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Management Practices Of Lean Supply Chain Operations: Performance Of Brazilian Dairy Farmers

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Abstract:
Background*: Management-related aspects are seldom explored in research in the dairy chain. This article aims analyze operations management practices and the relationship between dairy farmers and industries from the dairy farmers´ perspective, based on lean supply chain management.*
Materials and Methods*: A structured questionnaire composed of forty-one practices divided into eight conceptual pillars of lean supply chain management was applied to dairy farmers located in the Midwest region of São Paulo State, Brazil. The collected data were analyzed using multivariate analysis of multiple correspondence.*
Results*: The results shows that the practices performed are associated with the commitment of owners and the elimination of waste in the process. Partially performed practices are inherent to supply management with suppliers, customer relationship management, logistics management, and continuous improvement. Finally, the main risk to the dairy chain is associated with the non-use of information technologies by dairy farmers.*
Conclusion: *This study contributes to the literature by presenting practices for evaluating operations management in dairy farms, to signalize which are your bottleneck areas. In addition, the study assists the creation of action plans that provide small farmers with operational gains and quality in terms of property management, motivating them to make the right investments in their dairy activities to encourage them to remain active.*
Key Word*: lean supply chain; management of dairy property; small-scale family entrepreneur; restrictions of the production chain.*

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I. Introduction

Globally, Brazilian food production stands out. The country is among the main producers and exporters of agribusiness products (FAO, 2020). Agribusiness accounted for 26.6% of gross domestic product (CEPEA/CNA, 2020). Although Brazilian agribusiness products have a high degree of competitiveness, others such as milk do not have the same performance.

In several countries, Brazilian milk production fulfills important economic and social functions (IBGE, 2019). In Brazil, it is estimated that 1.1 million families depend on dairy activity as their main source of income (IBGE, 2020). Additionally, milk production occupies regions where other agricultural activities are less viable, contributing to the establishment of humans in the countryside and the development of some regions (Bánkuti and Caldas, 2018). Brazilian milk production is predominantly conducted in family systems and low-scale production (IBGE, 2019). This characteristic imposes on its managers (rural farmers) the challenge of meeting the current demands of the markets aimed at production on a larger scale, quality, and standardization of products, among others. Such demands are almost always achieved through financial investments in technologies and productive assets, such as land, animals, and food, as well as through efficient management of the system and the relationships between the agents of a production chain.

Although Brazil is one of the largest milk producers in the world, productivity indicators in Brazilian dairy systems are low compared with those obtained in systems in other countries (Lima et al., 2020). In addition, the share of Brazilian milk foreign markets has been minimal over the years (FAO, 2020). This situation may indicate the presence of management failures in dairy production systems and problems in the relationship between dairy farmers and the milk buying industry (Simões et al., 2021). These obstacles may partly explain the departure of an important proportion of rural farmers from dairy activities in Brazil over the last few years (IBGE, 2019).

Several studies have demonstrated deficiencies in the management of Brazilian milk production systems (Paixão et al., 2017; Zimpel et al., 2017). Others have pointed to problems in the relationship between dairy farmers and industry, such as information asymmetry, uncertainty, and opportunism in transactions (Brito et al., 2015; Casali et al., 2020; Simões et al., 2021). However, few studies have analyzed these issues in an integrated way and considered small-scale dairy farmers perspectives, we understand that the joint analysis of these aspects, considering the perspective of small-scale dairy farmers, can represent a crucial step in understanding the obstacles to increasing the competitiveness of the Brazilian milk production chain. Therefore, the objective is to jointly analyze operations management practices and the relationship between dairy farmers and industries from the dairy farmers´ perspective, based on lean supply chain management.

II. Material And Methods

The analysis of aspects of operations management and the relationship between small-scale dairy farmers and industries from the perspective of rural farmers was conducted based on the theory of lean supply chain management (LSCM). Considering this theory, we understand that organizations are directly connected by downstream flows of products, services, information, and funding that work together to reduce costs and waste, efficiently removing what is needed to meet individual customer needs (Vitasek et al., 2005).

There is a wide range of models for the evaluation of LSCM in the literature, as indicated by reviews conducted by Jasti and Kodali (2015) and Tortorella et al. (2018). Most of these are associated with eight essential pillars of LSCM (Jasti and Kodali, 2015) known as information technology management, supply management, waste elimination, production, customer relationship management, logistics management, ownership commitment, and continuous improvement.

In research, pillars are broken down at the operational level practices that can be understood, according to Marodin et al. (2017), to operationalize the LSCM principles and transcribe a way to carry them out daily in the workplace. However, there is no consensus in the literature on the composition or quantity of practices belonging to the pillars. According to Moyano-Fuentes et al. (2019), this occurs because of the need to explore analytically or empirically the constituent practices of the LSCM. Jasti and Kodali (2015) computed a set of eighty-two practices, while Tortorella et al. (2017) and Soares et al. (2021) counted twenty-seven practices; in the present study, forty-one constituent practices of the LSCM were listed.

However, according to Moyano-Fuentes et al. (2019), although the literature highlights the benefits of LSCM, few studies have analytically or empirically explored the constituent practices of lean supply chain management.

