paraná	2	7	
Santa Catarina		4	
Rio Grande do Sul	1	2	
Pernambuco			2
Alagoas	1		
Distrito Federal	1		
Goiás	1		

[1]Certifier = public or private organizations officially accredited by Ministry of Agriculture and Livestock (MAPA) to carry out independent audits and issue organic certificates; PGS = participatory guarantee system; OCS = social control organizations.

Characterization of Production Systems

The farms in the present study had an average size of 107 ha, ranging from 3 to 1,450 ha. The average area devoted to organic milk production was 44 ha, ranging from 1 to 550 ha. The herd consisted of 58 cows, ranging from 2 to 310 animals depending on the farm. An average of 40 lactating cows were identified, ranging from 2 to 255 animals with an average daily milk production of 13 L/d, ranging from 4 to 25 L/d. The average daily total milk production of the farms was 645 L/d, with farms producing between 12 and 5,000 L/d. Annual productivity averaged 7,517 L/ha per year, ranging from 21 to 29,877 L/ha per year. Regarding the family labor force, the number of family workers averaged 2 per farm and varied between 2 and 7, whereas the number of external workers averaged 3 and varied between 2 and 16 employees per farm. In terms of milking management, 65% of producers use mechanical milking without the calf, whereas 35% use mechanical milking with the calf present. Although precautions were taken to prevent classification bias by restricting suckling on recording days, in farms where calves were present with the cows their presence may have increased effective milking frequency, which could not be fully controlled and should be considered a limitation of this study.

Brazilian legislation on organic farming, represented by Brasil (2021), recommends the preference of breeds adapted to the specific climate and management of each region. The most common breeds in organic milk production include Holstein × Gyr, Jersey, and Holstein × Jersey. However, some producers keep 2 or more breeds on their farms.

Based on the results of the logistic regression (Figure 5), it was found that the probability of a producer breeding Holstein × Gyr, Jersey, or other breeds was similar at all production levels ($P > 0.05$). However, a difference was observed for the Holstein × Jersey crosses between HIG versus LO (Figure 5A) and MED versus LO (Figure 5B; $P < 0.05$). Farmers at HIG were 10.7 times more likely to have Holstein × Jersey crossbreds in their herd than farmers at the LO ($P < 0.01$). The MED farmers were 6.57 times more likely to have Holstein × Jersey crossbreds in their herd than LO ($P = 0.02$). This result suggests that HIG farmers have a particular preference for crossbred animals, possibly due to their production characteristics, especially milk yield and quality, as well as their adaptability to different environmental conditions and management systems. These aspects are in line with the requirements of more intensive and efficient production systems.

Furthermore, this pattern could reflect a deliberate strategy of breed selection by producers aimed at maximizing productivity and efficiency on their farms. In addition to increasing the volume of milk produced, the pursuit of higher milk solids content may make the dairy industry in Brazil more competitive. The trend indicates that the quality payment system will become more prevalent (Sorio, 2018). However, payment based on solids content is still in its infancy, as most premiums are paid based on milk volume rather than composition (Sorio, 2018).

Finally, regarding the use of reproductive technology, 47.5% of respondents stated that they use artificial insemination in their herd, 31.1% use natural mating, and 21.3% use both methods. According to the legislation, artificial insemination is allowed, but the semen used must preferably come from organically reared animals. However, in vitro fertilization, embryo transfer, and estrogen synchronization techniques are not allowed (Brasil, 2021).

Feed Use and Management

According to Brasil (2021), which establishes the technical regulations for organic production systems, it is necessary to provide a maximum use of the grazing system, with the proportion of fresh, dried, or ensiled feed being at least 60% of the DM of the feed, although this proportion may be reduced to 50% for lactating animals, for a maximum period of 3 mo from the start of lactation. As far as production systems are concerned, the farms in this study predominantly practiced pasture-based milk production with rotational grazing and semi-fencing. The predominant forage species mentioned by the participating producers were *Urochloa* spp., *Megathyrsus* spp., and *Cynodon* spp.

A difference was observed in farms with pastures consisting of forage plants of the *Urochloa* spp. and

