DOI: 10.5433/1679-0359.2019v40n6Supl3p3691

Characterization of goat production systems in five states of northeastern Brazil

Caracterização dos sistemas de produção de caprinos de cinco Estados no Nordeste

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Abstract

Goat farming is a very important activity contributing to the social and economic development of northeastern (NE) Brazil. The objective of the present study was to characterize the goat farming production system in five of the nine states that constitute the Brazilian NE (Ceará, Paraíba, Piauí, Rio Grande do Norte, and Sergipe). Research was carried out in 230 rural properties located in 62 municipalities of the NE of Brazil, in regions exhibiting a productive arrangement and significant goat population density. An epidemiological questionnaire seeking information on economic, productive, and social aspects of owners/properties was supplied to all properties. The results described the goat farming system in the Brazilian NE as family and subsistence, directed towards domestic consumption and local commerce, and exhibiting a low technological level. The farmers' education level, investments, and technical assistance were all considered low, and thus insufficient or inadequate for a full development of the activity in the region. Therefore, such aspects are suggested to be taken into account in the planning of future goat farming development policies—particularly financing and technical assistance, better preparation of farmers, administrative aspects, forage production and conservation, and the implementation of actions towards reproductive and frequent disease control.
Key words: Goat farming. Northeast. Productive characteristics.

Resumo

A criação de caprinos é uma atividade de grande importância para o Nordeste (NE), contribuindo para o desenvolvimento econômico e social da região. Diante disso, objetivou-se caracterizar o sistema produtivo da caprinocultura em cinco dos nove Estados que compõem o NE brasileiro (Ceará; Paraíba; Piauí; Rio Grande do Norte; Sergipe). A pesquisa foi realizada na região NE do Brasil, em 230 propriedades rurais de 62 municípios oriundos de regiões com arranjo produtivo e densidade populacional significativa de rebanhos caprinos. Nas propriedades foi aplicado questionário epidemiológico, buscando informações sobre aspectos econômicos, produtivos e sociais dos proprietários/propriedades. Os resultados obtidos classificaram o sistema de produção de caprinos no NE brasileiro como familiar e de subsistência,

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Received: Nov. 30, 2018 - Approved: June 06, 2019

para consumo doméstico e comércio local, com baixo nível de tecnificação. O nível de escolaridade dos criadores foi considerado baixo, bem como dos investimentos e assistência técnica realizadas, insuficientes ou inadequados para o desenvolvimento pleno da atividade na região. Dessa forma, sugere-se que tais aspectos sejam levados em consideração quanto ao planejamento de futuras políticas de desenvolvimento para a caprinocultura, especialmente quando relacionados a financiamento e assistência técnica, no melhor preparo dos criadores, nos aspectos administrativos, de produção e conservação de forragens e na implementação de ações no controle reprodutivo e das doenças mais frequentes.
Palavras-chave: Características produtivas. Caprinocultura. Nordeste.

Introduction

Goat farming occurs in all five large regions of Brazil, reaching a total of 9,592,079 animals in 2017. The activity is divided into two goat farming variants: the traditional, of great social and cultural importance, that occurs mainly in the Northeast (NE), and; the technological, of greater economic and productive importance and potential for agribusiness (CARVALHO, 2003; IBGE, 2017). The NE region stands out by concentrating 93 % of the national goat population (over nine million animals) distributed in more than one million farming properties, thus consolidating the importance of goat farming in terms of employment and income generation as well as a food source for families in this Brazilian region (SEBRAE, 2009; MOREIRA; GUIMARÃES FILHO, 2011). The rusticity and productive adaptability of goats highlight the production potential of the chain in the NE region, particularly for its socioeconomic development (CARVALHO, 2003).

The increase in consumer demand and great activity of the goat farming production chain in recent years has led to the involvement of states, industry technicians, producers, and industries to seek incentives aimed at improving and consolidating this productive chain in the NE. Examples include credit facilitation, increase in production-focused research, and market incentives to producers, put in place by projects such as: the "*Pacto do Novo Cariri*" and the "*Leite da Paraíba*" in the State of Paraíba (BANDEIRA et al., 2007); "*Programa do Leite*" in Rio Grande do Norte (SILVA, 2014), aimed at the economic development of goat dairy products in these States, and; the "*Cabras do Piauí*" project, aimed at structuring and developing goat farming in the State of Piauí (EMATER-PI, 2018). Additionally, social projects such as "*Cabra Nossa de Cada Dia*", aimed to improve basic nutrition access and socioeconomic development of rural communities in the vicinity of Sobral/CE (TEIXEIRA, 2009). However, despite the great concentration of herds, high productive potential, and the sociocultural aspects related to goat husbandry in the NE, research has shown a very limited productive profile for goat farming. These conditions arise from the peculiar circumstances of this chain, including cultural (rusticity of farms), conjectural (prices and markets), and ecological aspects (climate) (RIET-CORREA et al., 2013; SILVA et al., 2013), which limit the development of regional goat farming.