Data and information collection

Data and information were collected using a structured form comprising of two sections. The first section consisted of questions that characterized the sociodemographic and productive profiles of the respondents. The second section, composed of a matrix, was elaborated around the eight pillars of the LCSM, and included forty-one practices selected from the proposal by Jasti and Kodali (2015), which were adapted and validated by three experts. Thus, in its final format, the form is composed of forty-six variables, as shown in Table 1.

Table no 1: Variables investigated by the LSCM pillar and its data type.

First Section: Sociodemographic and production variables	**Data Type**
Owner's age (years)	Numerical
Gender	Ordinal (male or female)
Foundation year of the dairy farm	Numerical
Daily milk production volume (liters/day)	Numerical
Milk is the main economic activity of the property	Categorical (yes or no)
Second Section: Practices of LSCM	
Pillar A. Information technology management	
A1. Do you use computer programs to organize ownership?	Ordinal
A2. Do you use apps to organize ownership?	Ordinal
A3. Do you use a database on your computer documentation?	Ordinal
A4. Are you using information technology in communication with customers?	Ordinal
A5. Are you using technology in product tracking?	Ordinal
Pillar B. Management of suppliers	
B1. Do you search for new and better suppliers?	Ordinal
B2. Do you have a long-term partnership contract with suppliers?	Ordinal
B3. Do you accept suggestions or assistance from suppliers?	Ordinal

B4. Do you work with suppliers to reduce losses?	Ordinal
Pillar C. Waste elimination	
C1. Do you sell all the milk produced?	Ordinal
C2. Do you seek to reduce failures in the milking management process?	Ordinal
C3. Do you have control of the products in stock? (Animal food/medicines)	Ordinal
C4. Do you have control of the milking process to avoid improper processing?	Ordinal
C5. Is there standardization in the transport of milk from the milking to the tank, that is, always performing the same procedure?	Ordinal
C6. Do you have procedures to follow when failures/breaks occur?	Ordinal
C7. Do you make changes to the physical space to improve the movement of the milking parlor?	Ordinal
C8. Do you accept the opinion of employees to make improvements?	Ordinal
Pillar D. Production	
D1. Are you using means to control and monitor production steps?	Ordinal
D2. Are you using the same number of lactating animals during the year?	Ordinal
D3. Do you have a forecast of the volume of milk produced per month?	Ordinal
D4. Is there standardization in the milking process?	Ordinal
Pillar E. Customer relationship management	
E1. Is the amount to be paid for the product (milk) determined by customers (dairy/reseller)?	Ordinal
E2. Do you have a long-term partnership with customers (dairy/reseller)?	Ordinal
E3. Is customer satisfaction monitored after product delivery?	Ordinal
E4. Do you continuously evaluate customer reviews (dairy/reseller)?	Ordinal
Pillar F. Logistics management	
F1. Do you use third parties to transport milk?	Ordinal
F2. Is there a day and time routine for milk collection transportation?	Ordinal
F3. Looking for improved delivery performance (if there is own transportation)?	Ordinal
Pillar G. Commitment of owners	
G1. Do you have a vision that your property is a company?	Ordinal
G2. Do you think your customers (dairy/reseller) are part of the business?	Ordinal
G3. Do you consider your suppliers to be part of the business?	Ordinal
G4. Do you participate in training and capacitation?	Ordinal
G5. Do you take your employees into training and capacitation?	Ordinal
G6. Do you have the actions to develop employees for new command positions?	Ordinal
G7. Are there concerns of the owners about identifying and eliminating waste/losses?	Ordinal
Pillar H. Continuous improvement	
H1. Do you look for improved milk quality?	Ordinal
H2. Is it performed a continuous analysis of milk quality?	Ordinal
H3. Is there a continuous analysis of the feed intake?	Ordinal
H4. Is there an annual soil analysis conducted?	Ordinal
H5. Do you have control of process costs from milking to distribution?	Ordinal
H6. Are you using cost reduction methods?	Ordinal

Ordinal variables were measured on a three-point scale: "performs" (3), "performs in parts" (2), and "does not perform" (1).

For the variables of the second section of the form, based on the judging criteria, the respondents indicated in this matrix on an ordinal scale with three points – Likert scale (Likert, 1932), which are called "performs" (3), "performs in parts" (2) and "does not perform" (1). According to Malhotra (2019), the three-point Likert scale represents a psychometric measurement in which the interviewees express their perception of a particular statement answering the questionnaire and reveal measures of intensity and direction. Several studies have used the Likert scale to assess rural farmers' perceptions of the different practices adopted in production systems (Lopes et al., 2020; Lima et al., 2020; Bánkuti et al., 2020). The use of the three-point scale is appropriate for this research because it transmits credibility and adapts to the level of understanding of the interviewees (Dalmoro and Vieira, 2014), in this research, rural farmers of the dairy chain.

Research locality

The study was carried out with farmers in the state of São Paulo, the sixth largest milk producer in the country. In 2019, 2.8 billion liters of milk were produced by IBGE (2020) in São Paulo, representing over 11 per cent of Brazilian production. Thus, as in the whole country, milk production in the State of São Paulo is mainly carried out by small-scale dairy farmers.