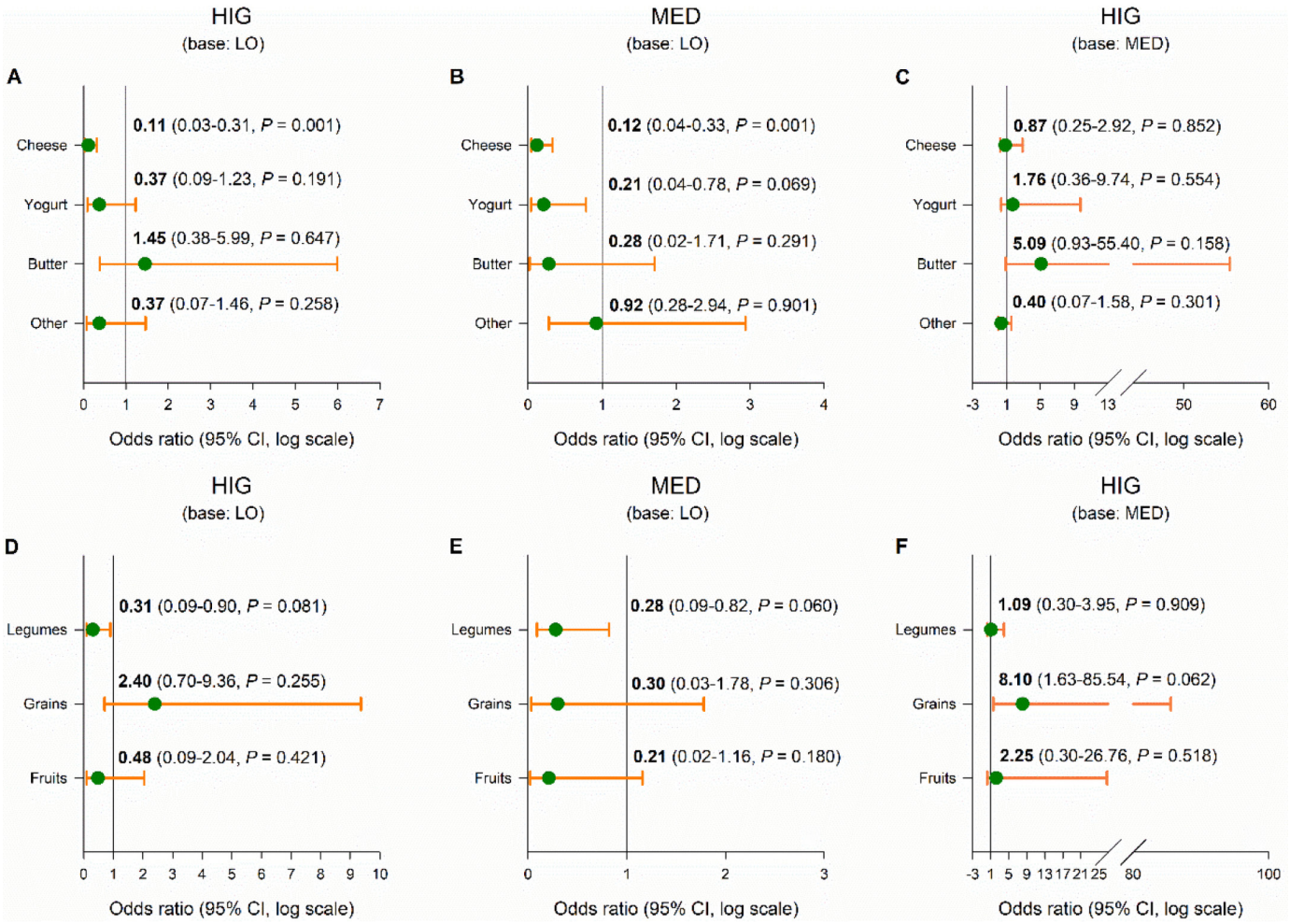

Figure 4. Effects and odds ratio from a logistic regression for the association between production level and organic dairy products (A, B, and C) and other organic activities (D, E, and F) of Brazilian organic dairy farms. LO = low production level; MED = medium production level; HIG = high production level.

Megathyrsus spp. ($P < 0.05$; Figure 6A and 6B). The HIG farms were 93.2% less likely to have *Urochloa* spp. in their pastures than LO farms ($P < 0.01$). Similarly, MED farms were 80% less likely to have *Urochloa* spp. in their pastures than LO farms ($P = 0.04$). As for the pastures formed by *Megathyrsus* spp., the probability that they contained *Megathyrsus* spp. was 4.66 times higher in HIG farms than in LO farms ($P = 0.03$). However, the probability that the pasture consisted of forage plants of the genus *Cynodon* spp., native willows, or other forage plants was similar at all production levels ($P > 0.05$). No differences were observed between HIG and MED farms (Figure 6C; $P > 0.05$).

Most Brazilian pastures consist of forage species from the genera *Urochloa* and *Megathyrsus* (Vilela et al., 2019). *Megathyrsus* pastures are widely used in MED to HIG production systems, as they are forage crops that have high productivity and consequently higher soil fertility requirements (Lima et al., 2020), resulting in higher implementation and maintenance costs. In contrast, *Urochloa* spp. pastures adapt well to LO systems with, as they are more resistant to acidic and low fertility soils, generally with lower productivity compared with *Megathyrsus* (Lima et al., 2020). Thus, the use of *Urochloa* spp. can reduce production costs in terms of implementation or maintenance.

