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SOURCES OF GROWTH IN CATTLE MILK PRODUCTION IN THE ACRE STATE, BRAZILIAN AMAZON

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ABSTRACT

The article evaluates the behavior of beef milk production and prices in the Acre state, Brazilian Amazon. Production growth rates, cow herd, animal productivity, prices and milk production value were calculated to identify their behavior patterns from 1990 to 2016. Acre state is the fourth largest bovine milk producer from northern region of Brazil and between 1990 and 2016 production grew 3.60% per year. The biggest influence is due to herd expansion, as the herd of milked cows grew 2.92% per year, compared to a 0.66% per year rate of animal productivity. The production value of Acre dairy farming grew during the three decades analyzed, and in 13 years positive rates were registered. However, prices received by producers showed a declining trend with steeper declines in the 1990s and 2000s and relative stability between 2013 and 2016. The growth in the gross value of dairy farming has been supported by the expansion of the herd and, to a lesser extent, for productivity gains which configures the predominance of extensive production systems.

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INTRODUCTION

Dairy farming in Brazil is one of the pillars of family farming economy and stands out as a fundamental productive activity for national economic development (Zoccal, 2007). The country currently ranks fourth in the world milk production, behind United States, India and China (CONAB, 2017). Regard to the Northern region, the 2017 production was 2.2 billion liters of milk (IBGE, 2018), with the Acre state in fourth position with production of 46.5 million liters of milk, preceded by states of Rondônia, Pará and Tocantins with 1.0 billion, 612.8 million and 432.1 million liters, respectively. Acre's dairy farming is characterized by its low technological level due to lack of sanitary and hygienic management in milking, low herd milk aptitude and poor pasture management (Carneiro Júnior, 2007). Dairy producers also produce the calf, which makes the activity more stable for the household economy (Amaral, 2014).

Thus, the activity is an important alternative for many Acre producers, who use the product for subsistence or sale of surplus (Bayma, 2011). In the post-2010 period, dairy farming was encouraged by state government to meet the National School Feeding Program (PNAE) and the Food Acquisition Program (PAA), within the scope of family farming (Brasil, 2009; Machado et al., 2011). This strategy aimed to ensure product insertion in institutional markets, allowing producers to expand market opportunities and more rewarding and stable prices. Based on the above facts, the objective was to evaluate the behavior of production and prices received by the dairy farmers in the Acre state, from 1990 to 2016. These analyzes aim to contribute strategic information to actors involved in milk production chain, as well as assist educational and governmental institutions in the development of research and extension projects, contributing to the activity development in the region. In addition, the evaluation of prices and quantities' behavior aims to guide the activity planning.

MATERIALS AND METHODS

The article was prepared from data obtained from the Brazilian Institute of Geography and Statistics (IBGE), involving time series, annual milk production, milking cows, productivity, prices and Gross Production Value (GPV) of Acre dairy farming in 1990 to 2016 period (IBGE, 2017). The variables' behavior was evaluated from geometric growth rates (GGR) estimated by linear regression (Gujarati; Porter, 2011). Milk GPV is obtained from multiplication of variables: milking cows herd, animal productivity and milk prices and was used as proxy variable to measure the activity income. Prices and income values were deflated through General Price Index Internal Availability (IGP-DI) from Fundação Getúlio Vargas, based on June 2016 (FGV, 2017). To calculate changes in dairy cattle income, annual variation rates for all income-determining variables were calculated: (a) milking cow herd, (b) dairy productivity and (c) prices received by dairy farmers (Santos *et al.*, 2015).

RESULTS E DISCUSSION

Evolution of production, productivity and prices: Table 1 describes the geometric growth rates (% per year) of production, milking cows, productivity and prices received by dairy farmers in Acre state from 1990 to 2016. Between 1990 and 2016 milk production grew at a rate of 3.6% per year and was mainly stimulated by the increase in milking cows' herd which was 2.92% per year, as animal productivity grew by only 0.66% per year. This behavior configures low technological level, because the simple increase in the number of animals is associated with extensive production systems, while the highest productivity growth is related to the adoption of technological innovations in products, processes and management. Thus, herd growth in detriment to productivity observed in Acre state, from 1990 to 2016, results from the characteristics of dairy activity carried out by producers, with low use of management, nutrition, health and genetics practices; culminating in low productivity (Carneiro Júnior *et al.* 2009).

