

Original Paper

Dairy cattle in Tocantins state: production, productivity, prices and income

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Abstract

The article evaluates the production, productivity, prices and income behavior of dairy cattle in Tocantins state, Brazil. Time series from the period 1990–2015 were used to calculate the growth rates of the studied variables and, thus, to identify their behavior patterns. Monetary variables were corrected to eliminate the inflationary effect. Currently, Tocantins state is the third largest bovine milk producer in the northern region of Brazil and, between 1990 and 2015, production increased by 5.03% per year. The most influential variable was productivity, which had a growth rate of 3.29% per year, which represents a higher level of technology adoption in the activity. Tocantins' milk income showed a growth trend with a real increase of 2.17% per year. However, the price received by producers showed large fluctuations in the evaluated period and the observed geometric growth rate was -1.69% per year. We concluded that the dairy cattle production and income evolution is mainly due to the increased milked cow number and to productivity gains, since prices showed a declining trend in the analyzed period.

Key-words: Milk cattle, Market analysis, Technology, Brazilian Amazon

Introduction

Bovine milk production in Tocantins state is a typical activity of family agriculture and has great importance in labor occupation and food security, especially in families from agrarian reform projects.

Currently, Tocantins occupies the 18th position in the national scope, contributing to only 1% of Brazil's production. However, within the North region, it accounts for 17% of the total produced, occupying the third place, being surpassed by the Rondônia (44.61%) and Pará (30.95%) states (IBGE, 2016).

The behavior evaluation of market variables such as production, productivity, prices and income of dairy cattle are important for the agents involved

in the milk production chain, being able to assist the producers in making production and commercialization decisions. They are also relevant for research, extension and development institutions, since they help in the definition of strategies for better allocation of public resources in programs to support the activity.

Based on the above, the objective of this article was to evaluate production, productivity, prices and income relating to the behavior of dairy cattle in Tocantins state from 1990 to 2015.

Material and Methods

The study was developed based on data from the Brazilian Institute of Geography and Statistics

(IBGE), involving temporal series of milked cows, including production, productivity, prices and value of bovine milk production from 1990 to 2015 (IBGE, 2016).

Dairy herd income was measured by the milk production value that results from multiplication of variables: milking cows, productivity and prices. In the specific case of the price and income variables, all analyses were carried out from the real value and the correction, to eliminate the inflationary effect, was made through the General Internal Price Index (IGP-DI) from Fundação Getúlio Vargas, based on figures from June 2016 (FGV, 2016).

The variables behavior evaluation was performed using the geometric growth rates (TGC), estimated by means of regression, using the semi-logarithmic model (Gujarati and Porter, 2011).

In order to evaluate the variations in milk income, the percentage variation rates of the variables that determine it were calculated for: (a) milking cows, (b) dairy productivity and (c) prices received by dairy farmers (Santos et al., 2015a).

Results and discussion

Production growth and productivity of dairy livestock

Table 1 presents milk production in the microregions of Tocantins state from 1990 to 2015. In 2015, Miracema do Tocantins, Araguaína, Rio Formoso and Dianópolis were the microregions that stood out the most with production of 83.9, 63.5, 42.1 and 36 million liters of milk, respectively, and together accounted for 69.82% of the state's total.

Table 1. Milk production evolution in the microregions of Tocantins state, 1990–2015.

Microregions	1990		2000		2015	
	Thousand liters	%	liters	%	Thousand liters	%
Miracema do Tocantins	25,698	24.36	30,361	19.46	83,925	25.97
Araguaína	30,685	29.08	45,382	29.09	63,547	19.66
Rio Formoso	13,693	12.98	15,529	9.95	42,136	13.04
Dianópolis	7,107	6.74	16,081	10.31	36,050	11.15
Gurupi	8,818	8.36	8,833	5.66	32,277	9.99
Bico do Papagaio	6,530	6.19	18,987	12.17	27,391	8.48
Jalapão	5,057	4.79	9,326	5.98	19,862	6.15
Porto Nacional	7,924	7.51	11,518	7.38	17,998	5.56
Total	105,512	100.00	156,017	100.00	323,186	100.00

Source: IBGE (2016).