Based on the results of the logistic regression analysis, there was a significant difference in the form of roughage supplementation used on the farms ($P < 0.05$; Figure 6D and 6E). No significant difference was observed for sugar cane supplementation or the provision of other types of supplementations ($P > 0.05$). However, in terms of grass supplementation, HIG farms were found to be 92% less likely to use grass as a form of herd supplementation compared with LO farms ($P = 0.02$). This suggests that the type of supplementation may vary depending on

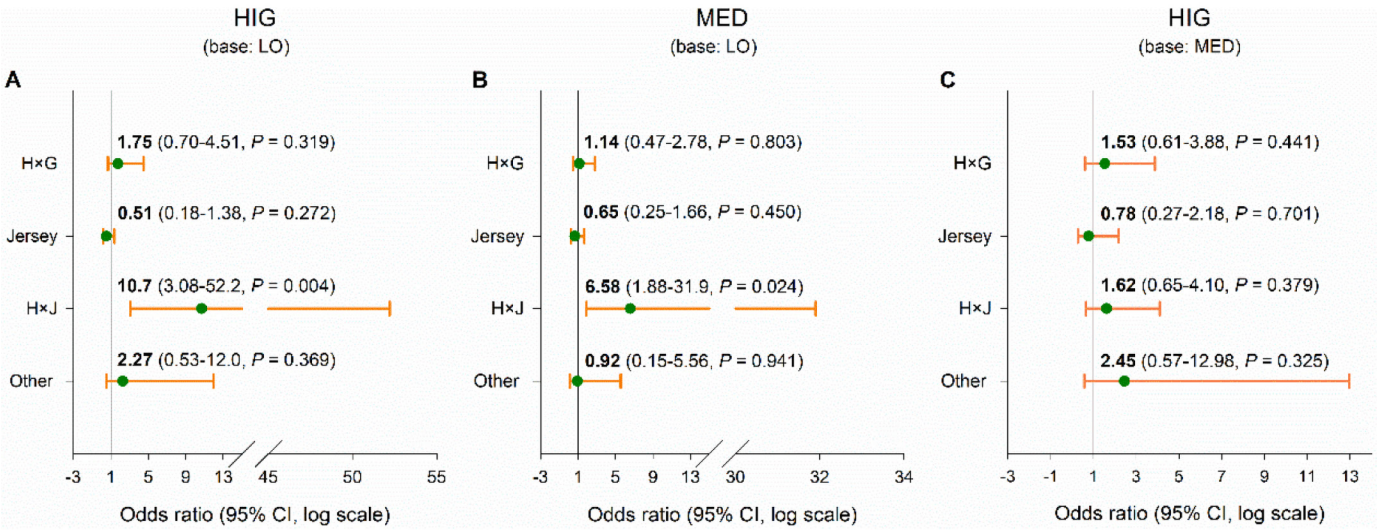

Figure 5. Effects and odds ratio from a logistic regression for the association between different production levels and dairy breeds of Brazilian organic dairy farms. LO = low production level; MED = medium production level; HIG = high production level; H × G = Holstein × Gyr crossbred; H × J = Holstein × Jersey crossbred.

the production level of the farm, with higher-producing farms tending to favor other forms of supplementation over grass. Similarly to the observations for the pastures, no differences were observed between HIG and MED farms for the roughage used (Figure 6F; $P > 0.05$)

In general, silage (corn, sorghum, and grass) was the predominant feed in all farms, regardless of production level, with more than half of the respondents opting for this type of supplement. Silva et al. (2023) conducted a study in 2019 and reported that in Rio de Janeiro, most producers use rotational grazing and supplementation with some type of roughage. The most used are chopped elephant grass (86%), chopped sugarcane (57%), hay (43%), and silage from grass, corn, or sorghum (43%).

Feed planning in production units in Santa Catarina and Paraná is a major challenge (Pacheco, 2013). Of the 30 participants in the survey, 40% did not carry out feed planning. Of those who did plan their herd's diet, 50% invested in annual summer grazing and 70% in annual winter grazing. For the supply of concentrates, 52.4% opted for commercial feed, whereas 47.6% prepared the concentrates on their own farm. In addition, half of the organic grain used was produced on site and supplemented with external products, whereas 40% of farmers purchased inputs from suppliers. Only 10% were able to produce all the feed on their own farm.

Herd Monitoring and Management

Farmers were asked if they monitor the farm and 95% said that they use some kind of tool to monitor information: notebook, spreadsheet, or management software (Figure 7). Based on the logistic regression analysis, no significant difference was found in relation to the use of a notebook or spreadsheet for monitoring control (i.e., the probability of using a notebook or spreadsheet for monitoring control was the same at all production levels; $P > 0.05$). However, a difference was observed in the use of monitoring and management software ($P = 0.033$), with HIG farms being 4.5 times more likely to use some type of monitoring and management software than LO farms. Additionally, no differences were observed between HIG and MED farms in the use of monitoring and management software (Figure 7C; $P > 0.05$).

