Scientific Electronic Archives
Issue ID: Sci. Elec. Arch. Vol. 13 (7)
July 2020
DOI: http://dx.doi.org/10.36560/13720201124
Article link
http://sea.ufr.edu.br/index.php?journal=SEA&page=article&op=view&path%5B%5D=1124&path%5B%5D=pdf
Included in DOAJ, AGRIS, Latindex, Journal TOCs, CORE, Discoursio Open Science, Science Gate, GFAR, CIARDRING, Academic Journals Database and NTHRYS Technologies, Portal de Periódicos CAPES, CrossRef

ISSN 2316-9281

Seasonal variation of price and milk production in Mato Grosso

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Abstract. Despite its secondary role to the regional economy, the dairy industry has an important social function, mainly to local family farms in the state of Mato Grosso. Unfortunately, regional milk production has been declining in the last decade, and dairy industries are facing difficulties to maintain production over the year, with an idle capacity of around 50% in some regions of Mato Grosso. This study aimed to identify the state pattern of milk yield and seasonal variation in price, analyzing the dynamics of the variables through descriptive and basic statistics. Authors calculated seasonal indexes using moving average in different periods: i) production from 1997 to 2018, and price and production from 2011 to 2018. Our findings indicate that the seasonality of milk yield in Mato Grosso over 1997 – 2018 spins around 41%, versus 44% from 2011 to 2018. In the same period, the Brazilian indexes reached 20%. In contrast, price seasonality is higher in Brazil (14%) than in Mato Grosso (11%). Considering the price index, we can point out two distinct periods: i) lower payment policy (January to March); ii) higher payment policy (July to September), with peaks in August and February. Regard the price index, the same behavior was seen in Brazil. In conclusion, the seasonality of raw milk production is higher in Mato Grosso concerning the national mean. That oscillation in the supply compromises the processing capacity of regional dairy industries, impacting the price paid to the farmers, reducing dairies production and commercialization.
Keywords: Dairy, macroeconomics, seasonality.

Introduction

According to the Food and Agriculture Organization of the United Nations | FAO (2016), approximately 150 million farms worldwide are inserted in the dairy chain. In most developing countries, the same as in Brazil, small dairy farmers have a close relation to the regional industries, and their income from livestock contributes significantly to the subsistence of these families. In contrast, the most significant volumes still being provided by another tiny fraction of Brazilian properties (Marcondes et al., 2017), mainly due to technology application and high herd genetic profile.

Although the milk production per cow has increased in Brazil during the past two decades, the national productivity on average still low (1,304 liters/cow/year) comparing to the largest milk producers countries. For instance, the United States stands out with 10,327 liters, New Zealand with 4,317, and European Union countries with 6,434 per cow milked (USDA, 2016). Regarding low production in some extracts of dairy farms, another significant characteristic of the Brazilian dairy chain involves the fluctuation of raw milk stock, with falls of around 40% depending on the season (Gomes, 2011). The oscillation due to the seasonality compromises the processing capacity of industries all over Brazil (Junqueira et al., 2008; Marin et al., 2011), directly affecting various sectors of the national dairy chain. Issues related to facilities, equipment, and laborers' idleness frequently are reflected in the supply of dairy products for the domestic market and the medium- and long-term strategic planning of these companies.

Moreover, regarding dairy farmers, seasonality usually reflects the reduction in profits due to the drop in the volume milked throughout the off-season (Novo et al. 2013). At the same time, there is an increase in production costs, whether due to the need to provide cattle with roughage supplementation or the greater use of grains to feed them (Junqueira et al., 2008).

Unfortunately, livestock productivity and seasonality are often closely related to the low quality of the raw milk in Mato Grosso. That could be a crucial issue to the non-development of a competitive regional agro-industrial complex, given that of the biggest industries established in Brazil, none of them has activity in the state (Milkpoint, 2017).

This study aimed to characterize the monthly raw milk yield in Brazil, in Mato Grosso, and seven other Brazilian states from 1997 up to 2018. Moreover, the study aimed to determine seasonal variations of the price paid by dairy industries to dairy farmers from 2011 up to 2018.

Methods

Seasonality is a feature of a time series in which the data experiences regular and predictable changes that recur every calendar year.. Factors related to the time that influences the series behavior can be identified and segregated, and a model might contain four patterns: tendential, cyclical, seasonal, or irregular/random (Mendenhall, 1993).

To determine the state and national seasonal variation pattern, we used monthly production and milk´ price series to evaluate the Brazilian dairy market. The same analyzes were done in the states of Mato Grosso (MT), Rio Grande do Sul (RS), Santa Catarina (SC), Paraná (PR), São Paulo (SP), Minas Gerais (MG), Goiás (GO), and Bahia (BA). We gathered the average milk price from historical data of the Center for Advanced Studies in Applied Economics (CEPEA). To determine de price variation in Mato Grosso, the authors accessed information from the IMEA dataset. We estimated the price of chilled raw milk in Reais per liter for each state. Gross prices include transportation cost and taxes (paid by dairy companies/cooperatives), and net prices represent the values received by farmers.

