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Dairy herd production aspects of family farms in Western Amazon, Brazil

Aspectos produtivos dos rebanhos leiteiros de propriedades agrícolas familiares na Amazônia Ocidental

Eduardo Mitke Brandão Reis[1*]; Marcos Aurélio Lopes[2]; André Luis Ribeiro Lima[3]; Fabiana Alves Demeu[4]; Gideon Carvalho de Benedicto[3]; Renato Mesquita Peixoto[5]; João Paulo Bussons[6]; Camilla Birenbaum Nobile[6]; Luane Pereira Linhares[6]

Highlights:
High-production farms had a production of 1,755.65 L ha^{-1} yr^{-1}.
Low-production cluster had a production of 492.75 L ha^{-1} yr^{-1}.
Average herd composition was inadequate for the studied farms.
Monthly household income was 97.47 higher in the high-production cluster.
Both groups have often used natural breeding in their reproductive.

Abstract

This study aimed to evaluate the production parameters of herds in 100 dairy family farms in the mesoregion of the Acre Valley, in Western Amazon, Brazil. To this end, the farms were divided into two levels of milk production. Data were collected from March to June 2016, using a 248-question semi-structured form and on-site observations. The information was recorded in SPSS® spreadsheets. Dairy farmers were divided into two clusters known as "high production cluster" (1,755.65 L ha^{-1} yr^{-1}) and "low production cluster" (492.75 L ha^{-1} yr^{-1}), using the K-means non-hierarchical method. Descriptive statistics was used and, with the aid of the multivariate cluster analysis, cattle ranchers were divided into the two clusters (high and low production). The results showed that the high-production cluster had larger total milk production (L milk cow^{-1} day^{-1}) and family income within smaller areas and using less workforce. The farmers in this group also used more ear tags for cattle identification and more technologies such as electric fence and artificial insemination at a fixed time. We concluded that family farms should improve their management and receive technical assistance to strengthen their weaknesses in dairy-cow health and reproduction systems. Moreover, milk yield in these dairy farms should be improved to increase profitability of farmers.
Key words: Acre. Dairy farming. Diagnosis. Rural development.

[1] Prof., Dr., Centro de Ciências Biológicas e da Natureza, Universidade Federal do Acre, UFAC, Rio Branco, AC, Brasil. E-mail: edumitke@gmail.com
[2] Prof. Titular, Dr., Universidade Federal de Lavras, UFLA, Departamento de Medicina Veterinária, Lavras, MG, Brasil. E-mail: malopes@dmv.ufla.br
[3] Profs. Drs., UFLA, Departamento de Administração e Economia, Lavras, MG, Brasil. E-mail: andreluisnep@yahoo.com.br; gideon.benedicto@dae.ufla.br
[4] Prof., Dr., Instituto Federal de Rondônia, IFRO, Ariquemes, RO, Brasil. E-mail: fabiana.alves@ifro.edu.br
[5] Dr., Empresa Brasileira de Pesquisa Agropecuária, EMBRAPA CAPRINOS E OVINOS, Sobral, CE. Bolsista de Desenvolvimento Científico Regional do Conselho Nacional de Desenvolvimento Científico e Tecnológico (DCR-CNPq/FUNCAP), nível C, Brasília, DF, Brasil. E-mail: renatomiraima@gmail.com
[6] Discentes de Mestrado do Programa de Pós-Graduação em Sanidade e Produção Animal Sustentável na Amazônia Ocidental, PPGESPA/UFAC, Acre, AC, Brasil. E-mail: camillabnobile@gmail.com; luanelinharesmv@gmail.com; bussonsj@gmail.com
[*] Author for correspondence