In this context, the activity development is hindered by the lack of pertinent information to enable the characterization of its productive system, conditions that limit the growth potential, and auto-correction of the activity, especially due to a lack of analysis of the socioeconomic and productive profiles of the agricultural production systems (SOUZA, 2009; LIMA et al., 2010). This situation is evidenced by the lack of data regarding the number and location of productive units, and an actual lack of awareness of both the number of farmers and the peculiarities of goat farming. Therefore, the study of the rural reality of various NE Brazil States will generate an important reference tool for the promotion and guidance of current or future development programs that may be applied by institutions responsible for the formulation of public policies, and in the planning and activity of rural extension services in this region. Thus, the objective

of this study was to characterize the goat farming production systems in the states of Ceará, Piauí, Rio Grande do Norte, Paraíba, and Sergipe.

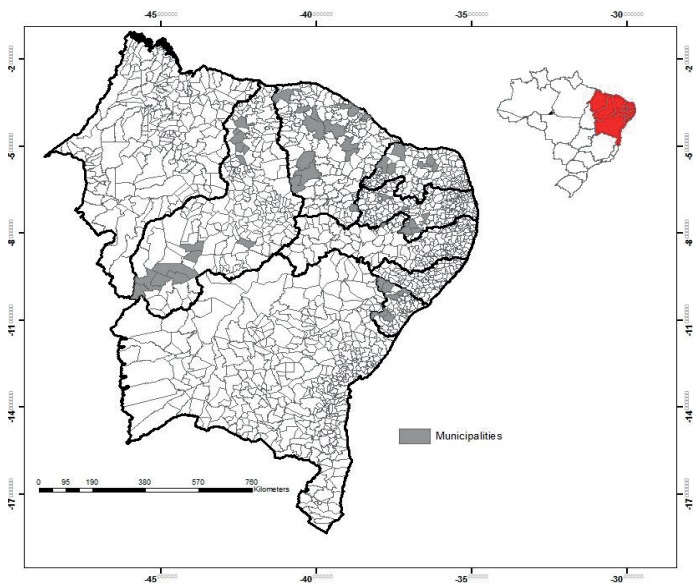
Materials and Methods

The Northeast region of Brazil encompasses an area of more than 1.5 million square kilometers (18 % of Brazilian territory), located below the equator, where the semi-arid climate is prevalent, and the typical biome is Caatinga. It is divided into four sub-regions (Forest Zone, Hinterland, Backlands, and Midnorth), comprising nine Federated States: Alagoas, Bahia, Ceará, Maranhão, Paraíba, Pernambuco, Piauí, Rio Grande do Norte, and Sergipe (SILVA et al., 2010; IBGE, 2017).

The research was carried out on farms from immediate geographic regions located in the five NE Brazilian states with a production pole, a significant goat population density, and a minimum of institutional support structure (e.g. unions, cooperatives, and/or research institutions). The minimum number of properties to be visited was calculated using the formula for simple random samples (THRUSFIELD, 2007), with a sample of n=30 properties per State; however, the final sample comprised 37 properties in Ceará (CE), 62 in Paraíba (PB), 48 in Piauí (PI), 56 in Rio Grande do Norte (RN), and 27 in Sergipe (SE). The following regions were selected: in the state of CE, the metropolitan Fortaleza, Hinterland of Ceará, Northwest of Ceará, and North of Ceará; in PB, Borborema and Sertão of Paraíba; in PI, the Southeast and Center-North; in RN, the Central and West regions; and in SE, the Outback and the Hinterland of Sergipe.