Our final dataset included amounts paid/received for raw milk for every month. The average price for each state was defined based on the participation of weighted milk production in the mesoregions, as pointed out by the most recent edition of the quarterly milk survey from the Brazilian Institute of Geography and Statistics (IBGE, 2018). The national average price was composed by the weighting of average in each state included in the study.Moreover, the weighting of production was calculated according to the last ten years of data published in the quarterly milk survey (IBGE, 2018), based on the average share of formal milk production in each state in the total sampled per month. Thus, we have a weighting panel that takes into account the seasonal production pattern in each state.

To analyze the price seasonality in Mato Grosso, we used the weighted average monthly price series paid to dairy farmers. Complementary, we included in the analysis of other studies and systematical analysis of the milk production chain by Instituto Matogrossense de Economia Agropecuária (IMEA, 2019). The collection of prices for the database follows a method similar to that practiced by CEPEA. The price in Mato Grosso was based on the farmers´ income (without tax rebates). The value of the liter of milk was established as that paid to the farmers by the regional dairy industries (R$/liter).

We gathered data on the second half of each month after the financial statement of cooperatives, considering milk price established to farmers in that month. The method excludes outliers and calculates the weighted price for the participation of each region of the state concerning the proportion of uptake of dairy products. The division of the areas took into account the limits of the municipalities, the formation of the economic centers, geographic coordinates, and the farm localization, according to the Region Map (IMEA, 2008).

To reach the seasonality production index, we set a monthly time series concerning milk yield (liters) from each state, based on data from IBGE according to Quarterly Milk Survey (PTL), from 1997 up to 2018. This period considers the monthly series within PTL, with the most extended available data period.

To eliminate the inflation effects the dataset was adjusted by the General Index Price - Internal Availability (IGP-DI), considering December 2018 as the base month/year for deflation. Then, the Centralized Moving Geometric Average as described by Hoffmann (2002), according to equation (1):

$$Gt = \sqrt[12]{P_{t-6}^{0,5}\ P_{t-5}\ \dots P_t \dots P_{t+5} P_{t+6}^{0,5}}$$

Where:
G_t = Geometric mean/month t;
P_t = Price or production/month t;
t = monthly mean.
From that average, the seasonal index (It) (Equation 2) was estimated. The seasonal index was calculated, dividing the values of the price series (Pt) by their respective moving geometric mean (Gt), then multiplied by 100.

$$It = \ D_t = \frac{P_t}{G_t} x100$$

Subsequently, the seasonal index for each month (Ɛ) was taken (Equation 3). This index indicates the pattern of seasonal price variation (Hoffmann, 2002).

$$\varepsilon_j = \frac{D_j^*}{C}$$

Where equation (4):

$$D_j^* = (\Pi_{i=1}^{n-1} D_{ij})^{\frac{1}{n-1}}$$

Since D_j* is the geometric mean of Dj values for the D_{ij} month, we had the following equation (Equation 5):

$$D_{ij} = D_t = \frac{P_t}{G_t}$$

The product of the 12 estimates of Ɛ_j should be equal to 1. So, if the product of Dj * is different from 1, each of them is divided by correction (C) (Equation 6) (Hoffmann, 2002):

$$C = (\Pi_{j=1}^{12} D_j^*)^{\frac{1}{12}})$$

The descriptive analysis of means and the standard deviation was performed by the CORR procedure of the statistical package SAS® online.

Results and discussion

Milk yield had an absolute growth within 1997 – 2017 in Mato Grosso, presenting an average annual rate of 2.2%. However, in the last decade, there was a reduction of 1.2% in production, with a sharp drop from 2012. Figure 1 shows the evolution of production in recent years, pointing toward a switch in the direction from 2012, with a more accentuated tendency of a drop from 2015. The rate of geometric growth from 1997 to 2007 was 10.3%. However, from 2007 to 2018, this rate decreased to 2.4%, indicating that the growth of milk production was quite lower than in the last decade.

The amplitude of the seasonal index observed in our study from 1997 to 2018 was 43.3% for Mato Grosso, while in Brazil, in the same period, this amplitude was 22.9%. The seasonality of Mato Grosso was superior if compared to the other seven states, according to PPM (Table 1).

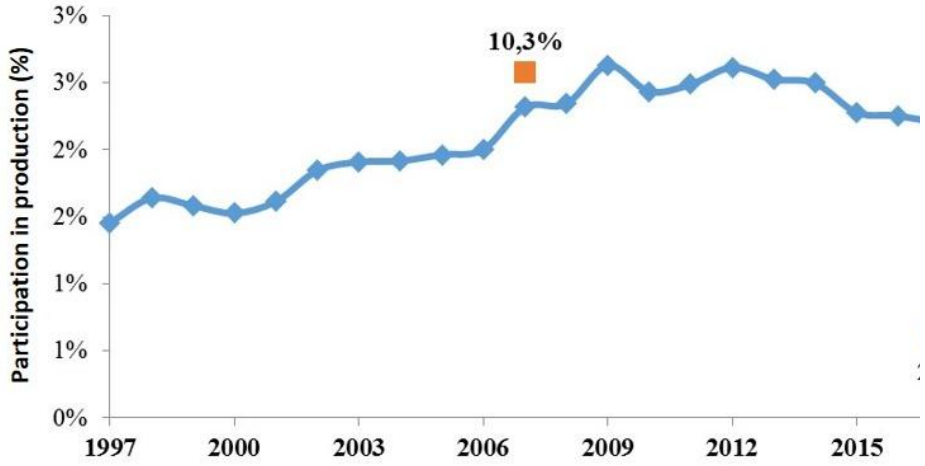


Figure 1: Evolution of milk production and geometrical growth from 1997 up to 2007, and from 2008 up to 2018 in Mato Grosso.