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Resumo

O objetivo deste estudo foi analisar 100 fazendas leiteiras sob regime de agricultura familiar a partir da mesorregião do Vale do Acre, na Amazônia Ocidental, Brasil. considerando alguns aspectos dos rebanhos, considerando diferentes níveis de produção de leite. Os dados foram coletados no período de março a junho de 2016, a partir de um formulário semiestruturado, contendo 248 questões, por meio de observação in loco, bem como as respostas obtidas com os proprietários; e gravados em planilhas SPSS®. Os produtores de leite foram divididos em agrupamentos denominados "maior produtividade" (1.755,65 litro/hectare/ano) e "menor produtividade" (492,75 litros / hectare / ano) utilizando o método não-hierárquico K-means. Adotou-se a estatística descritiva e, com o auxílio da metodologia de análise multivariada de clusters, os pecuaristas foram divididos em dois agrupamentos com diferentes características em termos de produtividade (maior e menor). Algumas diferenças relevantes entre as propriedades foram identificadas: aquelas pertencentes ao cluster de maior produtividade aumentaram a produção total de leite, leite/vaca/dia e renda familiar, e utilizaram menor área e força de trabalho para produção. Essas propriedades também mostraram maior uso de brincos para identificação e utilizaram mais tecnologias, como cerca elétrica e inseminação artificial em tempo fixo. Concluímos que é necessário melhorar a gestão das propriedades familiares e tomar medidas de assistência técnica para corrigir os pontos fracos na saúde e reprodução das vacas leiteiras. Além disso, é essencial melhorar a produtividade para aumentar a lucratividade das fazendas leiteiras rurais.

Palavras-chave: Acre. Desenvolvimento rural. Diagnóstio. Pecuária leiteira.

Introduction

Dairy cattle breeding is practiced all over Brazil, with ranchers of diverse organizational and technological levels, among family farmers, small cooperatives, highly technological farms (Willers, Ferraz, & Carvalho, 2014). This activity is highly important for the country, both in social and economic contexts.

Amazonian peasants are low-production itinerant growers who destroy their ecological habitat and have been threatened by extinction due to the advance of large landowners (stochastic frontier model). Such agricultural practice contrasts with the trend for a consolidated family farming, based on more complex production systems, including permanent crops, small animal husbandry, and livestock. This trend is more evident in northeaster Pará State but has also been statistically confirmed in the entire northern region of (Hurtienne, 2005). Among agricultural activities, dairy farming is essential for family farming development as income distribution promoter (Eurich, Weirich, & Rocha, 2016), more than half (58%) of the milk produced in Brazil comes from such farmers, which stand for 84.4% of all rural properties (Departamento Intersindical de Estatística e Estudos Socioeconômicos [DIEESE], 2011).

In livestock, reproductive management stands out as one of the key determinants for a good economic performance of the activity. In this sense, there are several factors that can interfere with reproduction rates. Besides animal reproduction, livestock profitability is also influenced by farm management, feed efficiency, and animal health due to lactation. In recent decades, genetic selection has been focused on increasing milk production to the detriment of reproductive traits (Norman, Wright, Hubbard, Miller, & Hutchison, 2009). Among the most significant studies are those related to genetics, animal nutrition, and zootechnical management of herds (Junqueira & Alfieri, 2006).

In the state of Acre, dairy activity is characterized by predominance of low technological farming, mainly in terms of animal nutrition, genetics, and reproduction (Andrade, Sá, Valentin, & Cavalcante, 2011). Thus, according to Lopes et al. (2015b), several technical and managerial efforts are required to increase yield and profitability in this area.

Production conditions in each producing region must be featured by its potentials and needs (Battaglini, Fagnani, Dunga, & Beloti, 2013). Milk production systems in the mesoregion of the Acre Valley should be characterized to identify their limitations and perspectives and to implement regional development plans, besides contributing to state public policies for the sector. In this sense, studies are needed to investigate the characteristics of the local family farms, and then develop programs aimed at strengthening possible weaknesses.

Cattle milk production generates jobs and income for many rural families in Western Amazon. Still, there are economic, technological, managerial, and professional qualification problems in production units that require consistent solutions. In this sense, our objective was to analyze 100 family dairy farms in the mesoregion of Acre Valley for some herd aspects at different milk production levels.

Materials and Methods

A survey was performed in 100 farms under family farming regime in the mesoregion of the Acre Valley, Western Amazon, Brazil. The study was carried out from March to June 2017. The studied area was composed of 14 municipalities with different number of ranchers: Acrelândia (6), Assis Brasil (3), Brasiléia (7), Bujari (4), Capixaba (8), Epitaciolândia (7), Manoel Urbano (4), Plácido de Castro (11), Porto Acre (6), Rio Branco (16), Santa Rosa dos Purus (5), Sena Madureira (12), Senador Guiomard (9), and Xapuri (2).