Only 39.3% of the farmers who responded to the survey use specialized technical assistance, and of those, 18% use some type of management software. This suggests that as production levels increase, farmers are more likely to use more advanced technologies such as management software to improve the control and monitoring of farming activities and make the management of operations more efficient and accurate. In this context, one of the great challenges for Brazilian agriculture is to spread the use of technologies, such as software, in rural farms, especially in small farms. In addition to being accessible, management software can be free of charge and simplify the collection and processing of production data, enabling the planning of medium and long-term actions (Melo et al., 2021).

We also examined the share of organic dairy farming in farmers' family incomes (Figure 8). The overwhelming number of farmers for whom organic dairy production is an important part of their income indicates a strong economic dependence on this activity. We found that for

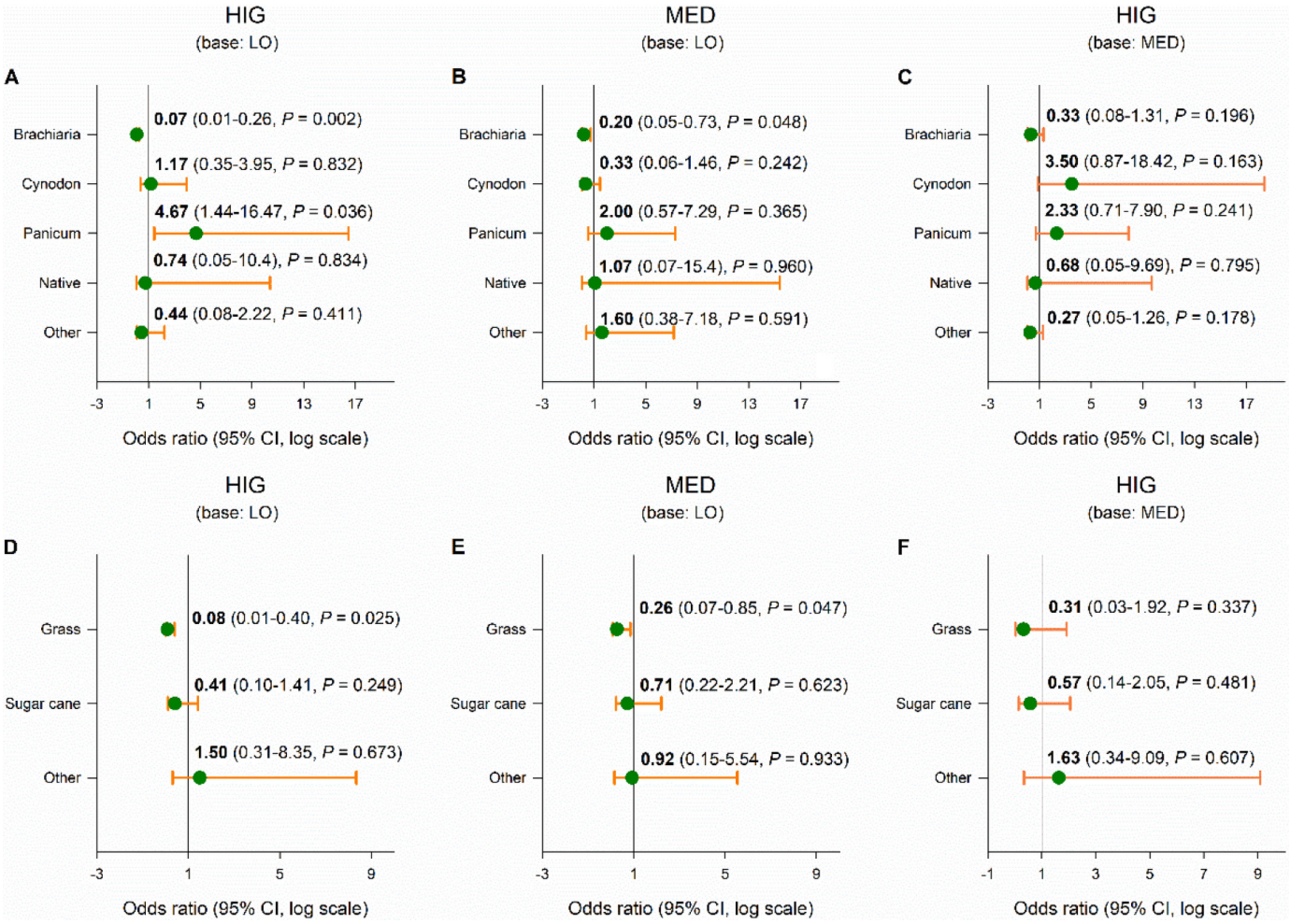

Figure 6. Effects and odds ratio from a logistic regression for the association between high and medium production levels when using grass (A, B, and C) or roughage supplementation (D, E, and F) on Brazilian organic dairy farms. LO = low production level; MED = medium production level; HIG = high production level.

about 45% of farmers who responded to the survey, organic milk production accounts for more than 75% of their income source, whereas for 21% of farmers it accounts for between 50% and 75% and for 9.8% of farmers it accounts for between 25% and 50%. However, the fact that there are states with a variety of organic production where milk accounts for less than 25% of family income underlines the need to consider strategies to strengthen the economic potential of organic milk production in the country.