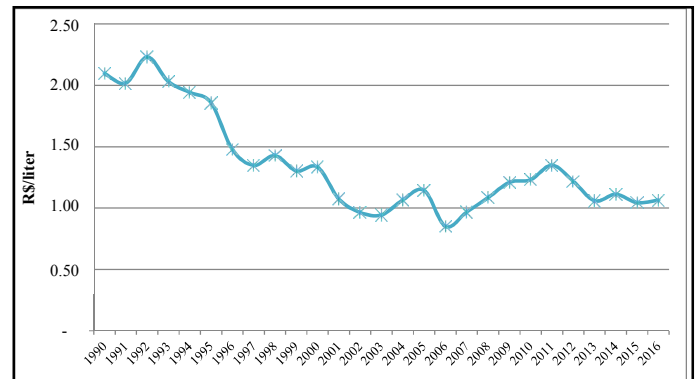
Table 1. Geometric growth rates (% per year) of production, milking cows, productivity and prices received by dairy farmers in Acre state, 1990-2016

Period	Geometric Growth Rate (% per year)			
	Production	Milking cows	Productivity	Milk price
1990-2000	6.32	5.26	1.01	-6.04
2000-2004	23.64	20.27	2.80	-5.61
2004-2010	-14.91	-13.40	-1.75	2.84
2010-2016	6.72	2.97	3.64	-3.65
1990-2016	3.60	2.92	0.66	-2.83

Source: Authors estimate based on IBGE data, 2017.

Another technological obstacle to Acre's dairy activity involves the existence of extensive areas of degraded pastures, and the use of most of them for animal allocation, with pasture as the main food source (Amaral, 2014), without, however, the use of management techniques, such as rotational grazing or fertilization, that would be essential for increasing milk productivity. The biggest incentive of Acre government has been the acquisition of dairy breeders, mainly European breeds, aiming at an increase in production (Cavalcante *et al.*, 2011). Dairy production exhibited different behaviors in some subperiods. From 2004 to 2010, negative rates were observed for all variables analyzed, except for milk price, which increased at a rate of 2.84% per year. Production declined at a

rate of 14.9% per year, against growth of 23.64% per year in the previous period (2000-2004). The decrease in production was greatly influenced by the size of herd, as this variable declined 13.40% per year in the same period evaluated, against a growth of 20.27% per year in relation to the previous period (2000 to 2004).



Source: IBGE, 2017. Amounts corrected for December 2016 by IGP-DI (FGV, 2017).

Figure 1. Behavior of real prices received by dairy farmers in Acre state, 1990-2016

On the other hand, from 2010 to 2016 there was a significant increase, in which the dairy activity had growth rates of 6.72% per year, for production, 2.97% per year, for the number of cows milked and 3.64% per year for productivity. Increases in growth rates in this period coincide with the establishment of public policies in support of the region's dairy farming, such as the PAA and PNAE, aimed at small producers in the region. One of the PAA modalities was the Incentive to Milk Production and Consumption with the purchase of milk from family farming and distribution to population in food and nutritional vulnerability (Machado *et al.*, 2011). In PNAE, 30% of the amount transferred by the program is invested in the direct purchase of family farming products, which stimulates local economic development (Brasil, 2009). The price behavior can be observed in Figure 1. It is observed that there are two well-defined periods, from 1990 to 2000 and from 2001 to 2016. In the first, prices above R\$ 2.00/liter with a declining trend over the years. This would be due to herd adjustment in milk market. In the second period (2001 to 2016), some price stabilization occurs. Similar results of declining milk price behavior could be found in the states of Rio Grande do Sul, Pará and Maranhão (Viana *et al.*, 2010; Santos *et al.*, 2015; Bezerra *et al.*, 2017), as well as in aggregate terms for Brazil (Vileta *et al.* 2017). This fact can be justified by herd and the productivity expansion that the activity has presented in the last decades. Technological innovations have caused the supply shift in dairy farming, which in the long run reflects a declining price trend.