Dairy ranchers were randomly selected and interviewed in their farms (Gudkova et al., 2016). They were sorted out from lists provided by the State Secretariat of Agriculture (SEAP) and the Secretariat of Agroforestry Extension and Family Production of Acre State (SEAPROF), regardless of the marketed milk volume or adopted production system. The number of respondents was defined according to Barbetta (2003), considering a maximum sampling error of 5%. For interview and diagnosis, a 248-question semi-structured form was used, following methods described by Foody (2003).

The questions were divided into the following topics: farmer and farm registration (52 questions), herd composition (12 questions), and milk production (184 questions). The latter includes production system, agricultural practices, nutritional management, infrastructure, zootechnical accounting, animal identification use, and reproductive management. Descriptive statistics were performed in the Excel® software, calculating average, standard deviation, median, interquartile range, and minimum and maximum values (Lopes et al., 2015a). SPSS 20.0 software (International Business Machines Corporation [IBM], 2011) was used to analyze the data from questionnaire surveys: production (total milk production per hectare per year), thus obtaining cohesive and liable results for analysis. Based on that, ranchers were divided into two clusters: “high production” (1,755.65 L ha^{-1} yr^{-1}) and “low production” (492,75 1,755.65 L ha^{-1} yr^{-1}), using the K-means non-hierarchical method (Hair, Black, Babin, Anderson, & Tatham, 2009).

A multivariate cluster analysis allowed us to group farmers by similarity or dissimilarity based on one or more variables (Kaufman & Rousseau, 1990). The Shapiro-Wilk normality test was used to evaluate the distribution of continuous variables, by which normal distribution and/or homoscedasticity were not detected. These variables were expressed as median and interquartile range (IQR), and multiple comparisons between high and low production clusters were made using the Mann-Whitney U-test (Maroco, 2010). Differences were deemed significant when $p < 0.05$.

Results and Discussion

After characterizing the dairy farms, we could find out factors related to the management adopted in the mesoregion of Acre Valley, in production and reproductive terms. And these can help ranchers to identify the most critical points in their production systems.

High and low production clusters showed milk productions of 1,755.65 L ha^{-1} yr^{1} and 492.75 L ha^{-1} yr^{1}, respectively (Table 1). These findings are much lower than those found by Moraes et al. (2016) for family farmers in the state of Rio de Janeiro (13,085.59 L ha^{-1} yr^{1}). When considering daily volume, milk yields were 80.00 and 42.50 L day^{-1} in high- and low-production clusters, respectively (Table 1). Godinho, Soares, Bertipaglia, Carvalho and Dian (2005) observed higher volumes (699.25 L day^{-1}) in São João Batista do Glória MG (Brazil), while P. O. Lima, Duarte, Souza, Aquino and Oliveira (2009) noted lower values (42.33 L day^{-1}) in the state of Ceará State (Brazil).

Regarding days of lactation, yields were 6.10 and 5.00 L cow^{-1} lactation day^{-1} in high- and low-production clusters, respectively (Table 1). These values are lower than those obtained in other states by: J. L. Parré, Bankuti and Zanmaria (2011) in southwestern Paraná (12.09 and 6.26 L cow^{-1} day^{-1} in high- and low-production farms), Lopes et al. (2007) in Minas Gerais (7.20 L cow^{-1} day^{-1}), R. D. Santos et al. (2009) in southern Bahia (9.46 L cow^{-1} day^{-1}), Moraes et al. (2016) in Rio de Janeiro (12.15 L cow^{-1} day^{-1}), and Battaglini et al. (2013) in the central region of Paraná (6.04 L cow^{-1} day^{-1}). In turn, our findings are higher than those of P. O. Lima et al. (2009) in the state of Ceará (1.26 L cow^{-1} day^{-1}). Oliveira, Figueiredo, Oliveira and Nasciff (2001) stated that milk yield per lactating cow has direct effect on dairy production and the most viable alternative to increase farm profitability is increasing animal production. Thus, our findings underline the need to implement technical assistance programs for the rural properties studied, differences are sharp among Brazilian regions. The milk production sector in Acre State currently has one of the worst production indexes country-wise (Instituto Brasileiro de Geografia e Estatística [IBGE], 2017). In the studied farms, such a scenario is directly related to several factors such as low technological level and absence of production chain structure.