Milk production also grew more strongly in the Miracema region of Tocantins, from around 25.7 million liters in 1990 to 83.9 million liters in 2015, representing growth of 58.2 million liters of milk. In general, this growth was 217.7 million liters in Tocantins state, as production rose from 105.5

thousand liters in 1990 to 323.2 million liters in 2015.

The growth rates of the production, milking cows and dairy productivity variables in Tocantins' microregions are shown in Table 2. The amount of milk produced may increase due to the increase in the number of cows milked, which would

characterize extensive growth in productivity gains, factors (Gomes, 1996).
reflecting intensive growth, or by combining these

Table 2. Production growth rates, milked cow and milk yield in the microregions of Tocantins state, 1990–2015.

Microregions	Geometric growth rates (GGR – % per year)		
	Production	Milked cows	Productivity
Miracema do Tocantins	5.98	2.66	3.23
Araguaína	3.18	0.69	2.47
Rio Formoso	4.31	1.55	2.72
Dianópolis	6.22	1.71	4.43
Gurupi	5.31	2.11	3.13
Bico do Papagaio	6.87	1.15	5.33
Jalapão	6.52	2.66	3.79
Porto Nacional	4.25	1.06	3.16
Tocantins state	5.03	1.68	3.29

Source: Estimates from IBGE data (2016).

Note: GGC – Geometric Growth Rate, in % per year, estimated by means of linear regression.

Table 3. Productivity of dairy cattle in Tocantins state, according to the main producing microregions, Average 2010–2015.

Order	Microregions	Productivity (l/cow/year)		CV (%)
		Mean	Standard Deviation	
1	Araguaína	688.25	56.76	8.25
2	Miracema do Tocantins	584.36	104.85	17.94
3	Rio Formoso	555.60	38.94	7.01
4	Dianópolis	559.73	86.52	15.46
5	Gurupi	558.52	60.50	10.83
6	Bico do Papagaio	816.66	205.78	25.20
7	Jalapão	536.59	40.84	7.61
8	Porto Nacional	563.25	88.47	15.71
	Tocantins state	623.19	149.42	23.98

Source: IBGE (2016).

From the data in Table 2, milk production exhibited growth in all microregions in the period 1990–2015. It is worth noting that the greatest influence has been on productivity gains, since productivity growth rates were higher than for milking cows. This is an important result and differs somewhat from that obtained by Martins et al. (2008) at the end of the decade of 2000, when they identified that the dairy farming in Tocantins had a predominance of farms with a low technological level, but with indications of production growth and milk yield in several municipalities.

In a more recent study, Santos et al. (2014) found that the process of modernization of dairy farming in Tocantins state is ongoing, and involves a transformation of traditional dairy cattle production to one involving a higher level of technology, and they also affirm that this activity is moving toward the integration of the chain from the improved herd and milk quality, added value and expanded production scale. This result suggests that dairy farming in Tocantins is undergoing a process of development with the adoption of some technological innovations, mainly in the areas of sanitary and alimentary management (Santos et al., 2014).

One of the ways to expand this modernization would be through public rural credit policies, since this is an important instrument for supporting technological innovation in agricultural production systems, such as milk cattle, by making investments in pasture, infrastructure, health, genetic improvement, as well as the contribution of resources to livestock costs (Reis Filho and Silva, 2013).

The average productivity between the years 2010 and 2015 for each microregion of Tocantins state, with the standard deviation and coefficient of variation, are shown in Table 3.

In the Bico do Papagaio microregion, there is a predominance of small properties, since 89.64% of the establishments have an area of less than 200 hectares and the average area is 116 hectares (IBGE, 2006). In addition, this microregion holds the largest number of municipalities in the state, where the high standard deviation indicates that these small properties differ greatly in their production levels. Despite this, it was the microregion that showed the highest productivity level.

The Araguaína microregion presented the second highest productivity (688.25 l/cow/year) and it also presented low standard deviation values (56.76) and coefficient of variation (8.25%), indicating that there is a more homogeneous technological pattern among the rural properties that are dedicated to dairy farming, compared to other microregions.

Studies carried out by Santos et al. (2014) which aimed to estimate an index to measure the dairy cattle modernization level by municipality in Tocantins state, identified that the Araguaína region was the one that presented the highest average of the dairy cattle modernization index of the state. The results obtained in this article confirm the Araguaína microregion as having the highest technological level in relation to its state dairy cattle.