Table 1: Seasonal index of milk production in Brazil, Mato Grosso, and the most meaning states inserted in the dairy chain from 1997 up to 2018.

Seasonality of milk production	Minimal	Maximal	Amplitude
Brazil	91,64%	112,64%	22,9%
Mato Grosso	83,57%	119,78%	43,3%
São Paulo	94,23%	107,60%	14,0%
Minas Gerais	91,30%	113,58%	24,0%
Rio Grande do Sul	82,96%	114,53%	38,0%
Paraná	90,11%	106,88%	19,0%
Goiás	88,20%	120,75%	37,0%
Bahia	86,59%	117,17%	35,0%
Santa Catarina	86,04%	110,20%	28,0%

Font: IBGE, 2019

According to Oviedo-Pastrana et al. (2016), São Paulo and Paraná got seasonality below than the national average. Paraná holds three cities with the highest productive density in the country: Castro, Toledo, and Marechal Candido Rondon. In this case, less seasonality is linked to higher animal productivity. Castro has an average per animal of approximately 7,000 liters per cow per year. In São Paulo, low seasonality was associated with the adoption of intensive production systems, where some of the biggest industrial-scale farms are located (MILKPOINT, 2015).

As seen in Figure 2, the seasonality in Mato Grosso gradually increases in a specific period, with lower milked volumes between the last fortnight of August and early September. It can be concluded that with a relatively short period of feed supplementation, it would be possible to minimize the seasonality of production in Mato Grosso. Although the recommendation seems reasonable, it is hard to find the cause for dairy farmers not adopt that strategy in a state heading crop production in Brazil. Moreover, several authors highlighted the viability of livestock supplementation (Shalloo et al.,

2014; Pancoti, 2009; Costa et al., 2011); maybe it is undoubtedly a cultural issue or even a lack of a feasible strategy to transfer technologies.

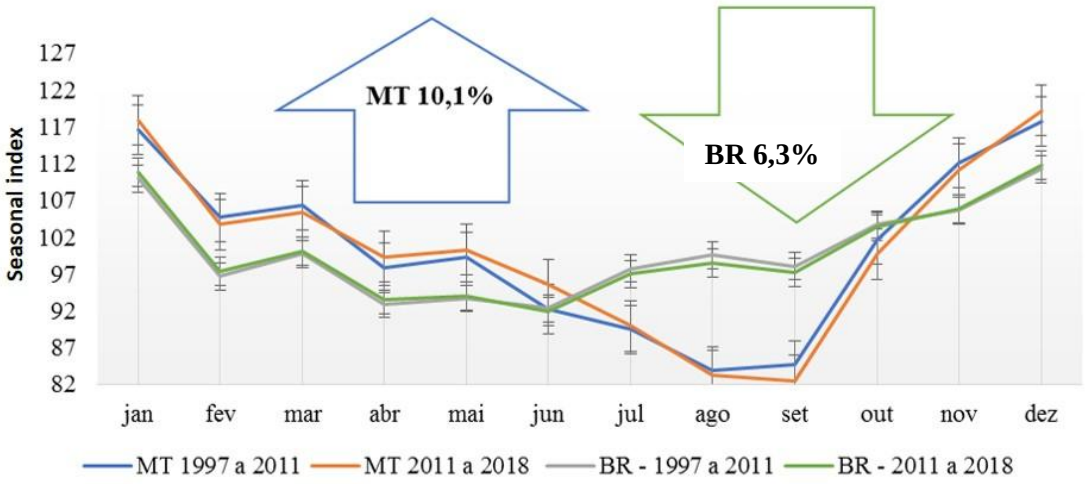


Figure 2: Seasonal index of Mato Grosso, and Brazil, in two periods: 1997 - 2018.
Source: IBGE, 2019

Also, observing the upward curve between September and October, it is possible to check that production already exceeds the cutpoint of the index (100). It can be seen as a gradual droop and then a rapid reestablishment in production levels after an increase in forage offer on pastures.

Pearson's correlation (r^2) from 2000 to 2018 (Figure 3), indicates that there is a high correlation between monthly rainfall and milk production (0.8284, p<0.01%). Our results reinforce the hypothesis that the primary vector of the seasonality of raw milk in Mato Grosso is closely related to annual climatic variations and the level of technology adopted (Junqueira et al., 2008). Mato Grosso has a well-defined rainfall regime, with two distinct seasons: a long period of drought, which historically varies from April to the beginning of October; and a long period of rain, between October and March. The climate was classified according to the criteria of Koppen, as Am – monsoon climate, which alternates between a rainy and a dry season (Alvares et al. 2013). During the rainy season, pastures are naturally more abundant, leading to higher volumes of production. On the other hand, during the dry season, there is an acute reduction in milked volumes due to the low availability of forage in pastures (de Castro et al. 2016).