Lopes et al. (2012) pointed out that many managerial and even technological efforts should be made to increase daily milk yield without increasing mean variable cost. According to the authors, an alternative is to increase production efficiency, that is, yield per cow, thus optimizing spending on labor, medicines, artificial insemination, fixed taxes, energy, among others.

With respect to number of lactating cows, high- and low-production clusters had medians of 13.00 and 12.00, respectively (Table 1). Battaglini et al. (2013) found that for every 18.64 animals on small farms in the center of Paraná State, 7.46 were lactating. Nero, Viçosa and Pereira (2009), studying 60 farms in a region of Minas Gerais State, observed less than 15 lactating animals in 51 of the studied farms (85.0%), between 16 and 30 animals in eight (13.3%), and more than 30 lactating cows in one (1.7%). The percentage of lactating cows is an important index to define productive capacity of the system. This, in turn, is influenced by herd management efficiency, as well as by food and nutrition improvements. Besides contributing to a reduction in the age of first calving, it also enables animals to express their genetic potential. As a result, the number of unproductive animals in a herd is reduced (M. F. Silva, Silva, Nascif, & Gameiro, 2018). Table 2 shows the stratification of herd composition.

Table 1
Descriptive statistics of productive factors of 100 farms as a function of milk production level in the Acre Valley mesoregion from March to June 2016

Factor	High-production cluster n = 22						Low-production cluster n = 78					
	Average	SD	Median	IR	Minimum	Maximum	Average	SD	Median	IR	Minimum	Maximum
Production ($L\ ha^{-1}\ yr^{-1}$)	1,839.60	733.65	1,755.65^{a}	2,633.21	1,095.00	4,380.00	558.45	299.30	492.75^{b}	419.97	91.25	1,460.00
Milk daily yield (L)	107.86	62.59	80.00^{a}	100.00	40.00	250.00	57.51	39.75	42.50^{b}	46.25	10.00	220.00
Milk yield per cow ($L\ cow^{-1}\ day^{-1}$)	6.44	1.80	6.10^{a}	2.06	4.10	10.90	4.28	1.07	5.00^{b}	1.37	2.00	6.00
Number of lactating cows (heads)	17.45	10.73	13.00^{a}	11.50	7.00	45.00	14.41	9.08	12.00^{a}	11.25	2.00	50.00
Number of dry cows (heads)	21.68	17.56	17.50^{a}	21.75	2.00	80.00	21.31	36.07	13.00^{a}	12.75	0.00	250.00
Total number of animals (heads)	80.91	53.62	61.00^{a}	68.25	17.00	217.00	73.78	87.59	75.00^{a}	34.50	16.00	621.00
Workforce involved	1.86	0.64	2.00^{a}	1.00	1.00	3.00	1.95	0.74	2.00^{a}	2.00	1.00	4.00
Total area used (ha)	22.50	14.05	16.50^{a}	16.00	5.00	60.00	45.55	42.82	34.50^{b}	25.75	9.00	250.00
Family Income (R$/month)	3,002.24	1,807.33	2,179.50^{a}	3,238.50	1,050.00	6,750.00	1,511.82	1,115.26	1,101.75^{b}	1,248.00	240.00	5,796.00

Caption: SD: standard deviation, IR: interquartile range. Different letters in the same row indicate statistical difference by the Mann-Whitney U-test ($p<0.05$).