In a survey of 483 farms in six municipalities of Acre state that covered all routes of the main dairy basins, Paiva (2015) identified that the main problem of Acre's dairy activity, reported by the region's producers, is related to the low price paid per liter of milk. In periods of forage scarcity, supplementary expenses burden production costs and prices received do not adequately remunerate the product, which implies a reduction in the activity profit (Braga, 2016). Additionally, it is noteworthy that milk prices are defined by dairy products, so they have control, blocking market dynamics.

Table 2. Milk production evolution in the municipalities of Acre state, 1990-2016

Municipalities	1990		2000		2010		2016	
	1000 liters	%	1000 liters	%	1000 liters	%	1000 liters	%
Acrelândia	-	-	2,214	5.43	5,237	12.75	6,253	11.00
Assis Brasil	179	0.84	257	0.63	487	1.19	560	0.98
Brasiléia	1,232	5.75	2,333	5.72	2,720	6.62	4,014	7.06
Bujari	-	-	1,286	3.15	1,084	2.64	1,173	2.06
Capixaba	-	-	1,647	4.04	2,248	5.47	3,316	5.83
Cruzeiro do Sul	1,554	-	1,349	3.31	1,117	2.72	967	1.70
Epitaciolândia	-	-	1,928	4.73	1,800	4.38	3,986	7.01
Feijó	2,850	13.30	1,203	2.95	1,395	3.40	1,955	3.44
Jordão	-	-	126	0.31	252	0.61	71	0.12
Mâncio Lima	149	0.70	554	1.36	476	1.16	447	0.79
Manoel Urbano	126	0.59	212	0.52	196	0.48	421	0.74
Marechal Thaumaturgo	-	-	356	0.87	394	0.96	213	0.37
Plácido de Castro	603	2.81	6,105	14.96	6,724	16.38	5,680	9.99
Porto Acre	-	-	5,091	12.48	3,162	7.70	4,203	7.39
Porto Walter	-	-	306	0.75	307	0.75	255	0.45
Rio Branco	5,967	27.84	5,920	14.51	3,703	9.02	4,617	8.12
Rodrigues Alves	-	-	861	2.11	549	1.34	519	0.91
Santa Rosa do Purus	-	-	104	0.25	278	0.68	254	0.45
Senador Guiomard	2,037	9.50	3,224	7.90	2,719	6.62	6,653	11.70
Sena Madureira	2,215	10.34	3,124	7.66	1,375	3.35	3,389	5.96
Tarauacá	2,300	10.73	1,125	2.76	1,710	4.16	2,246	3.95
Xapuri	2,220	10.36	1,478	3.62	3,128	7.62	5,677	9.98
Total	21,432	100.00	40,803	100.00	41,061	100.00	56,869	100.00

Source: IBGE (2017).

Table 3. Geometric rates of production growth in the 1990-2016 period and average dairy herd productivity in the municipalities of Acre state, 2012-2016