Research sample

According to data obtained from the Coordination of Integrated Technical Assistance (CATI, 2019), 688 small-scale dairy farmers are working in the target region of the research, located in the Midwestern part of São Paulo State, Brazil, composed of 14 municipalities in the micro-region of Tupã city. Of these, sixty-eight farmers from seven municipalities in this microregion were randomly sampled systematically. The response rate was valid for experimental planning, achieving a confidence level of 90 percent and a margin of error of 10 percent.

To guarantee the validity of the data and the knowledge of the respondents, the survey population consisted of dairy farmers selected using systematic aleatory sample criteria (Yin, 2017). Data collection was conducted for nine months (October 2018 to May 2019) through personal and individual interviews. Access to dairy farmers initially occurred through a list of farmers provided by government agencies and associations active in the study region, such as the CATI, the Rural Union, and the Kamby/UNESP extension project. In addition to this list, the researchers participated in meetings and field days to include new individuals in the research sample and further on to the indication made by the farmers of new potential participants.

Data and information analysis

Sociodemographic profile and production variables (section 1 of the questionnaire) were characterized using descriptive quantitative analysis by calculating the percentage of score items. The data collection in section 2 was analyzed by multivariate analysis of multiple correspondences. Therefore, this study analyzes the relationship between contextual practices and performance in the milk supply chain, with an extension to LSCM components based specifically on the eight pillars and forty-one practices shown previously.

A multivariate analysis of multiple correspondences (MCA) is perceived as a spatial map that involves three or more related categorical variables in a common perceptual space. This technique allows for data analysis through the association between a set of attributes. In general, the data are presented in graphic form, together with the qualitative association between rows and columns (Hair et al., 2013; Malhotra, 2019). MCA was generated using the Minitab software®.

III. Result

The sociodemographic and production variables identified that most respondents were producers with an average age of 44 years, in which 15 percent of respondents were female and 85 percent were male, and 25 percent of respondents were "children working in the field". The sampling properties began in milk activity between 1928 and 2018, and 98.5 per cent of those properties had milk production as the main economic activity. Among the respondents, there was a high average variation in daily milk production, ranging from 10 to 2,700 liters of milk.

For the data related to LSCM management practices, Table 2 shows the results of questions related to the practices applied in the dairy systems based on the eight theoretical pillars of the LSCM.

Table no 2: Percentage data (%) obtained from the survey of dairy farmers in a region of Sao Paulo State

A. Information technology management	P	PP	NP
A1. Do you use computer programs to organize ownership?	2.9	4.4	92.6
A2. Do you use apps to organize ownership?	7.5	3.0	89.6
A3. Do you use a database on your computer documentation?	4.4	1.5	94.1
A4. Are you using information technology in communication with customers?	8.8	2.9	88.2
A5. Are you using technology in product tracking?	1.5	2.9	95.6
B. Management of suppliers	P	PP	NP
B1. Do you search for new and better suppliers?	64.2	6.0	29.9
B2. Do you have a long-term partnership contract with suppliers?	3.0	3.0	94.0
B3. Do you accept suggestions or assistance from suppliers?	53.7	10.4	35.8
B4. Do you work with suppliers to reduce losses?	28.4	9.0	62.7
C. Waste elimination	P	PP	NP
C1. Do you sell all the milk produced?	82.4	10.3	7.4
C2. Do you seek to reduce failures in the milking management process?	80.6	9.0	10.4
C3. Do you have control of the products in stock? (Animal food/medicines)	64.2	14.9	20.9
C4. Do you have control of the milking process to avoid improper processing?	78.8	9.1	12.1
C5. Is there standardization in the transport of milk from the milking to the tank, that is, always performing the same procedure?	88.2	1.5	10.3
C6. Do you have procedures to follow when failures/breaks occur?	57.4	7.4	35.3
C7. Do you make changes to the physical space to improve the movement of the milking parlor?	29.9	4.5	65.7
C8. Do you accept the opinion of employees to make improvements?	64.0	4.0	32.0
D. Production	P	PP	NP
D1. Are you using means to control and monitor production steps?	55.2	10.4	34.3