Table 2
Characterization of herd composition and production system of 100 farms studied as a function of milk production level in the Acre Valley mesoregion from March to June 2016

Factor	Situation	High-production cluster (n=22)		Low-production cluster (n=78)	
		n	%	n	%
Production system	Pasture	22	100.00	78	100.00
	Semi-confined	0	0.00	0	0.00
	Confined	0	0.00	0	0.00
Predominant breed	NDB	3	13.64	20	25.64
	Girolando	19	86.36	57	73.08
	Dutch Belted	0	0.00	1	1.28
Number of lactating cows (heads)	Above or equal to 15	9	40.91	24	30.77
	Below 15	13	59.09	54	69.23
Number of dry cows (heads)	Above or equal to 15	11	50.00	27	34.62
	Below 15	11	50.00	51	65.38
Total number of cows (heads)	Above or equal to 50	16	72.73	41	52.56
	Below 50	6	27.27	37	47.44
Cow identification system	Ear tag	10	45.45	25	32.05
	Branding iron	3	13.64	8	10.26
	Name	9	40.91	45	57.69
Animal splitting system	None	18	81.82	67	85.90
	By lactation stage	2	9.09	7	8.97
	By milk production	2	9.09	4	5.13
Daily consumption of balanced ration per lactating cow	None	21	95.45	78	100.00
	Up to 1 kg	1	4.55	0	0.00
Mineral salt supply	Yes	22	100.00	78	100.00
	No	0	0.00	0	0.00
Suckling management	Artificial with bottle	0	0.00	0	0.00
	Artificial with bucket	0	0.00	0	0.00
	Natural	22	100.00	78	100.00
Water origin	Headwaters	3	13.64	4	5.13
	Dug reservoirs	12	54.55	52	66.67
	Wells	7	31.82	22	28.21
Drinking fountain	Yes	3	13.64	12	15.38
	No	19	86.36	66	84.62
Electric fence use	Yes	13	59.09	33	42.31
	No	9	40.91	45	57.69

Fewer lactating animals together with low yields reduce production scale, which hence decreases farmer profitability. For Lopes et al. (2006), production scale influences total and operating costs and, therefore, profitability. Moreover, it is known that optimizing the physical structure of companies increases production scale to certain levels, with a reduced fixed cost per unit. In this context, Lopes, Santos, Resende, Carvalho and Cardoso (2011) and Demeu, Lopes, Costa, Rocha and Santos (2016) stated that, in most Brazilian states, a bonus is offered to milk producers based on the milk volume produced, and thus increasing their income.

Average herd composition was inadequate because high- and low-production clusters had only 17.45 and 14.41% of lactating cows, and 21.68% and 21.31% of dry cows, respectively (Table 1). These indices are well below the ideal composition of 42% of lactating cows and 8% of dry cows proposed by Campos & Ferreira (2009). If the farmer has good planning and suitable herd composition, economic efficiency and income can be higher by sale of animals, what, for Lopes et al. (2011), can reach about 20%. In sum, technicians and ranchers must be aware that the composition of dairy herds plays a fundamental role in the economic development of a rural property.

In terms of workforce, the studied farms showed a median of 2.00 for both clusters (Table 1). This is higher than those reported by Moraes et al. (2016) in Rio de Janeiro (1.42); and by Lopes et al. (2007) (1.44) and Ferrazza, Lopes, Moraes and Bruhn (2015), both in Minas Gerais. This parameter is important because, as daily milk production increases, labor productivity also increases (Bewley, Palmer, & Jackson-Smith, 2001). Low production and number of lactating cows per worker contribute to the workforce idleness, with significant effects on production costs. In this sense, actions could be taken to increase workforce productivity, as follows: workforce training and specialization, and adoption of standard operating procedures and performance incentives (Stup, Hyde, & Holden, 2006), as well as a business management focused on improving yield, allocating efficiency of production factors, and thus increasing production scale (Marques, Reis, Sáfadi, & Reis, 2002).

In median, low-production cluster used a dairy production area (34.50 ha) 109% larger than did high-production group (16.50 ha) (Table 1). As the latter produce more in a smaller area, these farmer may have had a more efficient land use (J. A. Santos, Vieira, & Baptista, 2005), reducing representativeness of land remuneration (a fixed cost component) by use optimization (Lopes, Cardoso, Demeu, & Dias, 2008), and hence increasing profitability of farmers.