Municipality	Geometric Growth Rate (% per year) 1990-2016			Productivity (l/cow/year) 2012-2016		
	Production	Milked Cows	Productivity	Mean	Standard deviation	CV (%)
Acrelândia	13.73	10.82	2.62	807.62	160.15	19.83
Assis Brasil	5.44	4.39	1.00	561.72	48.50	8.63
Brasiléia	4.54	2.88	1.62	650.99	32.12	4.93
Bujari	-0.05	-0.79	0.74	651.75	65.94	10.12
Capixaba	4.10	3.57	0.51	640.68	79.34	12.38
Cruzeiro do Sul	-0.44	-0.05	-0.40	474.09	83.91	17.70
Epitaciolândia	2.50	1.95	0.54	610.76	84.23	13.79
Feijó	-0.38	0.54	-0.92	477.95	38.33	8.02
Jordão	-1.41	-1.41	-0.00	465.59	23.25	4.99
Mâncio Lima	3.01	4.06	-1.01	469.19	98.41	20.97
Manoel Urbano	1.60	0.86	0.73	639.70	200.74	31.38
Marechal Thaumaturgo	1.19	1.53	-0.34	484.90	13.90	2.87
Plácido de Castro	9.24	7.90	1.24	693.57	57.80	8.33
Porto Acre	1.46	0.30	1.16	796.23	22.86	2.87
Porto Walter	-2.48	-1.26	-1.23	512.94	39.12	7.63
Rio Branco	-1.04	-1.78	0.75	767.39	29.82	3.89
Rodrigues Alves	1.26	2.28	-0.99	465.09	98.78	21.24
Santa Rosa do Purus	5.61	5.78	-0.16	439.50	12.87	2.93
Senador Guiomard	4.48	5.01	-0.50	601.75	50.05	8.32
Sena Madureira	-0.42	-1.41	1.01	547.23	55.22	10.09
Tarauacá	0.94	2.19	-1.23	477.99	38.32	8.02
Xapuri	3.88	1.72	2.12	707.55	81.00	11.45
Total	3.60	2.92	0.66	650.08	53.85	8.28

Maia *et al.* (2014) highlight the relationship between the number of dairy products in a region and the price received by producers, showing that the lowest price received by local producers is associated with the lower number of dairy products. According to Vileta *et al.* (2017), one way to address this market control would be through the organization of producers into cooperatives and associations.

Production spatial distribution: The municipalities that stood out with the highest milk production in the Acre state in 1990 were Rio Branco (27.84%), Feijó (13.30%), Tarauacá (10.73%), Xapuri (10.36%), Sena Madureira (10.34%) and Senador Guiomard (9.50%). These municipalities held about 80% of total state production this year. From 1990 to 2016, milk production decreased in the municipalities of Cruzeiro do

Sul, Feijó, Rio Branco, Sena Madureira and Xapuri. This reduction may be related to low productivity and high production costs that decrease the activity profitability. As a result, many farmers have kept dairy farming on the property as secondary with dual aptitude herd and even replacing with another. Paiva (2015), visiting 240 dairy farms distributed among the municipalities of Rio Branco, Plácido de Castro, Acrelândia, Porto Acre and Cruzeiro do Sul, found 58% of the interviewees work in the raising of beef cattle, in addition to dairy cattle. Fish farming has been carried out in 23% of the visited properties, with higher incidence in the municipalities of Xapuri, Rio Branco and Cruzeiro do Sul. In a survey conducted in the municipality of Xapuri, Paiva and Martins (2012) identified through an interview with milk producers that most do not have adequate infrastructure and hygienic

management of milking, and have low technology. Other factors that have also contributed to dairy farming with stagnant or decreasing production and productivity are the poor education level of Acrea rural producer, unstable technical assistance and difficulty in accessing credit for investment in technological innovations (Paiva, 2015).

Table 4. Rates of annual variation in milking cows, productivity, prices and gross value of milk production in Acre state, 1990-2016

Year	Milked cows	Productivity	Price	Gross Production Value
1990	-3.08	14.29	-14.12	-4.87
1991	-9.22	14.60	-3.63	0.25
1992	2.17	-9.30	10.53	2.42
1993	69.68	-14.06	-9.03	32.65
1994	-2.95	3.63	45.39	46.23
1995	0.10	-2.09	-37.08	-38.33
1996	-12.60	20.82	-20.45	-16.00
1997	1.74	-0.22	-8.73	-7.35
1998	3.25	-0.05	5.92	9.32
1999	10.34	1.05	-8.77	1.72
2000	10.48	0.84	2.40	14.08
2001	55.26	35.39	-19.55	69.12
2002	18.16	2.47	-10.13	8.81
2003	6.29	-9.37	-2.20	-5.79
2004	15.16	-5.25	13.05	23.35
2005	-1.80	-25.68	7.33	-21.67
2006	7.05	15.03	-25.70	-8.51
2007	-9.29	-9.55	13.77	-6.65
2008	-3.71	-9.61	12.09	-2.44
2009	-50.75	23.45	11.55	-32.18
2010	1.32	-4.86	1.79	-1.88
2011	0.98	1.92	9.53	12.72
2012	0.97	0.16	-9.63	-8.61
2013	7.71	2.39	-13.06	-4.13
2014	4.79	5.14	4.88	15.56
2015	0.89	11.61	-6.05	5.80
2016	-0.96	-1.80	1.93	-0.86