D2. Are you using the same number of lactating animals during the year?	44.1	30.9	25.0
D3. Do you have a forecast of the volume of milk produced per month?	91.2	5.9	2.9
D4. Is there standardization in the milking process?	85.1	10.4	4.5
E. Customer relationship management	P	PP	NP
E1. Is the amount to be paid for the product (milk) determined by customers (dairy/reseller)?	80.9	7.4	11.8
E2. Do you have a long-term partnership with customers (dairy/reseller)?	16.4	1.5	82.1
E3. Is customer satisfaction monitored after product delivery?	52.2	6.0	41.8
E4. Do you continuously evaluate customer reviews (dairy/reseller)?	46.3	9.0	44.8
F. Logistics management	P	PP	NP
F1. Do you use third parties to transport milk?	83.8	0.0	16.2
F2. Is there a day and time routine for milk collection transportation?	75.0	10.3	14.7
F3. Looking for improved delivery performance (if there is own transportation)?	22.2	0.0	77.8
G. Commitment of owners	P	PP	NP
G1. Do you have a vision that your property is a company?	80.6	7.5	11.9
G2. Do you think your customers (dairy/reseller) are part of the business?	85.3	7.4	7.4
G3. Do you consider your suppliers to be part of the business?	85.3	7.4	7.4
G4. Do you participate in training and capacitation?	60.6	9.1	30.3
G5. Do you take your employees into training and capacitation?	19.0	23.8	57.1
G6. Do you have the actions to develop employees for new command positions?	20.0	10.0	70.0
G7. Are there concerns of the owners about identifying and eliminating waste/losses?	88.2	2.9	8.8
H. Continuous improvement	P	PP	NP
H1. Do you look for improved milk quality?	91.2	5.9	2.9
H2. Is it performed a continuous analysis of milk quality?	92.6	4.4	2.9
H3. Is there a continuous analysis of the feed intake?	20.6	4.4	75.0
H4. Is there an annual soil analysis conducted?	60.3	5.9	33.8
H5. Do you have control of process costs from milking to distribution?	58.8	17.6	23.5
H6. Are you using cost reduction methods?	54.4	22.1	23.5

* Legend: A to H – Pillars of LSCM; Ai to Hn–Variables investigated by the pillar; P–performs; PP–performs in parts; NP–does not perform

The data presented in Table 2 were applied as inputs to the MCA. The results obtained from the analysis of the objects, practices, and attributes are listed in Table 3.

Table no 3: MCA results for the analysis of objects, practices, and attributes

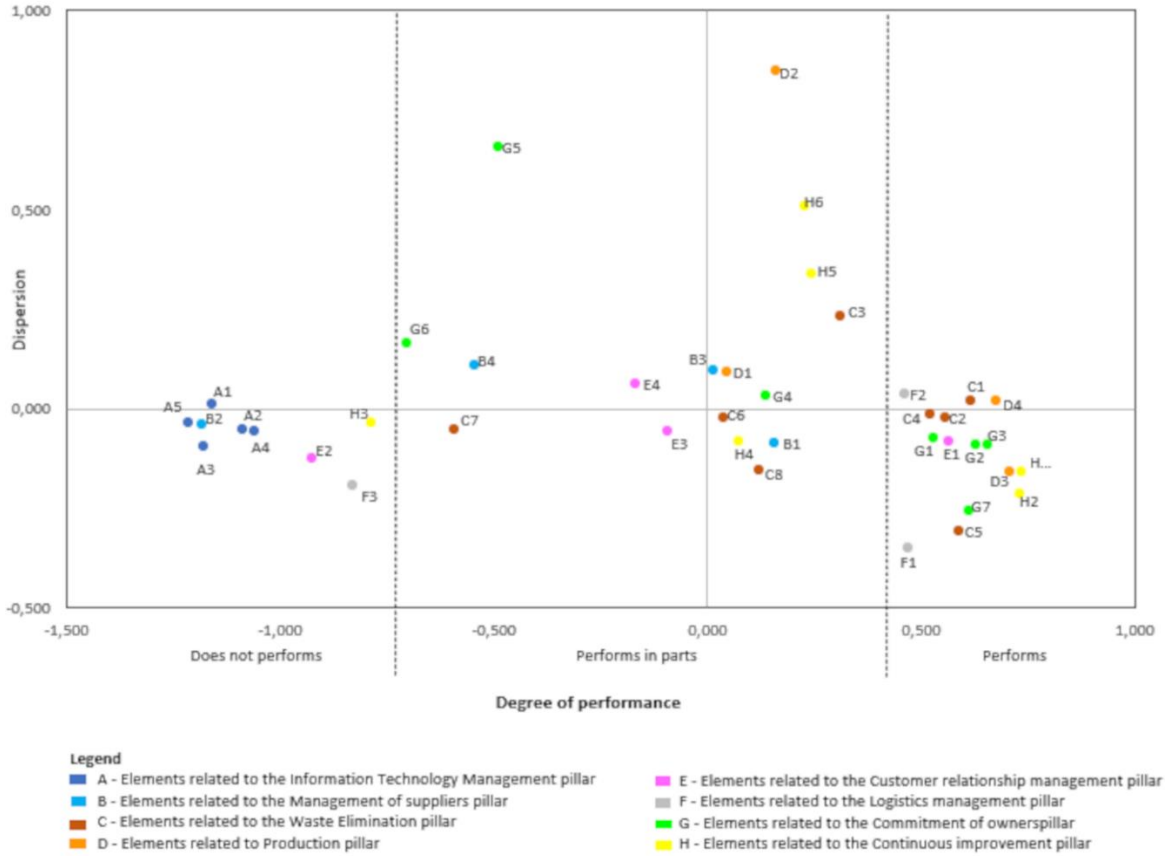
Object	Mass	Inertia	Coordinate		Contribution	
			I	II	I	II
Practice						
A1	0.026	0.075	-1.160	0.011	0.052	0.000
A2	0.026	0.066	-1.089	-0.051	0.045	0.001
A3	0.026	0.078	-1.179	-0.097	0.054	0.005
A4	0.026	0.063	-1.061	-0.056	0.043	0.002
A5	0.026	0.083	-1.216	-0.038	0.057	0.001
B1	0.026	0.002	0.158	-0.088	0.001	0.004
B2	0.026	0.077	-1.184	-0.040	0.053	0.001
B3	0.026	0.000	0.014	0.097	0.000	0.004
B4	0.026	0.017	-0.547	0.108	0.011	0.006
C1	0.026	0.022	0.615	0.020	0.015	0.000
C2	0.026	0.017	0.556	-0.023	0.012	0.000
C3	0.026	0.008	0.311	0.230	0.004	0.025
C4	0.026	0.014	0.520	-0.014	0.010	0.000
C5	0.026	0.025	0.589	-0.308	0.013	0.046
C6	0.026	0.000	0.038	-0.022	0.000	0.000
C7	0.026	0.019	-0.591	-0.055	0.013	0.001
C8	0.010	0.002	0.121	-0.157	0.000	0.004
D1	0.026	0.000	0.046	0.093	0.000	0.004
D2	0.026	0.041	0.160	0.847	0.001	0.346
D3	0.026	0.031	0.706	-0.159	0.020	0.012
D4	0.026	0.025	0.675	0.018	0.017	0.000
E1	0.026	0.016	0.564	-0.081	0.011	0.003
E2	0.026	0.049	-0.926	-0.127	0.033	0.008
E3	0.026	0.000	-0.094	-0.058	0.000	0.002