In median, high-production cluster had a monthly family income of R$ 2,179.50, which is 97.47% higher than that of the low-production group (Table 1). This can be explained by the following parameters: lactating cow rate, milk liter per cow, and daily milk yield. It is worth mentioning that all these indexes are far below the ideal. Therefore, there is a clear need to improve them, which can be done by offering technical assistance to farmers. According to Nascimento and Pinto (2017), the absence of a technical monitoring often reduces farm productive potential, reducing yield, profitability, and competitiveness.

Table 1 displays the statistical analysis for quantitative parameters. Significant differences were observed between high- and low-production clusters for production (L ha^{-1} yr^{-1}) ($p=0.000$), daily milk production (liters) ($p=0.000$), daily production per cow (liters) ($p=0.000$), total area for daily activity (ha) ($p=0.001$), and family income (R$/month) ($p=0.000$). In short, there are several parameters that differentiate high and low production farms; therefore, it is believed that, if these parameters are well worked, profitability low-production farms can be increased.

All farms used a pasture production system. In the mesoregion of Acre Valley, dairy cattle are commonly reared in grazing systems to reduce costs, mainly due to the high cost of concentrated feed in the region. According to Stella, Stella and Gomes (2019), milk production at pasture is the most economical system. Conversely, Ervilha and Gomes (2017) stated that dairy production is economically attractive when production per area exceeds 4,576 milk liters per hectare per year, which was not achieved by any of the studied farms. To achieve this goal, pastures must have a satisfactory quantity and quality. F. A. P. Santos, Danés, Macedo and Chagas (2011) pointed out that dairy cattle production systems based only on tropical pastures does not meet the nutritional demand for high individual yields. In this sense, feed supplementation should be made to meet animal nutritional needs and be directly associated with economic income. This is because one of the reasons for the low use of concentrated foods by Brazilian cattle ranchers may be the lack of calculations about the efficiency of supplements (Teixeira et al., 2019)

Concerning cattle breeds, only one farm (1.24%) in the low-production cluster reared Dutch Belted cattle; the others, 20 (25.64%) and 57 (73.08%), reared predominantly non-defined breeds (NDB) and Girolando, respectively (Table 2). The low production of dairy herds in Brazil is mainly due to two factors: poor reproductive performance and low genetic quality of animals, resulting in low lactation production, short lactation periods, and low persistence in production (Ferreira & Teixeira, 2000).

Battaglini et al. (2013) highlighted that NDB and Girolando were the most observed in farms of central Paraná, with frequencies of 50.00% and 16.67%, respectively, followed by Holstein and Girolando (6.86%) and Girolando and Jersey (4.90%) crossbreds. The same authors reported that the rates of purebreds were only 4.90% for Holstein and 1.96% for Jersey, and for other crossbreds totaled 14.71%.

In terms of cattle identification, nine (40.91%) and 45 (57.69%) of the farms identified animals by name, and only 10 (45.45%) and 25 (32.05%) by ear tags, in the high- and low-production clusters, respectively (Table 2). For Lopes (1997), safe animal identification is basis for all management system functions, which result in zootechnical progress, besides production control and savings.

Most of the studied farms do not split lactating cows from the rest of the herd, 18 (81.82%) and 67 (85.90%) in high- and low-production clusters, respectively (Table 2). A herd management in grouped rearing is based on gathering animals as uniformly as possible in terms of size, age, production stage, and lactation and/or reproductive condition (G. S. L. Silva & Silva, 2016). This is an important technique so that cows can be fed specific diets, which increases precision in reaching their nutritional requirements (Carrijo, Linhares, & Barcelos, 2008). The general advantage is to meet the nutritional needs of different groups, reducing feed costs per animal per day, and being able to provide special supplements for each group (R. B. Reis, Souza, B. M. & Oliveira, 2009).