Source: Estimates from IBGE data (2017).

In 2016, the municipalities of Acrelândia, Brasiléia, Epitaciolândia, Plácido de Castro, Porto Acre, Rio Branco, Senador Guionard and Xapuri concentrated 72.25% of the state's milk production. That same year, Acre state government, under the command of the State Secretariat of Agriculture and Livestock and the Secretariat of Agroforestry Extension and Family Production, made a diagnosis to stimulate investments in dairy farms that already had experience with the activity. The objective was to serve 160 properties, of which 60 would be suppliers of the main dairy located in the municipality of Rio Branco and the remaining in cheese shops in the municipalities of Cruzeiro do Sul, Feijó, Sena Madureira and Tarauacá, which the government promoted the distribution of equipment (Aquino, 2016). However, Acre "soft belly" milk does not compete with boxed milk and powdered milk, with the activity maintaining PAA and PNAE, as well as the production of cheese and yogurt. Geometric growth rates of milk production, milking cows herd and productivity from 1990 to 2016, as well as the average dairy herd productivity from 2012 to 2016, in each municipality of Acre state, are presented in Table 3. GGR were observed in the municipalities of Acrelândia (13.73%) and Plácido de Castro (9.24%), which were boosted by the milking cow herd. In these municipalities are located the main dairy basins of the state (Andrade *et al.*, 2014). Acrelândia municipality also leads in productivity (807.62 liters/cow/year), however the high coefficient of variation (19.83%) reveals a large dispersion in terms of property productivity. This means that the technological levels developed in each property are very different. The municipalities of Porto Acre (796.23 liters/cow/year), Rio

Branco (767.39 liters/cow/year) and Xapuri (707.55 liters/cow/year) also stand out with high productivity, but in contrast with the Acrelândia municipality for having greater homogeneity of properties involved in milk production, having lower coefficient of variation.

Variation sources in gross value of dairy farming production: In order to assess the effects of changes in milking cows, productivity and prices on changes in the Acre Dairy Gross Production Value (GPV) Table 4 was prepared, which shows the variation rates of these variables in the 1990-2016 period. Acre dairy cattle income showed a growth trend during the three decades analyzed, since in 13 years there were positive rates of variation (Table 4). The growth of herd supported the income of Acre dairy farming, since there were positive rates of change in 18 years; followed by productivity gains, with positive rates over 15 years. However, the effect of milk prices has limited income growth given its 14-year negative rates. The fact that milk is a product with inelastic supply at price may explain this behavior, as the strong price inelasticity of supply makes the income of producer unstable (Santana & Santana, 2015), since for products with this market characteristic any price variation has a major impact on producer income. This effect of prices on income from Acre dairy farming has also been found in other states, within the northern region (Santos *et al.* 2015b) and the Northeast region (Bezerra *et al.* 2017). According to Santos (2015b), the modernization of dairy farming, in the long run, is related to the income of producers, since obtaining greater economic return enables investments in technological innovations to improve production systems.

Conclusion

Bovine milk production in Acre state has been characterized by extensive growth, with greater growth of milking cows in relation to animal productivity. Prices showed a declining trend in the period under analysis with steeper declines in the 1990s and 2000s, and in the last four years analyzed remained relatively stable. As a result, the growth trend of Acre dairy farming income has been supported by the growth of milking cows and, to a lesser extent, by productivity gains.

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