E4	0.026	0.002	-0.169	0.063	0.001	0.002
F1	0.026	0.019	0.471	-0.349	0.009	0.059
F2	0.026	0.013	0.460	0.038	0.008	0.001
F3	0.004	0.005	-0.829	-0.194	0.004	0.002
G1	0.026	0.016	0.530	-0.076	0.011	0.003
G2	0.026	0.022	0.627	-0.092	0.015	0.004
G3	0.026	0.022	0.657	-0.092	0.015	0.004
G4	0.026	0.002	0.136	0.032	0.001	0.000
G5	0.008	0.011	-0.490	0.659	0.003	0.065
G6	0.008	0.009	-0.705	0.166	0.006	0.004
G7	0.026	0.025	0.614	-0.256	0.015	0.032
H1	0.026	0.031	0.736	-0.159	0.020	0.012
H2	0.026	0.033	0.732	-0.215	0.021	0.022
H3	0.026	0.035	-0.788	-0.034	0.024	0.001
H4	0.026	0.000	0.075	-0.081	0.000	0.003
H5	0.026	0.009	0.244	0.340	0.002	0.056
H6	0.026	0.017	0.226	0.508	0.002	0.124
Attribute						
Performs (P)	0.552	0.343	-0.476	0.065	0.364	0.084
Performs in parts (PP)	0.078	0.079	-0.238	-0.565	0.013	0.909
Does not perform (NP)	0.370	0.577	0.760	0.023	0.623	0.007

A high degree of uniformity was noted for the practices when analyzing the resulting mass values of the objects of analysis. However, this fact is different for the attributes, where it is observed in the statistical inference representativeness of 55.2 per cent for the P (perform) attribute, 37.0 per cent for the NP (does not perform) attribute, and 7.8 per cent for the PP (partially performs) attribute. This result indicates that the analysis is adequate to explain how the practices are distributed in these attributes. This will allow us to respond to the research objective of jointly analyzing aspects of operations management and the relationship between milk farmers and industries from the perspective of rural farmers.

Therefore, coordinate data I (x-axis) and II (y-axis), available in Table 3, are plotted in the scatter plot in Figure 1, which presents the behavior of the dairy farmers interviewed for each practice.

Figure no 1: Multivariate analysis of multiple correspondences relating to management practices for dairy farmers.



The X-axis, called the degree of performance, represents the performance of the practice by the respondent, and the more to the right of the graph (scale 1.0), the higher the percentage of dairy farmers who perform the practice. At a medium point, as the intersection is closer to the Y-axis (scale 0.0), the practice is performed in parts. On the other side, closer to the left of the graph (scale -1.5), it represents the percentage of dairy farmers who do not perform the practice.

The Y-axis, called the degree of dispersion of the results, represents the concentration of the responses. If the practice is close to 0.0, there is greater uniformity between dairy farmers in terms of the degree of performance (x-axis). In addition, the practices are subdivided by color, which represents the pillars of the LSCM to which they are linked.

The distribution of practices in Figure 1 is the result of the values calculated using the Contribution I indicator. Associated with the mass values obtained from the previously mentioned attribution calculation, it is possible to identify how 41 evaluated LSCM practices are being applied by the interviewed dairy farmers, as represented in Table 4.

Table no 4: Distribution of management practices evaluated according to the degree of performance.