Main Challenges for Organic Milk Production in Brazil

The present study examined the main challenges faced by farmers in organic dairy farming. In this sense, one of the main problems is the difficulty of marketing organic milk due to several factors, such as limited market access and competition with conventional products. In addition, the lack of organic inputs such as non-genetically modified organisms (**GMO**) and organic corn and soybean, as well as high market prices, are an obstacle. Another critical problem is the lack of knowledge about ecological systems and the lack of specialized technical advice, which often leads to inappropriate production practices. In addition, the certification process is perceived as costly and bureaucratic, which discourages many farmers from continuing their activities.

As far as health challenges are concerned, many farms are struggling with considerable difficulties. The control of endo- and ectoparasites in the herd and on pasture and the treatment of mastitis are proving to be outstanding problems. The limited availability of suitable treatment options for animals kept in organic systems exacerbates these challenges. Wallenbeck et al. (2019) showed a high prevalence of mastitis and metabolic diseases in organic systems in Europe.

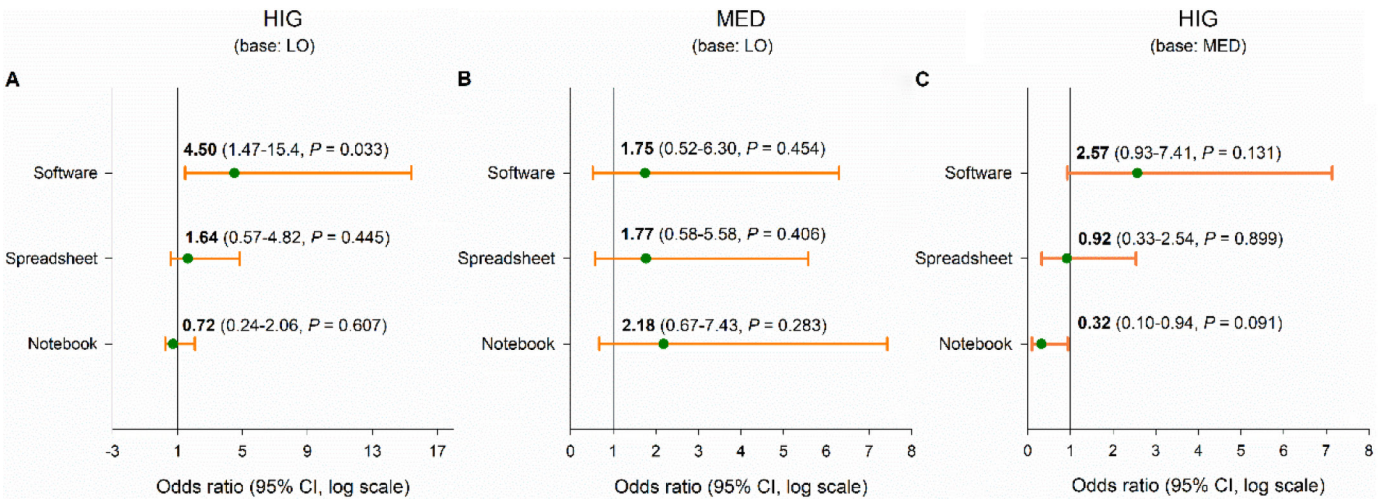

Figure 7. Effects and odds ratio from a logistic regression for the association between different production levels and herd management tools on Brazilian organic dairy farms. LO = low production level; MED = medium production level; HIG = high production level.

In this context, some farmers on the farms studied used antibiotics, whereas others took measures such as drying and separating contaminated udder and homeopathic treatments. In some countries, the use of antibiotics or anthelmintics is permitted, but the withdrawal period is quite long. In Brazil, antibiotics or other unauthorized drugs may be used at most twice a year, if necessary, with a withdrawal period of at least 96 h or twice the withdrawal period indicated on the label. If it is necessary to exceed the maximum permitted number, the animal must be removed from the organic system (Brasil, 2021).