Variations in the rainfall regime are an inherent feature of the Mato Grosso as well as in the entire Brazilian Midwest region. Thus, be prepared to adopt some kind of supplementation strategy for livestock and face clime challenges should not be a big issue for most dairy farmers, but an ordinary necessity for all of them.

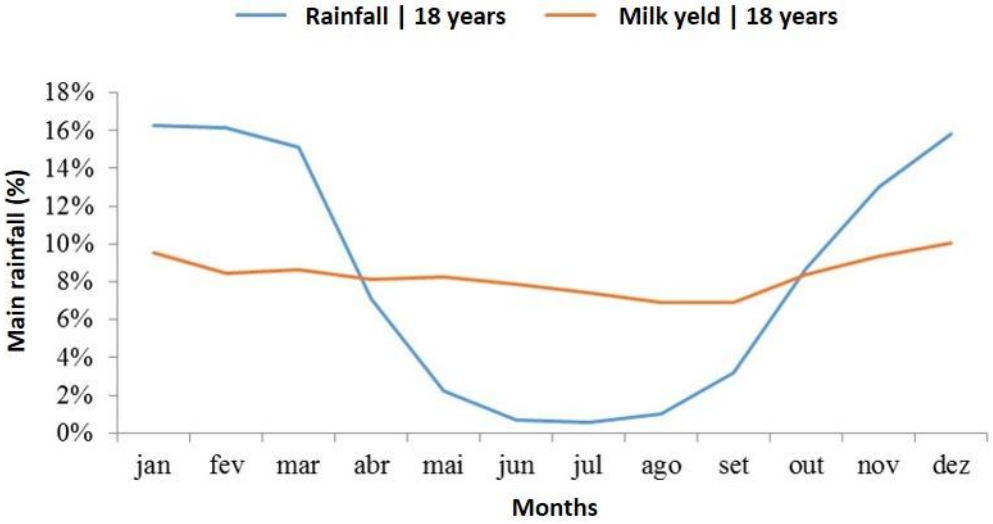


Figure 3: Rain precipitation and monthly milk production in Mato Grosso from 2000 up to 2018.
Source: IBGE, 2019

The montly milk price seasonality index in Mato Grosso has a range of 11%, and the variation in Brazil was 14% in the same period. The analysis indicated two critical periods of low (January to March) and high variation (July to September), with peaks of amplitude in August and February. The same kind of pattern was observed in Brazil for minimal prices; however, the high peak occurs between July and August (Table 2). That happened in a series of price seasonality index in the Rio Grande do Sul for the period from 1995 to 2007 (Viana et al. 2010).

Table 2. Seasonal indexes: monthly, minimal, maximal milk prices in Mato Grosso and Brazil between 2015 - 2018.

Months	Mato Grosso 2011 / 2018	Brazil 2011 / 2018
January	96,02	93,28
February	95,09	93,64
March	95,50	95,63
April	97,46	99,10
May	99,80	101,85
June	102,0	106,56
July	104,44	105,58
August	105,43	106,68
September	105,15	104,41
October	102,51	100,00
November	100,67	98,16
December	96,63	95,82
Minimal	95,05	93,28
Maximum	105,43	106,68
Variation	10,90%	14,40%

Source: IMEA & Cepea, 2019

The differences between the minimum, maximum, and average prices are 23.28%, 27.81%, and 23.29% lower in Mato Grosso, respectively. The states of São Paulo, Minas Gerais, Goiás, and Paraná had the highest prices, and Santa Catarina, Rio Grande do Sul and Mato Grosso, got the lowest (Figure 4).

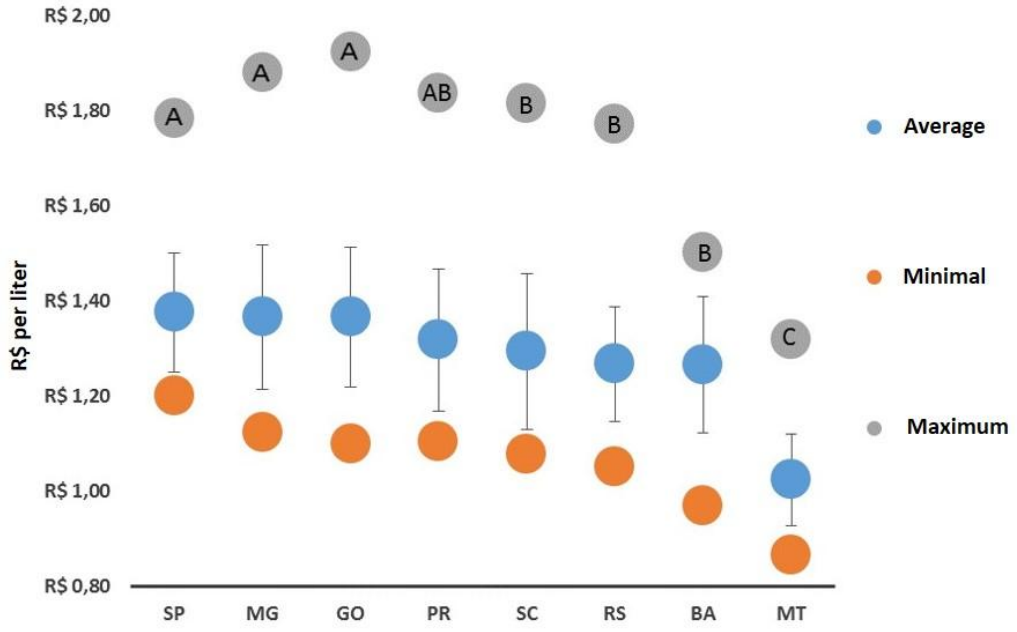
The price of raw milk seems not to encourage the sustenance of production in Brazil and Mato Grosso as well. It should be considered different variables in regional scenarios, such as low technological level adopted in dairy ranches, the low quality of milk produced, health problems of herds, the low genetic potential of cows, inadequate and insufficient feeding, reduced reproductive rates, lack of planning and management, and logistical issues. These characteristics contribute to rising production costs, and to impose barriers to dairies commercialization.