Degree of performance	Practices	% of practices
Performed	C1, C2, C4, C5, D3, D4, E1, F1, F2, G1, G2, G3, G7, H1, H2	36.6
Performed in parts	B1, B3, B4, C3, C6, C7, C8, D1, D2, E3, E4, G4, G5, G6, H4, H5, H6	41.5
Does not perform	A1, A2, A3, A4, A5, B2, E2, F3, H3	22.0

Table 4 shows that for the practices evaluated by the survey, 36.6 per cent are performed, 41.5 per cent are performed in parts and 22.0 per cent are not performed by the dairy farmers interviewed. Considerations for each practice and their impacts on dairy farm management are presented in the Discussion section.

IV. Discussion

Management practices performed by dairy farmers

This section discusses the impacts of the practices performed by dairy farmers (see Table 4).

For the interviewed dairy farmers, rural land was perceived as a company (practice G1). This aspect is important in terms of business management, as it shows the need to maintain financial sustainability. A common

feature of farmers is the performance of several crops, which allows them to bring safety due to the risks inherent in the perishability of the product and edaphoclimatic changes.

The understanding of rural land as a business extends to chains and customers, which are indicated by the respondents as part of the business (practices G2 and G3). The milk supply chain is considered a chain risk in which the actors in the chain must be connected in a way that makes it possible to manage and perhaps reduce these risks (Daud; Putro; Basri, 2015). This vision of partnership, indicated by dairy farmers, can be explored in terms of managing the relationship between suppliers and customers. This can be achieved by creating medium- and long-term contracts that would bring a single contact point to the chain. Therefore, Muhammad et al. (2014) called for a primary, accurate, complete, reliable, timely, and continuous flow of information to all parties in the dairy chain.

Nonetheless, it is observed that this partnership lacks improvement, noting that the farmers indicate that it is the dairy farmer who determines the price to be paid for the product (practice E1). The literature shows that in emerging countries, small dairy play a central role and are responsible for the supply of 80–90 per cent of milk produced (FAO, 2022). Although it is noted that dairy products for the region studied exercise bargaining power, according to Casali et al. (2020), its dominant role in the sector. Nicholson and Stephenson (2015) justified this oscillation in the price determined by dairy products and the consequent unstable profitability of the chain to the seasonality of production and inadequate management practices on the property, which would lead to a reduction in product quality.

All dairy farmers sell all milk produced (practice C1). This sale is mainly dairy, which is located within a 60 km radius of the property, and is compatible with studies showing this aspect, such as Roman (2018) and Eide (2002).

The distance from where dairy products is processed and from farmers means that the milk transported from a farmer to a dairy processor is carried out by third parties (practice F1), with a date and time for collection (practice F2).

This collection by third parties is mainly due to outsourced transport refrigerated trucks contracted by dairy farmers, which establish collection routes to aggregate the production volumes of small dairy farmers (Kazancoglu et al., 2018). Dairy farmers have the advantage of not moving for product delivery and are not directly responsible for ensuring the quality of their products by normative standards.

However, the farmer must ensure that in the event of problems with the milk collected in shared tanks or storage, and because of the route chosen by the outsourced transport, it is not unfairly punishable. Monitoring by dairy farmers is important because of the characteristics of local non-refrigerated trucks, which, along the route, may suffer a loss of milk temperature and cause a loss in quality. This fact, according to Eide (2002), does not occur when this transport is carried out in refrigerated trucks, even at higher distances.

Roman (2018) also mentioned that negative points in milk transport are evident when there are aspects such as the fragmentation of dairy farmers (many low-volume farmers distributed in the same region). These aspects can include different transport routes, seasonal production variations, and deficiencies in milk storage, as they are changeable problems that change the microbiological and physicochemical properties of the product, as well as the planning of milk transport to dairy farms.

Farmers who partially sell their milk justify that this is due to the production of milk by-products (e.g., cheese) and their consumption. The production of milk derivatives is a beneficial alternative that allows farmers to increase income due to the higher added value of the product.

Knowledge of the monthly production volume of milk (practice D3) by dairy farmers provides security in terms of the possibility of promising future sales. Regardless, in terms of management, dairy farmers can exploit this information to generate a forecast vision of revenue, production costs, and in negotiations with dairy processors of the price to be paid for the delivery of a minimum volume of production. In a study conducted by Sabbag and Costa (2015), in the same region of this data collection, it was reported on the importance of knowing the costs of milk property production, in order not to assume a high risk of failure and low profitability within a process.

Another point that reinforces the business view of dairy farmers is the concern for the identification and elimination of waste and losses, as indicated by the respondents (practice G7). At this point, it was confirmed that dairy farmers focus on the central process (milking). They perform steps in a standardized manner (practice D4) and work to reduce process failures using waste elimination measures (practice C2). They also control the process by avoiding inadequate processing (practice C4) and standardize the transport of milk from the milk to the tank (practice C5), which is carried out by plumbing or gallons.

However, the indication of the conduct of standardized measures by dairy farmers in the milking process does not imply that it is being carried out properly or follows the manuals of good practice, which only shows that they always occur in the same way. One of the reasons for the greatest loss in dairy production is clinical and subclinical mastitis in the herd. In a study by Costa et al. (2017), losses of 15.2 per cent to 20.7 per

cent were found in two types of production analyses due to cases of subclinical mastitis, given a somatic cell count (SCC) greater than or equal to 200,000 mLcells-1.