Daily supply of a balanced feed for lactating cows was observed in only one farm (4.55%) of the high-production cluster (Table 2). Stelzer et al. (2009) highlighted that milk production increases by 3.8 kg with an increase in the ratio of concentrated feed in the diet. According to Deresz (2001), efficiency of supplementation with concentrates to dairy cows at pasture ranges from 0.50 to 0.90 kg milk per kg concentrate in the rainy season and from 0.80 to 0.95 in the dry season. Likewise, Vilela, Ferreira, Resende, Lima and Verneque (2007) reported that cows supplemented with 3 and 6 kg concentrate per day reached daily average yields of 15.5 kg and 19.1 kg milk, respectively, considering 330-day lactation period and higher lactation persistence. According to Bargo, Muller, Kolver and Delahoy (2003), when dairy cows at pasture are supplemented, forage dry matter intake usually decreases, which is known as replacement rate. It is worth highlighting that concentrated supplementations should be used rationally and economically to supply the correct balance of nutrients required by animals, which may not be met by only forage diets.

All farms supplied mineral salt (100%) (Table 2). As carbohydrates and proteins, minerals are also important nutrients in animal diets (Wilde, 2006). Moreover, according to Lamb et al. (2008), minerals take part in several metabolic pathways and play important roles in reproduction, growth maintenance, energy metabolism, immune response, and other metabolic activities for a good productive performance.

In all the studied farms, calves were suckled naturally (Table 2). According to Van Amburgh and Drackley (2005), conventional suckling generally does not meet the nutritional requirements of dairy heifers for growth and development. Artificial suckling has provided suitable amounts of milk to calves in the first weeks of life, restricting to weaning and stimulating the best growth and adaptation to diets with roughages and concentrates (Virginio et al., 2016).

Absence of drinking fountains was a structural problem observed in 19 (86.36%) and 66 (84.62%) farms in the high and low production clusters, respectively (Table 2). Drinking fountains offer better quality water (cleaner and fresher) to cattle reared at pasture. According to cattle ingestion needs, animals must have free access to water, avoiding energy costs and hierarchical disputes. Therefore, the use of drinking fountains in pastures increases cattle yield (Tavares & Benedetti, 2012). By contrast, in the majority of farms (12, 54.55%; and 52, 66,67% in the high- and low-production clusters, respectively), animals ingested water from large reservoirs dug in pastures during the dry period, which are fill up in the rainy season, the so-called “time of the waters”. This process changes physical aspects of water such as temperature, color, and turbidity, besides its organoleptic properties (e.g., appearance, taste, and odor), which can make animals reject it for drinking purposes (World Health Organization [WHO], 1993). Dairy cattle require proper supply of good quality water for many organic functions such as rumen fermentation and metabolism, food-flow through digestive tract, digestion, nutrient absorption, blood volume, and tissue irrigation system (Nóbrega Neto, Araújo, & Távora, 2016). Unfortunately, animal water intake has been often disregarded as a limiting factor to detriment of other dietary nutrients. However, low water intake increases hematocrit content and blood urea concentration, which reduces respiratory rate, rumen contractions, live weight, and milk production (L. Ribeiro & Benedetti, 2011).

A limited water consumption reduces animal performance faster and more shortly than any other nutrient deficiency (Boyles, Wohlgemuth, & Fisher, 1988). Cattle need constant and abundant supply of good quality clean water for regular rumen fermentation and metabolism, so that food flow could be maintained in digestive tract, favoring good digestion and nutrient absorption to supply body tissue demands (Adams & Sharpe, 1995). Notwithstanding, water intake has direct impact on productive performance of cattle reared at pasture. According to Marino (2006), a bovine weighing 450 kg (1 UA) at an ambient temperature of 27 °C consumes a water volume of 55 L day^{-1}. Moreover, Benedetti (2009) claimed that a minimum requirement is 45 L $head^{-1}$ day^{-1} or about 8 to 9 L per 100 kg live weight, under proper management conditions.

The use of electric fence was reported in 13 (59.09%) and 33 (42.31%) farms of the high- and low-production clusters, respectively (Table 2). This technology helps reduce production system costs, increasing the efficiency and profit of dairy activities. In practice, cattle containment using electric fence properly can reduce up to 80% of the costs compared to barbed-wire fence (Torres, Machado, & Mundim, 2007).

Pastures were considered regular in most farms, 11 (50.00%) and 61 (78.21%) in high- and low-production clusters, respectively (Table 3). However, it is important to point out that animal performance may be suboptimal in forage-based cattle feeding systems (Mesacasa et al., 2015). Grazing animals are known to be selective (Hodgson & Brookes, 1999). So, in regular pastures (quality and quantity) as those in the studied farms, cattle diet may have affected voluntary consumption and hence dry matter intake.