Two-hundred and thirty rural properties in 62 municipalities of the five states were visited (Figure 1). The information was obtained between 2010 and 2012 by applying a questionnaire comprising qualitative and quantitative information, subdivided into sections. The questionnaire was applied to each selected property - goat farming was the criterion adopted for their inclusion, and the selection was based on convenience. The criteria defined for social, economic, and technical issues were the Embrapa Caprinos e Ovinos/CNPC - Sobral / CE database itself, which was created based on studies conducted by a specialized team in the area. The sections were identified as infrastructure, herd, and social and technical variables, with the purpose of obtaining information on property characteristics, producer profiles, and technological levels.

Figure 1. Geographic distribution of the municipalities investigated in the five states of Northeast Brazil (Ceará, Paraíba, Piauí, Rio Grande do Norte, and Sergipe).



The interview was presented to the interviewee using structured questions to allow the appropriate answers to be obtained for the research objective. The producers were interviewed directly on their properties by EMBRAPA technicians and scholarship awardees, supervised *in loco* by EMBRAPA researchers. The questions, response options, and questioning sequence were identical for all respondents to ensure that variation between responses arose from the interviewees (rather than interviewers'), seeking to identify and evaluate the main adopted management systems.

A simple frequency analysis was performed on the collected information using the STATISTICA Trial Program (2009).

Results and Discussion

From the total of the 230 property owners interviewed, the education level of 44.3 % of respondents was primary education (elementary school) and illiteracy among the producers was not significant. This trend was mostly higher in the State of PB (60.7 %), followed by SE (47.3 %), RN (42 %), PI (38.2 %), and CE (32.4 %) (Table 1). The interpretation favors an environment conducive to the training of labor, assimilation of new technologies, and improvements in the economic aptitude of goat farming. However, according to Guilherme et al. (2017), although high school education-level producers are more receptive towards training programs, this condition should be carefully evaluated as the quality of public education in the Brazilian inland cities is limited. The PI and CE states also showed a higher frequency of interviewees with a higher education level - above 29 % - whereas SE, RN, and PB exhibited a lower secondary education level. This condition is promising in terms of future improvements and requirements that may become necessary in these properties, be it a greater perception and organization of productive needs (especially those of an administrative nature), or the search for specialized guidance and economic improvements.

Table 1. Analysis of the social profile of goat farmers in the Northeast region of Brazil, 2010-2012.

Variables	Total (230)		Sergipe (27)		Piauí (48)		Ceará (37)		Rio Grande do Norte (56)		Paraíba (62)	
	N	%	N	%	N	%	N	%	N	%	N	%
Education Level												
Illiterate	5	0	0	0	0	0	0	0	5	10	0	0
Up to 1st grade (elementary school)	91	47.3	9	47.3	18	38.2	12	32.4	21	42	31	60.7
Up to Grade 2 (high school)	64	42.1	8	42.1	10	21.2	11	29.7	17	34	18	35.2
Superior	44	10.5	2	10.5	19	40.4	14	37.8	7	14	2	3.9
Place of residence												
In the city	87	41.2	7	28	32	66.7	18	50	17	34.6	13	23.2
At the property	124	58.7	15	60	16	33.3	18	50	32	65.3	43	76.7
Participation in Union/Cooperative												
Yes	133	76.4	-	-	17	36.1	26	74.2	44	95.6	45	100
No	41	23.5	-	-	30	63.8	9	25.7	2	4.3	0	0

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Accounting												
Yes	18	8	0	0	1	2.1	8	22.2	3	5.4	6	10
No	207	92	27	100	45	97.8	28	77.7	53	94.6	54	90
Acquisition of bank loan												
Yes	112	52.5	11	45.8	21	46.6	14	43.7	30	58.8	36	59.0
No	101	47.4	13	54.1	24	53.3	18	56.2	21	41.1	25	40.9

N = number of questionnaire replies; % = percentage of questionnaire replies.

Since goat farming deficiencies may arise from the technical level of the farmers themselves, such as when entrepreneurship, organizational resistance, or the poor perception of the use of new technologies in small ruminant cattle farming were found to be a consequence of the low education level of farmers and other involved agents (SOUZA NETO et al., 1996). Future interventional approaches to the goat farming production chain must necessarily respect the socioeconomic profile and productive reality of each region in order to strengthen the individual potential of each goat farming center. This observation should be considered, since technology usage perceptions may vary with the farmers' level of education, as well as the ease and diligence in the search for assistance and technical support in property management.