Although some studies show good health indicators for organic farms due to the low incidence of disease (Rutherford et al., 2008; Levison et al., 2016), others indicate a high prevalence of disease (Krieger et al., 2017), reflecting the complexity and diversity of factors involved in animal health in organic systems. The use of antibiotics is controversial. Some farmers resort to them in case of illness, whereas others look for alternatives such as homeopathic and herbal treatments.

The main challenges of feed management in organic production systems include the scarcity and high cost of organic inputs and the difficulties associated with on-farm feed production (Escribano, 2018). Out of a group of 83 respondents, only 17 farmers stated that they grow any type of cereal or grain on their land. However, most farmers appear to rely on pasture as the main source of feed for their livestock, a decision that can affect livestock production depending on the genetics of the livestock (Honorato et al., 2014).

In Brazil, organic farmers are allowed to include up to 15% of non-GMO concentrates in the diet (Brasil, 2021). As Honorato et al. (2014) noted, organic farmers face challenges in sourcing these inputs, particularly due to the lack of testing for transgenes. This lack of testing is a significant obstacle, as regulations prohibit the use of transgenic products in any form (Brasil, 2021). Testing for GMO is crucial in the context of organic milk production to ensure that livestock feed, such as concentrates or supplements, meets organic standards and remains free of GMO. This is crucial for farmers as it allows them to maintain organic certification and offer consumers truly organic, GMO-free products.

When it comes to the herd, several challenges arise, focusing on the complexity of general management and in particular reproductive management. In addition, issues relating to genetics and the low productivity of organically reared animals are also a major concern. Of the 58 farmers surveyed, only 13 reported that they had no specific problems with their herd, highlighting the extent of these difficulties among farmers. According to Röös et al. (2018), the low productivity observed in organic systems can be partly attributed to the limited use of high-yielding breeds and the lower proportion of concentrates in the diet. These results underline the importance of effective management strategies and appropriate genetic selection to maximize herd productivity and welfare on organic dairy farms.

In terms of marketing, the majority of farmers pointed out the difficulty of selling their products, mainly due to the lack of processing plants for organic milk. Out of a total of 64 respondents, only 11 had no problems marketing their organic milk. When asked whether the milk produced was sold as organic milk, 21 of the 83 respondents stated that they marketed their milk as conventional milk to local dairies, large dairy companies, or direct sales to consumers. Of these responses, 8 farmers in the state of São Paulo indicated that they had ceased their activity.

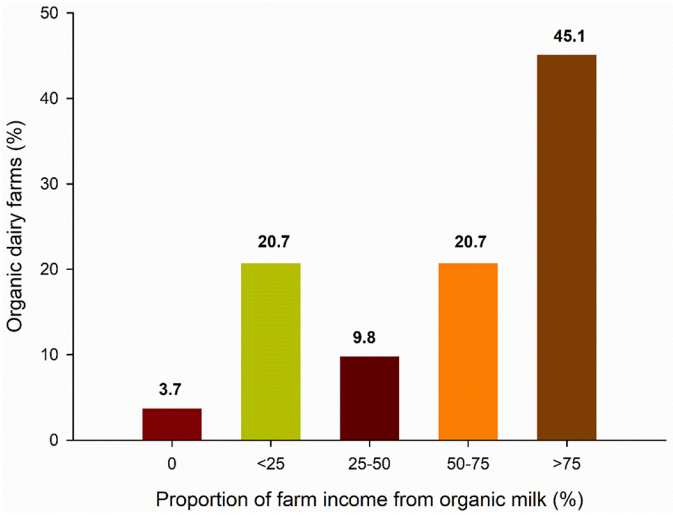

Figure 8. Percentage of organic dairy farms according to the proportion of farm income from organic milk production, by stratum.

Between 2018 and 2020, as discussed previously, dairy companies such as Nestlé and Danone made substantial investments in organic milk production in Brazil. These investments encouraged the entry of new farmers into the sector and the introduction of advanced technologies in already certified farms, especially in the Southeast. However, these companies have recently reduced and stopped collecting organic milk (Machado et al., 2021). These changes may therefore have influenced the decision of some farmers to abandon organic production.

In Brazil, the market for organic milk is still developing and the product remains more expensive than conventional milk because of several factors, including high certification costs, sustainable farming practices, and the limited availability of organic inputs. In 2022, Brazil's gross domestic product per capita was around US$8,917, whereas in the United States and European countries, where organic products are consumed on a larger scale, the gross domestic product per capita was over US$48,000, according to the World Bank. In Brazil, organic milk may be perceived as a luxury item and develop into a niche market. Despite the growing interest in healthy and sustainable food, most Brazilians still prefer cheaper options. Although the consumption of organic food is gradually increasing in the country, there is still a large gap between demand and supply.