Despite advances in animal productivity levels in this microregion, improvements in the hygienic-sanitary aspects of milk production are necessary, since milk quality is still low and it does not meet all the requirements of Normative Instruction 62 (Pedrico et al., 2009; Santos et al., 2015b). This aspect deserves to be highlighted, since sanitary management is highlighted as one of the most relevant factors for the production growth based on gains in productivity and quality.

Behavior of prices received by milk producers

The behavior of prices received by dairy farmers between 1990 and 2016 can be seen in Figure 1. There are large swings in the period analyzed. Between 1990 and 2003, prices showed a declining trend, with a subsequent recovery between 2003 and 2008, and between 2009 and 2015 the behavior did not maintain a pattern of regularity and showed large fluctuations.

The trend of falling milk prices in Tocantins state, mainly within the 1990s, followed a national trend, according to studies by Gomes et al. (2004). The development of the real plan is reflected in the behavior of prices from 1995 to 1996. According to Gomes et al. (2004), the rise in real income and demand for dairy products in that period influenced the country to opt for an increase in imports to adjust supply to demand, which prevented the sharpest increases in domestic prices.

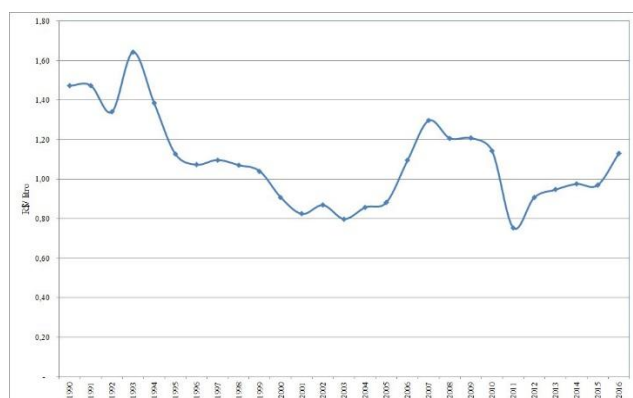


Fig. 1. Behavior of prices received by milk producers in Tocantins state, 1990–2016. Source: IBGE and SEAGRO Tocantins.

When analyzing the monthly price behavior of milk in the period of March 2012 and May 2016 (Figure 2), a marked variation was not identified, where prices reached maximum levels in October 2013 (R\$ 0.97 / liter) and minimums in March 2015 (R\$ 0.76 / liter).

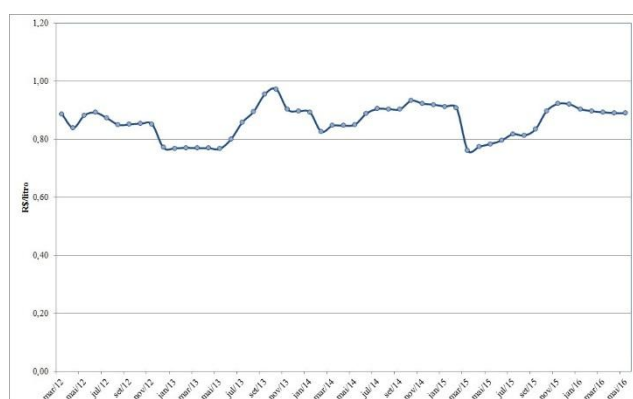


Fig. 2. Behavior of the monthly prices received by milk producers (R\$ / liter) in Tocantins state between March 2012 and May 2016. Source: SEAGRO Tocantins Note: values adjusted for May 2016 by the IGP-DI (FGV, 2016).

From 2012 to early 2013, prices averaged R\$ 0.83 / liter with growth starting in May 2013, reaching the maximum price (R\$ 0.97 / liter) in the period analyzed. The average price at the end of the year 2013, the year 2014 and the beginning of 2015 was R\$ 0.89 / liter with a sharper drop in March 2015, reaching the lowest value of the whole period (R\$ 0.76 / liter) and recovering gradually in subsequent months.

The milk prices show seasonal behavior throughout the year, setting crop and off-season periods (Figure 3). Seasonality is a phenomenon that

occurs in the short term, related to the times of the year due to the climatic characteristics of the region (Santos et al., 2015a).