The lower amplitude of raw milk prices in Mato Grosso can be a sign of less competition among dairy industries. This fact, combined with a 43% seasonality in production, reinforces the hypothesis that there is a sharp reduction in raw milk supply which it is not followed by an increase in price. This aspect of the dairy market has already been pointed out by Sexton & Zhang (2001). As the supply of raw milk is inelastic, there are structural barriers to production growth. In Mato Grosso, these barriers include climatic variables and technological limitations.

In any productive chain, multiple issues are able to influence the formation of prices, such as external factors (e.g., world supply) as well as internal factors (e.g., climatic risks and commercialization capacity). We must also consider difficulties in storage due to the perishable characteristic of dairy products. These factors indicate that milk price is influenced by the amount that each company receives back for the commercialized dairies, reflecting directing on demand for the products in the retail and wholesale market.

Moreover, the continental dimensions of Mato Grosso (more than 90 thousand km²) contribute to logistical barriers due to enormous distances between municipalities, promoting even more low competitiveness among industries also. Although few companies take a large volume of milk to manufacture, the low quality of dairies and seasonal distortions of milk supply in the domestic market discourages most multinational companies from establishing itself in Mato Grosso.

Based on the Imea dataset, the analysis of the seasonality of manufacturing raw milk points out a range of 35% between the peak and the lower levels (35% - 70%) for each year, from 2015 to 2018. Approaching this same data bank, according to the mean test, we found a maximum operation level of 70%, a minimum of 40%, a mean and median of 52% and 53%, respectively. This increase in inactivity, especially in July, August, and September, can be one of the factors that limit prices to increase concerning the domestic market, even in need of raw milk (Table 3).



*means with same letters are not significative according to Tukey test p<0,01

Figure 4. Maximal, minimal, mean, and standard deviation of prices paid to farmers | 2011- 2018, adjusted IGP-DI basis to the variables price and production in Brazil, Mato Grosso, and the head states inserted in the dairy chain.

Table 3. Seasonal indexes: monthly, minimal, maximal labor capacity in dairy industries of Mato Grosso between 2015 - 2018.

Months	2015 up to 2018
January	111,60
February	111,28
March	101,76
April	103,27
May	102,03
June	93,53
July	86,40
August	84,55
September	85,90
October	99,53
November	113,20
December	113,56
Minimal	84,55
Maximum	113,50
Variation	35,00%

Source: Imea, 2019

Silva et al. (2013) highlight the great difficulty that the sector has encountered in the high seasonality of production, a consequence of different technological approaches on farms, and the influence of climatic factors. Some studies show how the industry in developed countries such as New Zealand and the USA have adapted to address the issue of seasonality adjusting their operational process, offering a wider variety of products, or even halting the production at different times during the year (Nicholson & Fiddaman, 2003).

Based on our results, the industrial inactivity in Mato Grosso was higher than the Brazilian average. This characteristic of the inactiveness rate above 50% dramatically reduces the payback capacity, especially in machinery and equipment. That may be a decisive factor in flattening prices during the off-season since higher incomes are not effective in stimulating growth production.

A strategy to stimulate production in the off-season would be the establishment of quotas. Quota milk is considered the volume in liters delivered by farmers during a particular period. In the states of

São Paulo, Rio de Janeiro, Espírito Santo, Minas Gerais, Goiás, Mato Grosso, Mato Grosso do Sul and the Federal District, the quota is established from June to September. The primary reason to adopt quota and an extra-quota is to stimulate milk production along the dry season, when production costs are, in general, higher than those in the rainy months (Gomes, 1988). The lack of pricing policies established by industries and cooperatives in Mato Grosso, including payment for quality of raw milk and incentives to reduce seasonality, or even policies that remunerate the volume produced per farm, can be a factor to non-establishment of a reference price.

As presented before, the Brazilian dairy chain is composed of micro and small companies, with a processing capacity lower than 100 thousand liters/day. In general, these establishments have limited technological potential (Lima et al., 2018a). Foward the same tendency, most industries in Mato Grosso are characterized as a medium or small company, processing from 200 to 5,000 liters daily. Even with inactivity issues, the cooperatives are responsible for approximately 30% of the raw milk manufactured, being always a valuable player and determinant to influence the bottom price. In contrast, the market share of private companies had decreased in the last decade (Figure 4). Ferreira et al. (2008) report that, in general, the cooperatives had fewer problems with inoperability due to its members are closely associated with the corporation, which generates loyalty and commitment.