CONCLUSIONS

The analysis of the distribution of certified organic dairy farms revealed a concentration in the southeastern region of Brazil, where production is mainly focused on milk, whereas other regions have a more diversified organic production. The production level of the farms influenced decisions regarding cattle breeds, herd supplementation, pastures types, milk productivity, and the adoption of management tools. Organic dairy farming is an important source of income for many farmers, with 45.1% of them deriving more than 75% of their total income from it. These data underline the importance of technology in organic dairy production and its significant economic contribution to farmers. However, it is noteworthy that specialized technical support and the use of management software are still adopted by a minority of farmers, indicating the opportunity for greater integration of technology into farm management. These findings highlight the need for public policies that promote the adoption of technological and sustainable practices to increase the efficiency and productivity of the organic dairy sector.

NOTES

We are grateful to the following Brazilian foundations for their help with this study: the National Council for Scientific and Technological Development (CNPq; Brasiliz, DF, Brazil), the Higher Educational Personnel Improvement Coordination (CAPES; Brasilia, DF, Brazil), the Minas Gerais State Research Support Foundation (FAPEMIG; Belo Horizonte, MG, Brazil), and Embrapa Dairy Cattle (Juiz de Fora, MG, Brazil). Supplemental material (survey) for this article is available at https://doi.org/10.17632/bdnbwrmvfs.1. The study was approved by the Human Research Ethics Committee of the Universidade Federal de Viçosa (Minas Gerais, Brazil) under protocol number 5,664,620. The authors have not stated any conflicts of interest.

Nonstandard abbreviations used: AL = Alagoas; CNPJ = Corporate Taxpayer Identification Number; CNPO = National Registry of Organic Producers; CPF = Social Security Number; DF = Distrito Federal; ES = Espírito Santo; GMO = genetically modified organisms; GO = Goiás; H × G = Holstein × Gyr crossbred; H × J = Holstein × Jersey crossbred; HIG = higher production level; IBGE = Brazilian Institute of Geography and Statistics; LO = lower production level; MG = Minas Gerais; MID = medium production level; OCS = social control organizations; PE = Pernambuco; PGS = participatory guarantee system; PR = Paraná; RJ = Rio de Janeiro; RS = Rio Grande do Sul; SC = Santa Catarina; SP = São Paulo.

REFERENCES

Brasil. 2021. Boletim da Agricultura Familiar. Conab, Brasília.