For this purpose, participation in training will allow farmers to acquire knowledge of production management tools that are clear, simple, and cost-effective (Belhadi et al., 2018). Samples of management tools are flowcharts, Ishikawa diagrams, and visual management, which will help standardize production with the guaranteed execution of best practices.

The introduction of the above practices will contribute to a constant search for improvements in the quality of the product (practice H1) and the continuous analysis of milk quality (practice H2) of dairy farmers. At this point, it is worth noting that Brazilian milk is considered of low quality (Defante et al., 2019), and the search for improvement of milk quality by dairy farmers could be affected by the new norms of milk standards that entered into force in 2019. Furthermore, farmers who perform the continuous analysis of milk are affected by the local culture of dairy processing in providing technical reports.

Milk quality is one of the biggest problems with traditional milk production systems, where several factors influence animal genetics, such as management practices, quality and safety of food offered to animals, type of milking, use of excess medicines, and transport of milk (Daud; Putro; Basri, 2015).

Management practices partially performed by dairy farmers

This section discusses the impacts of the practices partially performed by dairy farmers (see Table 4).

This partial execution of operations management practices often means that dairy farmers divide the dichotomy between the practice and the dichotomy in its application. In other cases, there are categories with percentage distribution, which indicates migration from non-performing to performing the practice.

Among the practices shown in this process of evolution by farmers are measures to control the costs of the process (practice H5), which represents a search for professional management of rural land. This measure by dairy farmers is limited to the control of the cost of high-impact production, including feed and medicines, and there are few cases in which the farmer determines the cost of production of the liter. The progress in practice H5 is causally related to the use of cost-reduction methods (practice H6), which are presented in this developmental profile of dairy farmers.

The economic factors of dairy products are also associated with good practices adopted in property management. Studies have shown that the introduction of rational management brings economic benefits, such as increased milk production, decreased mortality rates, and decreased use of antibiotics. It also brings benefits to workers who, as a result, work with most domesticated animals and improve the relationship between humans and animals, and are at lower risk of work accidents, with an increase in work motivation and a lower turnover of workers (Costa and Ceballos, 2021).

Although these two practices are evolving, there is a wide margin for farmers to act in this aspect to work with productivity indicators that allow the comparison of results, the creation of indicators, and the visualization of the possibility of improvements in the property. For example, the need for improvement in practices is cited, such as those related to the establishment of procedures for failures/breaks (practice C6), the use of means for controlling and monitoring production steps (practice D1), the control of stock supplies (practice C3), the use of the same number of lactating animals during the year (practice D2), and annual soil analysis (practice H4). The integration of rural properties in programs with technical assistance and educational lectures on sound agricultural practices is important to alleviate failures and breaks in processes within the dairy production chain as well as to help monitor the stages and control production costs.

Another point, partially performed by the farmer, is the constant improvement in the physical milk space (practice C7). In Brazilian dairy farming, specifically for milk management, it is recommended to follow the Guide to Good Practices in Dairy Cattles (FAO, 2011). In addition, the normative instructions IN76 and IN77, established by the Ministry of Agriculture, Livestock, and Supply (MAPA) on November 26, 2018, to produce raw milk, appropriate management, facilities, forms, and hygiene regulations are presented in these materials, including information for quality production.

Tischer et al. (2018) analyzed dairy products in Southern Brazil and found that if good practices, particularly hygiene, were not followed, it caused a direct decline in the quality of dairy products.

Pires and Oliveira (2021) showed that adopting sound agricultural practices on dairy farms improves production by between 13 per cent and 20 per cent and leads to an improvement in milk quality, reducing SCC levels in milk by between 30 and 37 per cent, and up to 31 per cent of CBT levels.

Nonetheless, for this paradigm shift in rural dairy management, constant search for information is necessary. Currently, only some dairy farmers and some employees participate in training and capacitation (practices G4 and G5). According to Lourenzani (2006), management skills are crucial for minimizing the negative effects on the development of dairy farming. With skill development, the farmer can understand how the different links of the production chain are connected and understand the development of projects, production

decision-making, and choice of technologies to be used, among other factors that may affect business performance.

In the research locality, training and capacity are often offered by rural unions, government agencies, and often by suppliers and dairy processors to maintain the farmer.

Even though there is an effort in the region to study actions that propose to train and qualify teams, the MCA analysis indicated that there is partial development of actions by dairy farmers to develop staff for leadership positions (practice G6). From this perspective, dairy farmers do not exploit the benefits inherent in the development of personal leadership, including the responsibilities of professional leadership, the demonstration of knowledge, the construction of trust, the care and sharing of people, and moral action (Mastrangelo et al., 2004).

Sometimes, the family rural farmer has property collaborators who act directly in the execution of the dairy process. They accumulated knowledge and performed the daily routine of the property. This allows the employee to sometimes recognize improvements to be made, but the acceptance of employees' opinions is still partial (practice C8). Inhibiting the suggestions of employees can bring losses to the property, and listening to them can bring economy, not only in financial resources, but also in time to treat animals, in the process of milking, unnecessary moves, and excess acquisition of materials.