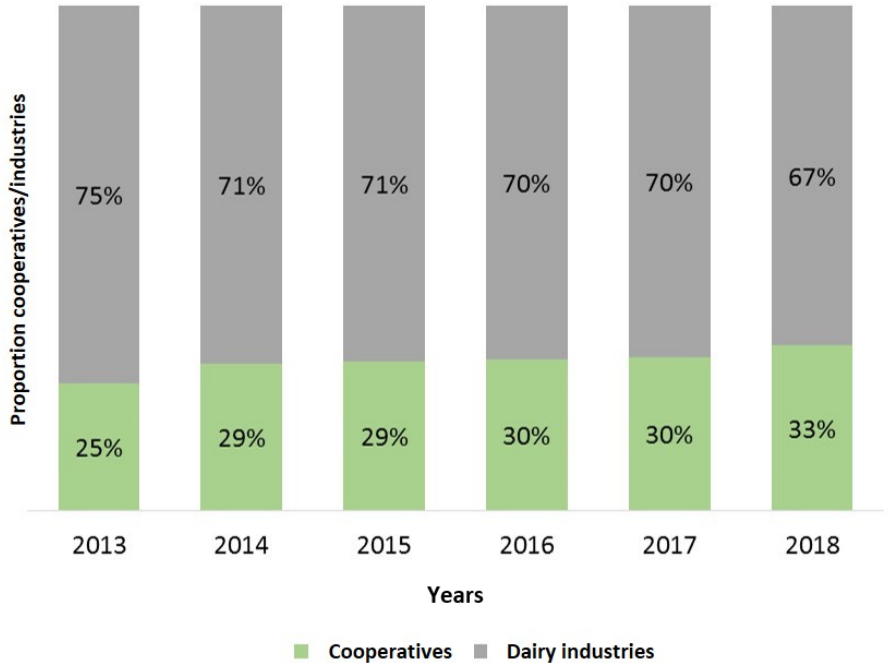


Figure 4. Processed milk by dairy industries and cooperatives in Mato Grosso.
Source: Imea, 2019

Based on that complex scenario, composed by climatic, public policies, and dairy company issues, a key factor for the dairy ranches is technical assistance. Some Brazilian programs such as "Balde Cheio" (Embrapa), "Educampo" and "Nosso Leite" (Sebrae), Senar Technical and Managerial Assistance Program (ATeG) show positive results all over the country (Lopes et al., 2015). However, Durigon (2019) showed in his study that the actual actions in Mato Grosso to improve the dairy chain are uncoordinated and without alignment. That study also pointed out several barriers faced by local dairy farmers, and some of them were highlighted: genetics limitation of herds, technical assistance privation, lack of nutritional strategies, poor milk quality, absence of infrastructure, and finally, easy access to rural credit.

The need for technical support in dairy ranches is reinforced by checking out data from the last national agricultural census (IBGE, 2017). Bult from census data, Table 4 includes the percentages of establishments receiving or not professional assistance in Mato Grosso, in Brazil, and Santa Catarina. According to the numbers, the state of Santa Catarina has the highest proportion of farms receiving technical support (63%). In contrast, only 19% of farmers received some kind of support in Mato Grosso, private or not. There is a lack of adherence to hiring professionals, not only concerning farms in general (81%) but on livestock ranches, reaching 83% of properties.

Table 4. Percentage of farms with or without technical assistance in Brazil, Mato Grosso, and in other seven states included in this descriptive analysis.

Technical assistance	It has	It has not
Brazil	30%	70%
Mato Grosso	19%	81%
Santa Catarina	67%	23%
Paraná	52%	48%
Rio Grande do Sul	60%	40%
São Paulo	45%	65%
Minas Gerais	30%	70%
Goiás	22%	78%
Bahia	11%	89%

Source: IBGE (2017)

Conclusions

The seasonality of raw milk production is higher in Mato Grosso than the other principal milk-producing states in Brazil, however, regarding mik price, the seasonal variation is lower. That oscillation in the supply compromises the processing capacity of regional dairy industries, impacting the price paid to the farmers, and reducing dairies production and commercialization, right in the period of highest output. These issues negatively contribute to the promotion of better policy concerning prices paid to dairy farmers in Mato Grosso.

Acknowledgment

Weare grateful for the support provided by Coopernova and IMEA.

References

Alvares CA, Stape JL, Sentelhas PC, De Moraes G, Leonardo J, Sparovek G (2013). Köppen's climate classification map for Brazil. Meteorologische Zeitschrift 22, 711–728. doi:10.1127/0941-2948/2013/0507

CEPEA-Centro de Estudos Avançados em Economia Aplicada. Indicadores preço leite, 2019. Disponível em: https://www.cepea.esalq.usp.br/br/método/leite.aspx

Costa, J. Avaliação de indicadores técnicos de eficiência e renda da propriedade leiteira. Tecnologias para o desenvolvimento da pecuária de leite familiar do Norte de Minas e Vale do Jequitinhonha, 2007. Juiz de Fora: Embrapa Gado de Leite (EMBRAPA) (2014). Dados Estatísticos Embrapa Gado de Leite. Disponível em: http://www.cnpgl.embrapa.br/nova/informacoes/estatisticas/producao/tabela0234.php.