Brasil. 2025. Cadastro Nacional de Produtores Orgânicos. Accessed Jan. 1, 2025. https://www.gov.br/agricultura/pt-br/assuntos/sustentabilidade/organicos/cadastro-nacional-produtores-organicos.
Candiotto, L. Z. P. 2018. Organic products policy in Brazil. Land Use Policy 71:422–430. https://doi.org/10.1016/j.landusepol.2017.12.014.
Escribano, A. J. 2018. Organic feed: A bottleneck for the development of the livestock sector and its transition to sustainability? Sustainability (Basel) 10:2393. https://doi.org/10.3390/su10072393.
Holmström, T. C. N., D. A. Santos, N. Fragata, F. G. Ragazzi, and E. C. Modesto. 2020. The merits of organic milk production: High economic and zootechnical performance – Is this true? Int. J. Dev. Res. 10:39600–39604.
Honorato, L. A., L. C. P. Machado Filho, I. D. Barbosa Silveira, and M. J. Hötzel. 2014. Strategies used by dairy family farmers in the south of Brazil to comply with organic regulations. J. Dairy Sci. 97:1319–1327. https://doi.org/10.3168/jds.2012-6532.
IBGE (Brazilian Institute of Geography and Statistics). 2019. Censo Agropecuário 2017: Resultados Definitivos. Accessed Jan. 1, 2025. https://censoagro2017.ibge.gov.br/resultados-censo-agro-2017/resultados-definitivos.html.
IFOAM (International Federation of Organic Agriculture Movements). 2018. Working for Organic Farming in Europe - Annual Report 2018. IFOAM EU Regional Group.
KPMG. 2018. Global Organic Milk Production Market Report 1–12.
Krieger, M., K. Sjöström, I. Blanco-Penedo, A. Madouasse, J. E. Duval, N. Bareille, C. Fourichon, A. Sundrum, and U. Emanuelson. 2017. Prevalence of production disease related indicators in organic dairy herds in four European countries. Livest. Sci. 198:104–108. https://doi.org/10.1016/j.livsci.2017.02.015.
Kyrylov, Y., S. R. Thompson, V. Hranovska, and V. Krykunova. 2018. The world trends of organic production and consumption. Manag. Theory Stud. Rural Bus. Infrastruct. Dev. 40:514–530. https://doi.org/10.15544/mts.2018.46.
Levison, L. J., E. K. Miller-Cushon, A. L. Tucker, R. Bergeron, K. E. Leslie, H. W. Barkema, and T. J. DeVries. 2016. Incidence rate of pathogen-specific clinical mastitis on conventional and organic Canadian dairy farms. J. Dairy Sci. 99:1341–1350. https://doi.org/10.3168/jds.2015-9809.
Lima, S. K., M. Galiza, A. Valadares, and F. Alves. 2020. Produção e Consumo de Produtos Orgânicos No Mundo e No Brasil. 1st ed. Institute for Applied Economic Research (IPEA).
Machado, F. S., C. R. T. Castro, F. H. Diniz, W. C. P. de M. Júnior, and M. de F. Á. Pires. 2021. Leite Orgânico: Cenário Da Pecuária Leiteira Orgânica No Brasil. Document 260. Empresa Brasileira de Pesquisa Agropecuária (EMBRAPA).
Melo, D. M. de, F. C. Fernandes, S. T. da S. Costa, M. R. L. da Silva, M. R. Filho, and P. V. A. Chaves. 2021. A importância da gestão rural e da sustentabilidade em pequenas propriedades rurais. Rev. GeTeC 10:1–20.
Pacheco, D. I. 2013. Caracterização de unidades de produção de leite em sistema orgânico ou em transição: Produção e qualidade do leite. Master's dissertation. Graduate Program in Agroecosystems, Universidade Federal de Santa Catarina, Brazil.
Piao, R. S., M. S. Macchione Saes, V. L. Silva, and F. B. Bronzatto. 2021. Shaping the sustainable supply chain of organic milk in Brazil. J. Clean. Prod. 297:126688. https://doi.org/10.1016/j.jclepro.2021.126688.
R Core Team. 2025. R: A language and environment for statistical computing. R Foundation for Statistical Computing.
Röös, E., A. Mie, M. Wivstad, E. Salomon, B. Johansson, S. Gunnarsson, A. Wallenbeck, R. Hoffmann, U. Nilsson, C. Sundberg, and C. A. Watson. 2018. Risks and opportunities of increasing yields in organic farming. A review. Agron. Sustain. Dev. 38:14. https://doi.org/10.1007/s13593-018-0489-3.
Rutherford, K. M. D., F. M. Langford, M. C. Jack, L. Sherwood, A. B. Lawrence, and M. J. Haskell. 2008. Hock injury prevalence and associated risk factors on organic and nonorganic dairy farms in the United Kingdom. J. Dairy Sci. 91:2265–2274. https://doi.org/10.3168/jds.2007-0847.
Silva, J. F. M., F. A. Soares, J. C. C. Almeida, G. M. Da Costa, and A. Sanavria. 2023. Organic milk production in Rio de Janeiro State, Brazil. Concilium 23:90–104. https://doi.org/10.53660/CLM-846-23B10.
Silvano, J. 2018. O projeto da Nestlé para lançar seu leite orgânico no Brasil em 2019. Cent. Intel. Em Orgânicos.
Sorio, A. 2018. Cadeia Agroindustrial do Leite no Brasil: Diagnóstico dos Fatores Limitantes à Competitividade. Ministry of Development, Industry, Foreign Trade and Services (MDCI).
Vilela, G. F., J. A. de C. Mangabeira, L. A. Magalhães, and S. G. Tôsto. 2019. Agricultura Orgânica No Brasil: Um Estudo Sobre o Cadastro Nacional de Produtores Orgânicos. Document 127. Empresa Brasileira de Pesquisa Agropecuária (EMBRAPA) Territorial.
Wallenbeck, A., T. Rousing, J. T. Sørensen, A. Bieber, A. Spengler Neff, B. Fuerst-Waltl, C. Winckler, C. Peiffer, F. Steininger, C. Simantke, S. March, J. Brinkmann, J. Walczak, P. Wójcik, V. Ribikauskas, S. Wilhelmsson, T. Skjerve, and S. Ivemeyer. 2019. Characteristics of organic dairy major farm types in seven European countries. Org. Agric. 9:275–291. https://doi.org/10.1007/s13165-018-0227-9.
Willer, H., J. Trávníček, and B. Schlatter. 2024. The World of Organic Agriculture: Statistics and Emerging Trends 2024. 25th ed. Research Insitute of Organic Agriculture (FiBL) and IFOAM – Organics International. Accessed Oct. 22, 2025. https://orgprints.org/id/eprint/52272/.

ORCIDS

Amanda B. Sant'ana, https://orcid.org/0000-0002-2656-9452
Fernanda S. Machado, https://orcid.org/0000-0002-7380-4961
Fábio H. Diniz, https://orcid.org/0000-0003-2160-6434
Maria F. A. Pires, https://orcid.org/0000-0002-1186-3018
Polyana P. Rotta, https://orcid.org/0000-0002-1185-8120
Emília F. Ribeiro, https://orcid.org/0000-0002-4287-3446
Alex L. Silva https://orcid.org/0000-0002-3288-4387