Table 3
Characterization of zootechnical and reproductive factors of 100 farms studied as a function of milk production level in the Acre Valley mesoregion from March to June 2016

Factor	Situation	Cluster 1 (n=22) High-production		Cluster 2 (n=78) Low-production	
		n	%	n	%
Pasture quality	Optimal	1	4.55	0	0.00
	Good	8	36.36	14	17.95
	Regular	11	50.00	61	78.21
	Poor	2	9.09	3	3.85
Pasture infested by weed	Yes	21	95.45	77	98.72
	No	1	4.55	1	1.28
Zootechnical bookkeeping	Yes	1	4.55	3	3.85
	No	21	95.45	75	96.15
Breeding system	Natural mating	20	90.91	72	92.31
	Artificial insemination	1	4.55	6	7.69
	FTAI	1	4.55	0	0.00
Cow body condition at calving	Lean	12	54.55	56	71.79
	Average	8	36.36	22	28.21
	Fat	2	9.09	0	0.00

*FTAI: fixed time artificial insemination.

Presence of invasive plants was observed in pastures of 21 (95.45%) and 77 (98.72%) farms of the high- and low-production clusters, respectively (Table 3). Weed infestation does not occur in isolation but is an ecological response to crop management. Previous practices always have effect on weed population, so inadequate managements make desirable species less competitive to detriment of undesirable ones (Kemp & King, 2001).

Zootechnical bookkeeping was not practiced in 21 (95.45%) and 75 (96.15%) of the farms in high- and low-production clusters, respectively (Table 3). The main objective of this practice is to obtain extremely necessary information to plan, monitor, manage, and assist decision-making in any milk production system (E. M. B. Reis et al., 2019). J. N. Santos, Carvalho and Silva, (2006) stated that a barrier for increases in daily milk production and livestock breeding is the lack of information, hindering improvement of zootechnical indexes, which are the basis for a good management planning focused on livestock production effectiveness. For Lopes (1997), farm technological level, number of animals, among others are zootechnical records that can be made in simple notebooks or records of productive and reproductive control, or even in sophisticated computer systems. Despite being applicable, handwritten records are subject to errors and, therefore, not 100% reliable. When evaluating farms in the city of Ilhéus, Bahia state (Brazil), A. R. P. Ribeiro, Lobato and Abreu (2003) observed that zootechnical bookkeeping was done on a computer by 4.7% of the farmers, 34.1% used notebooks, and 54.1% made no record of herd situation. Similarly, Belchior (2001) reported that 62.0% of the farmers in the State of Minas Gerais did not make any type of herd record.

In regards to reproductive management, natural mating was used in 20 (90.91%) and 72 (92.31%) of the farmers in high- and low-production clusters, respectively (Table 3). This observation is similar to that reported by Clementino et al. (2015) in the state of Paraíba (99.10%) and much higher than that of N. Lima, Pinto and Floss (2015) in the state of Paraná (48.18%).

Animals showed low body condition score at calving in most of the farms, 12 (54.55%) and 56 (71.79%) in high- and low-production clusters, respectively. Body weight loss and negative energy balance at calving may negatively influence return to anestrus state and ovarian activity resumption in ewes (Mbayahaga, Mandiki, Bister, & Paquay, 1998). Body score is a determining factor for faster endometrium recovery and heat manifestation, decreasing calving intervals (Barbosa et al., 2016) and hence increasing animal yield.

Since the production environment is dynamic, it is of practical interest to identify, quantify, and establish technical-managerial and zootechnical reference indexes, which should be considered by managers of rural companies and professionals who work with technical assistance and rural extension (Ferrazza et al., 2015).

Conclusions

High-production-cluster farms increased total milk production, milk yield per cow per day, and family income using a smaller area and less labor. They also had predominance of Girolando breed animals, higher quality pastures, and cows of better body condition at calving. Moreover, high-production farms made more use of ear tags and technologies such as electric fence. Some of the productive factors found in the surveyed farms must be improved to enhance results and hence farmer profitability.

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