Costa, L. T.; Silva, F.F Da; Veloso, C. M.; Pires, A. J. V.; Neto Rocha, A. L.; Mendes, .B. L.; Rodrigues, E. S. O.; Silva, V. L. Análise econômica da adição de níveis crescentes de concentrado em dietas para vacas leiteiras mestiças alimentadas com cana-de-açúcar. Revista Brasileira de Zootecnia, Viçosa, MG, v. 40, n. 5, p. 1155-1162, 2011.

De Lima, L., Perez, R., & Chaves, J. 2017. A indústria de laticínios no brasil – Um estudo exploratório. Boletim do Centro de Pesquisa de Processamento de Alimentos, 35(1). doi:http://dx.doi.org/10.5380/cep.v35i1.55942

Durigon, M. A. Diagnóstico Das Ações Relacionadas À Cadeia Da Pecuária Leiteira Em Mato Grosso. Relatório de pesquisa. Cuiabá: Aproleite, 2019. Disponível em: http://www.imea.com.br/imea-site/view/uploads/estudos-customizados/DiagnosticoLeite.pdf.

Ferreira, M.A.M.; Braga, M.J.; Lima, J.E. Eficiência técnica e de escala das cooperativas no setor lácteo. Organizações Rurais & Agroindustriais, Lavras, v.10, n.1, p.49-57, 2008.

FOOD AND AGRICULTURAL ORGANIZATION (FAO). 2016. Livestock primary - Cow milk. Disponível em: <http://faostat.fao.org/>. Acesso em: 25 Jun. 2018.

FUNDAÇÃO GETULIO VARGAS, Conjuntura Econômica - IGP (FGV/Conj. Econ. - IGP) Índice Geral de Preços - Disponibilidade Interna (IGP-DI). Taxa de inflação anualizada: elaboração IPEA. Atualizado em: 01/03/2019.

Gomes, S.T. Diagnóstico da cadeia produtiva do leite no Estado de Mato Grosso, 2011. Relatório de pesquisa. Cuiabá: FAMATO, 2012. Disponível em: http://www.imea.com.br/imea-site/view/uploads/estudoscustomizados/DiagnosticoLeite.pdf.

Hoffmann, R. Estatística para economistas. 3. ed. Piracicaba: Biblioteca Pioneira de Ciências Sociais. 2002, 430p
.

IBGE – Instituto Brasileiro de Geografia e Estatística. Produção da Pecuária Municipal, 2018.

Disponível em: https://sidra.ibge.gov.br/pesquisa/leite/tabelas.

IBGE – Instituto Brasileiro de Geografia e Estatística. Pesquisa Trimestral do Leite , 2019. Disponível em: https://biblioteca.ibge.gov.br/index.php/bibliotecacatalogo?view=detalhes&id=298009.

IBGE – Instituto Brasileiro de Geografia e Estatística. Censo Agropecuário 2017 - Resultados preliminares. Disponível em: https://sidra.ibge.gov.br/tabela/6719.

IBGE - Instituto Brasileiro de Geografia e Estatística. Censo Agropecuário 2006 - Agricultura Familiar - Primeiros Resultados. 2006. Disponível em: <https://biblioteca.ibge.gov.br/visualizacao/periodicos/50/agro_2006_agricultura_familiar.pdf>. Acesso em 14 de fev. 2018

IMEA - Instituto Mato-grossense de Economia Agropecuária. Indicadores pecuários preço do leite, 2019. Disponível em: http://www.imea.com.br/imea-site/indicadores.

IMEA - Instituto Mato-grossense de Economia Agropecuária. Agronegócio no Brasil e em Mato Grosso: Relatório de mercado. Cuiabá: Imea, 2019. Disponível em: http://www.imea.com.br/imea-site/view/uploads/relatorios-Mercado/Apresentacao_20190326.pdf.

Junqueira, R.; Zoccal, R.; Miranda, J.E. C. Análise da sazonalidade da produção de leite no Brasil. Panorama do leite, on-line, Ano 2, n. 23, Out/2008, Centro de Inteligência do Leite - CILeite. Embrapa Gado de Leite, Juiz de Fora, MG, 2008.

Lima, L.P.; Ribeiro, G.B.D.; Perez, R. The energy mix and energy efficiency analysis for the Brazilian dairy industry. JOURNAL OF CLEANER PRODUCTION, v. 181, p. 209-216, 2018a.
Lima, L.P.; Ribeiro, G.B.D.; Perez, R. An analysis of the Brazilian dairy industry efficiency level. International Food Research Journal, v. 25, p. 2480-2487, 2018b.

Lopes, M.F. De, F.A., Pascoti, F.Y Mitke, E. The effect of technological levels on profits of milk production systems participating in the “full bucket” program: a multicase study. Semina: Ciências Agrárias. 36 (4): 2015.

MAPA-Ministério da Agricultura, Pecuária e Abastecimento - Relatório de Produção por Estabelecimento por Produto. Mapa 2018. Disponível em: http://www.agricultura.gov.br/assuntos/inspecao/produtos-animal.

Marcondes, M.I.; Brandão, V.L.N.; Ferreira, G.A.T.; Silva, A.L. Impact of farm size on milk quality in the Brazilian dairy industry according to the seasons of the year. Cienc. Rural, 47, 1 – 8, 2017.