However, this restrictive culture is also observed in suppliers (practice B3), where only a portion of the dairy farmers accept proposals and support. In this aspect, part of the farmer´s focus on the search for new and better suppliers (practice B1), sometimes with a central focus on price, but by not strengthening partnerships, they lose aspects inherent in training, special technical assistance services that reduce losses, and bring benefits to property (practice B4).

The points that need to be considered are E3 and E4, which deal with customer satisfaction. As observed, dairy farmers indicated that they performed quality analysis (practice H1) provided by dairy processors in the researched region. However, the continuous evaluation of customer feedback (practice E4) and monitoring of customer satisfaction after product delivery (practice E3) are partially performed by farmers. This shows that although dairy processors provide quality indicators to farmers, this concern for information analysis and improvement through satisfaction monitoring does not occur at the same level because of educational factors, including a low level of education (Simões and Protil, 2015).

Management practices not performed by dairy farmers

This section discusses the impacts of the practices that dairy farmers do not perform on the dairy chain (see Table 4).

As described in the item on the performed practices, dairy farmers envision their rural land as a business, but they must consolidate this vision with customers and suppliers.

At this point, dairy farmers do not enter long-term contracts with customers (practice E2). Sometimes, this is because of an attempt to negotiate a higher selling price with another dairy. However, this aspect leads to insecurity in terms of revenue generated and brings to the dairy a lower commitment on the part of the farmer to improve the quality of its product and engage in the proposed measures of training and capacitation, which have an impact on the chain.

Like suppliers, dairy farmers indicated that they did not have long-term partnerships (practice B2). The establishment of a long-term partnership with suppliers, for example, would help dairy farmers improve the performance of input feed analysis (practice H3). Sabbag and Costa (2015) highlight that in the dairy production process, approximately 57 per cent of the effective operational costs (EOC) are aimed at the acquisition of supplies, mainly animal feed. They also recalled the importance of knowing the composition of supplies and their respective costs within the dairy industry. Furthermore, counting labor costs and depreciation of facilities increases the risk of production. Moreover, according to Tortorella et al. (2018), strengthening the relationship between a company and its suppliers provides advantages such as knowledge sharing, cost reduction, technological knowledge, and quality improvement, among others.

The delivery performance of farmers with their transport (practice F3) is also not a target of improvement. At this point, performance improvement permeates not only the reduction in transport time and distance but also the responsibility of the dairy farmer to ensure that the product meets the specifications of the legislation along the way, thereby avoiding the spread of microorganisms (Ruangwittayanusorn; Promket, 2016).

Finally, among the various analyzed practices, those dealing with the management aspects inherent in information technology are the least performed by farmers. Appropriate flow of information is indispensable for the success of supply chain activities. Moreover, information has become fundamental in providing knowledge for the supply chain, as Jasti and Kodali (2015) pointed out.

The dairy farmers interviewed did not use computer programs and applications to organize property information (practices A1 and A2). The use of technologies in dairy products is important to increase

communication between the various links of the production chain and to promote improvements through rapid decision-making when there is a deficiency in the process.

In return, we highlight the need to implement product tracking, which can be facilitated by using information technology (practice A5). Martínez et al. (2018) tested a traceability system for milk production systems in Europe. By monitoring more than 500 milk samples from dairy farms, they concluded that the use of traceability technologies contributes to and improves the conditions of milk collection, transport, and storage, resulting in fewer losses to the farmer.

There is also a loss due to the inadequate registration of the property database (practice A3) conducted by 4.4 per cent of respondents, which allows the creation of historical performance indicators and allows to trace the tracing of evolution, as well as new approaches to the management of the property. Santos et al. (2020) indicated the need for a change in attitude on the part of dairy farmers, who need to use information technology that would allow the recording, retrieval, and analysis of collected data and support decisions in the context of milk production and commercialization of milk with dairy products. Currently, various technologies are connected to computers.

Furthermore, the low use of IT to support the administrative management of dairy activities affects the quality of management of the company, as these technologies facilitate decision-making mainly in the management sector.

In addition, the technology can be associated with the farmer to establish communication with customers (practice A4), which is a tool for quick measures when the farmer has difficulties. According to Roman (2018), the use of information technology resources facilitates the flow of information between many suppliers and a cooperative, both in the circulation of documents and in the optimization of routes for milk transportation.

V. Conclusion

The operations management practices investigated were presented on distinct performance scales by the investigators participating in the research. Practices related to the pillar of ownership (G) and waste elimination (C) represented a higher performing percentage. Alternatively, practices related to the pillar of information technology management (A) are rarely used by dairy farmers. Thus, it is concluded that the placement of the farmer as the main link of the chain is important for improving management in the dairy production chain so that it can better relate to its suppliers and customers and have a management plan to improve milk quality in the management, sanitation, financial, productive, and technological aspects. The results of this study contribute to the creation of action plans that provide operational and quality gains in the management of property for dairy farmers. This will motivate them to make the correct investments in their dairy activities and encourage them to make the right investments in the business.

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