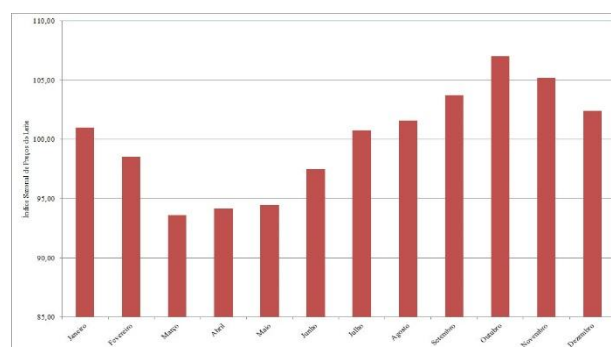


Fig. 3. Milk price seasonal index in Tocantins state, 2012–2016. Source: Estimated from SEAGRO Tocantins data.

From November prices decline to a low in March, which represents the harvest period. From April, seasonal indexes rise and peak in October. The understanding of these movements helps the producers in the planning of the activities and in the commercialization process, allowing them to identify the period of the year in which the milk price oscillations can affect their decisions more strongly (Martins et al., 2008).

The coefficients of variation of the milk price seasonal indices in Tocantins state for the dates between 2012 and 2016, can be observed in Table 4. These coefficients were calculated with the objective of identifying the price variability monthly. The minimum coefficient of variation was 1.50% in November and the maximum of 6.73% in February. Based on the minimum and maximum values of variation, it can be said that the most pronounced variability is found in the first semester, where there are also lower prices. In the second half of the year, prices rose, reaching higher levels, but with lower coefficients of variation.

Effects of prices on milk livestock income

In order to assess the effects of variations in milking cows, productivity and prices on the variations in the Gross Production Value (GPV) of Tocantins' milk production, Table 5 was elaborated, which shows the variation rates of these variables in the period 1990 to 2015.

Table 5 shows that the income of Tocantins dairy cattle showed a growth trend, since in the analyzed period, from 1990 to 2015, 14 years presented positive values in the variation rates.

The cows' number growth sustained the increase of milk producers' income, since positive values were recorded in 21 years within the three decades analyzed. On the other hand, both

productivity and the price of the product pushed the income down, since they exhibited negative values in 13 years. These results indicate that the producer needs to improve investments in technology and property management, since they have no influence on price behavior, as the milk market operates in the mold of perfect competition.

Table 4. Descriptive statistics of the Seasonal Price Indices of milk in Tocantins state, 2012–2016.

	Inferior Limit	IEP	Superior Limit	DPAD	CV (%)
January	95.99	100.99	105.99	5.00	4.95
February	91.93	98.56	105.19	6.63	6.73
March	90.23	93.62	97.01	3.39	3.62
April	92.02	94.17	96.32	2.15	2.28
May	92.34	94.46	96.59	2.13	2.25
June	94.26	97.49	100.71	3.22	3.31
July	97.83	100.79	103.75	2.96	2.94
August	97.27	101.58	105.89	4.31	4.24
September	98.22	103.74	109.26	5.52	5.32
October	102.79	107.02	111.24	4.23	3.95
November	103.62	105.19	106.77	1.57	1.50
December	97.36	102.40	107.43	5.03	4.91

Source: Estimates from SEAGRO Tocantins data.

Table 5. Annual variation rates of milking cows, productivity, prices and milk production gross value in Tocantins state, 1990–2015.

Year	Milked cows	Productivity	Price	Gross production value
1990	7.66	3.67	-70.35	-66.91
1991	4.41	1.25	0.07	5.79
1992	6.90	-3.07	-9.12	-5.83
1993	-35.14	18.49	22.60	-5.79
1994	5.06	2.71	18.43	27.79
1995	6.18	1.93	-42.00	-37.23
1996	-13.10	59.91	-4.87	32.20
1997	6.37	-9.94	2.23	-2.07
1998	2.91	-1.25	-2.37	-0.79
1999	7.92	0.86	-2.86	5.73
2000	4.80	-2.52	-12.81	-10.93
2001	6.34	0.07	-9.20	-3.38
2002	8.82	2.99	5.44	18.18
2003	8.29	-0.11	-8.06	-0.55
2004	5.06	1.54	7.30	14.46
2005	2.92	-0.24	3.02	5.78
2006	-0.65	-0.79	24.04	22.27
2007	-1.05	-0.63	18.38	16.41
2008	5.12	-0.89	-6.87	-2.98
2009	5.27	-0.57	0.07	4.74
2010	2.83	12.47	-5.34	9.48
2011	-19.14	22.67	-34.06	-34.59
2012	2.84	-1.83	20.34	21.50
2013	1.00	-1.22	4.33	4.09
2014	5.82	14.11	3.06	24.45
2015	0.28	-0.88	-1.06	-1.66