Marin, S.R.; Cavalheiro, A.G. & Anschau, D. Sazonalidade do preço do leite no Rio Grande do Sul (1986-2009). Ciência Rural, v.41, n.2, p.361-364, 2011.

Mendenhall, W. A Second Course in Statistics: regression analysis. Editora Pearson, 1993.

MILKPOINT. Top 100 = fazendas líderes de produção estão em São Paulo, publicado levantamento top 100. Disponível em: https://www.milkpoint.com.br/noticias-e-mercado/giro-noticias/top-100-fazendas-lideres-de-producao-estao-em-sp-94118n.aspx, 30 de mar de 2015.

MILKPOINT. Ranking Leite Brasil:Captação das maiores empresas cresce 5,6% em 2017. Disponível em: https://www.milkpoint.com.br/noticias-e-mercado/giro-noticias/ranking-leite-brasil-captacao-das-maiores-empresas-cresceram-56-em-2017-207683/ acesso em 07/01/2019.

MINISTÉRIO DO DESENVOLVIMENTO, INDÚSTRIA E COMÉRCIO EXTERIOR – SECRETARIA DE COMÉRCIO EXTERIOR (MDIC-Secex)–Base de dados do Comex, 2018. Stat. Disponível em: http://www.mdic.gov.br/balanca/bd/tabelas/NCM_PPE.csv.

Nicholson, C.F. & Fiddaman, T. 2003. Dairy policy and price volatility. In Proceedings of the 21st International Conference of the Systems Dynamics Society, 20–24, New York City, USA (Eds R. L. Eberlein, V. G. Diker, R. S. Langer & J. I. Rowe), p. 98 (abstract). New York, NY, USA: Systems Dynamics Society.

Novo, A.M. et al., 2013. Feasibility and competitiveness of intensive smallholder dairy farming in Brazil in comparison with soya and sugarcane: Case study of the Balde Cheio Programme. Agricultural Systems, 121, p. 63–72.

Oviedo-Pastrana, M.E., Oviedo-Socarrás, T.J., & Haddad, J.P.A. 2016. Avaliação de um novo método para a representação da pecuária no Brasil. Arquivo Brasileiro de Medicina Veterinária e Zootecnia, 68(6), 1681-1689.

Pancoti, C.G. Cana-de-açúcar tratada com óxido de cálcio, em diferentes tempos de hidrólise, na alimentação de novilhas holandês x zebu. 2009. 101p. Dissertação (Mestrado em Zootecnia)

Universidade Federal de Minas Gerais, Belo Horizonte.

Pindyck, R.; Rubinfeld, D. Microeconomia. São Paulo - SP, Brasil: Pearson Education, 2015.

Ronsani, A. J; Parré, J.L. Variação estacional da produção e do preço do leite no estado do Paraná – 1980 a 1999. Informe GEPEC, Cascavel - Edunioeste v.7, n. 1, jan/jun 2003.

SAS. Free Statistical Software, SAS University Edition | SAS https://www.sas.com/pt_br/software/university-edition.html. Acesso em: 24/03/2019.

SNA – Sociedade Nacional de Agricultura. Queda do consumo de produtos lácteos reflete na captação do setor de laticínios, 2016. Disponível em: https://www.sna.agr.br/queda-do-consumo-de-produtos-lacteos-reflete-na-captacao-do-setor-de-laticinios.

Santos, F.A.P; Martinez, J.C.; Greco, L.F.; Carareto, R.; Penati, M.A. Nutrição das vacas em lactação, no período chuvoso, para produção intensiva de leite em pasto. In. simpósio de nutrição e produção de gado de leite; produção de leite em pasto, III. Anais... Belo Horizonte, 2007. p.1-27.

Sexton, R.; M. Zhang. An assessment of the Impact of Food Industry Market Power on U.S. Consumers. Agribusiness 17(1): 59-79, 2001.

Silva, A.N.; Lima, J.E.; Perez, R. Caracterização e desempenho logístico das indústrias laticinistas da Zona da Mata e Campo das Vertentes em Minas Gerais, Brasil. Ciência Rural, Santa Maria, v.43, n.7, p.1337-1343, 2013.

Soares, B.C.; Lourenço, J. De B.; Santos, M.A.S. Dos; Rodrigues, J.A.; Sena, A.L. Dos S.; Santana, A.C. De; Homma, A.K.O., Silva, A.G.M. E S. Profile of bovine-milk-producing farms in Rondon do Pará, state of Pará, Brazil, Semina: Ciências Agrárias, Londrina, v. 39, n. 5, p. 2113-2124, set./out. 2018.

SOMAR - Somar Metereologia; Dados metereológicos Disponível em: http://www.somarmeteorologia.com.br/v3/. 2019.

Shalloo, L., Cromie, A., & Mchugh, N. Effect of fertility on the economics of pasture-based dairy systems. Animal, 8(S1), 2014, 222-231. DOI:10.1017/S1751731114000615.

Varian, H. R. Microeconomia - Uma abordagem moderna. 9ª Edição ed. Rio de Janeiro - RJ; Brasil: Elsevier, 2015
.

Viana, J.G.A.; Zen, B.; Karlec, F.; Souza, R.S. Comportamento dos preços históricos do leite no Rio Grande do Sul. Ciência e Agrotecnologia, v.34, n.2, p.451-460, 2010.