Source: Estimates from IBGE data (2016).

Conclusion

The study results indicate that dairy farming in Tocantins has exhibited technological gains in recent decades. However, productivity is still low and production is concentrated in some microregions that have production with greater technological content.

The prices received by the milk producers showed intense fluctuations in the analyzed period and, throughout the year, show periods of harvest and off-season that are important in the management of the property and commercialization of the production.

The income of Tocantins dairy cattle showed a tendency of growth during the analyzed period, being this growth driven, mainly, by the expansion of milked cows.

Conflict of interest: All authors declare no conflict of interest.

References

- Fundação Getúlio Vargas. 2016. FGVDADOS: Informação Econômica On-line. Available at: <http://fgvdados.fgv.br>. [Accessed Dec 20, 2016]
- Gomes, S.T. 1996. A economia do leite. Embrapa CNPGL, Coronel Pacheco, MG
- Gomes, A.T.; Alves, E.; Zoccal, R. 2004. Mercado de leite: uma análise dos preços recebidos pelos produtores nos últimos anos. *Revista de Política Agrícola* 3: 5-12
- Gujarati, D.N.; Porter, D.C. 2011. *Econometria básica*. 5. ed. AMGH, Porto Alegre
- Instituto Brasileiro de Geografia e Estatística – IBGE. 2016. Censo Agropecuário 2006. Available at: www.ibge.gov.br. [Accessed Nov 14, 2016]
- Instituto Brasileiro de Geografia e Estatística – IBGE. 2016. Pesquisa Pecuária Municipal. Available at: www.sidra.ibge.gov.br/bda/tabela/listabl.asp?c=74&z=t&o=24. [Accessed Jun 8, 2016]
- Martins, G.C.C.; Rebello, F.K.; Santana, A.C. 2008. Mercado e dinâmica espacial da cadeia produtiva do leite na região Norte. Banco da Amazônia, Estudos Setoriais, 6, Belém
- Pedrico, A.; Castro, J.G.D.; Silva, J.E.C.; Machado, L.A.R. 2009. Aspectos higiênico-sanitários na obtenção do leite no assentamento alegre, município de Araguaína, TO. *Ciência Animal Brasileira* 2:610-617
- Reis Filho, R.J.C.; Silva, R.G. 2013. Cenários para o leite e derivados na Região Nordeste em 2020. SEBRAE, Recife
- Santos, M.A.S.; Santana, A.C.; Raiol, L.C.B.; Júnior, J.B.L. 2014. Fatores tecnológicos de modernização da pecuária leiteira no estado do Tocantins. *Revista em Agronegócios e Meio Ambiente* 3:591-612
- Santos, M.A.S.; Costa, A.D.; Rebello, F.K.; Silva, J.S. 2015a. Comportamento dos preços recebidos pelos produtores de leite no estado do Pará. p. 295-308. In: Lourenço Júnior, J.B.; Santos, M.A.S., eds. *Qualileite: qualidade e tecnologia na cadeia produtiva do leite no estado do Pará*. Marques Editora, Belém
- Santos, M.A.S.; Lourenço Júnior, J.B.; Neres, L.S.; Rodrigues, A.E.; Soares, B.C.; Rodrigues Filho, J.A.; Nahúm, B.S.; Sena, A.L.S., Santos, J.C. 2015b. Perfil socioeconômico dos produtores de leite no estado do Pará. p. 57-80. In: Lourenço Júnior, J.B.; Santos, M.A.S., eds. *Qualileite, qualidade e tecnologia na cadeia produtiva do leite no estado do Pará*. Marques Editora, Belém

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