The majority of the producers 58.7 % resided on site. This trend was prevalent in PB (76.7 %), RN (65.1 %), and SE (60 %), but not in PI (wherein the majority of respondents 66.7 % lived in cities) nor in CE (50-50% distribution between city and property dwellers) (Table 1). Living on site contributes to an increase in the time dedicated to goat farming, allowing a daily monitoring of services and streamlining of necessary solutions to address the productive and administrative needs of the property (HOLANDA JUNIOR; CAMPOS, 2003). On the other hand, residing outside the property demands frequent trips from the farmer to attend to daily activities, thus limiting the resolution of specific goat farming aspects, as well as the real-time management and economic losses in the property. In this regard, the importance of both establishing the farmer on the property and adopting public policies to stimulate this (by creating the necessary conditions and opportunities for this settlement) is clear.

A majority of respondents (52.5 %) claimed they had acquired bank loans for their property, of which 91.5 % had paid their loans off. Most of the bank credit was earmarked for investments and agricultural funding for the property (Table 1); however, the low productive indices did not demonstrate a positive repercussion arising from this practice on properties. Obtaining credit for goat farming activity was frequent in most of the producers evaluated. However, the absence of this practice was also significant (47.4 % of properties), providing evidence of the farmers' concerns about acquiring credit for the goat farming activity. Other activities may aid in meeting investment needs, demonstrating that goat farming may not be the principal income goal for some of the evaluated properties. This situation is often associated with a family agriculture profile, where it is not uncommon for the property owner to have another source of income, such as commerce, agriculture, or an off-property occupation (SILVA et al., 2013; SILVA, 2014).

Only 8 % of respondents performed accounting, revenue, and expense control of property activities (varying between 22.2 % in CE and 0 % in SE) (Table 1). The fact that the majority of producers do not perform their activities' accounting shows they were unprepared towards the financial aspects of

farming, as the realization of this balance is essential for the advancement of any economic activity.

In this study, enrollment in unions and associations was indicated as the main form of organization of producers (76.4 %), reflected in PB (100 %), RN (95.6 %), and CE (74.2 %) (Table 1), demonstrating that the farmer community organization in unions and associations is a reality in the rural environment. This shared support space among producers can benefit the composition of these groups in an environment amenable for the intervention of public policies, and as an alternative means for the improvement of owners and workforce (BRITO, 2006). Despite this potential, the social organizations was focused mostly on the social security of union members rather than on developing the productive activity, according to Guilherme et al. (2017). Nonetheless, this social organization is indispensable for farmers to collectivize knowledge and centralize a promising environment to access information on financial institutions, research, and training of micro and small enterprises.

The majority of interviewees (59.7 %) were individuals aged 31-56 years old, followed by individuals over 57 (27.6 %) (Table 2). The mean age in this study was 47 years, with the oldest farmer being 91 years old; gender-wise, only 6 were women. The higher age of producers may be associated with the migration of younger generations to urban centers in search of better living conditions, emphasizing the necessity of attracting this age group to this market, considering that younger generations are more entrepreneurial and interested in new technologies (HOLANDA JUNIOR; CAMPOS, 2003; LIMA; BAIARDI, 2000). The higher frequency of men and elderly people in NE Brazil goat farming reflects the traditional condition of these producers, wherein the experience and habits of the elders cannot be ignored.

Table 2. Analysis of the quantitative variables: producer age, time in husbandry, and labor destined for goat farming activity in the Northeast region of Brazil, 2010-2012.

Variables	Total (230)		Sergipe (27)		Piauí (48)		Ceará (37)		Rio Grande do Norte (56)		Paraíba (62)	
	N	%	N	%	N	%	N	%	N	%	N	%
Age of producer (years)												
≤ 30	26	12.6	2	11.7	3	6.3	3	8.8	3	5.8	15	25.4
31-56	123	59.7	13	76.4	22	46.8	22	64.7	31	60.7	35	59.3
> 57	57	27.6	2	11.7	22	46.8	9	26.4	15	29.4	9	15.2
Time in husbandry (years)												
≤ 26 years	132	59.7	19	73	29	60.4	23	67.4	31	58.4	30	50
> 26 years	89	40.2	7/	26.9	19	39.5	11	32.3	22	41.5	30	50
Time dedicated to goat farming (years)												
≤ 20 years	159	71.9	21	77.7	37	77	20	62.5	31	58.4	50	81.9
> 20 years	62	28	6	22.2	11	22.9	12	37.5	22	41.5	11	18
Acquisition of property?												
Spot purchase	94	41.9	6	24	25	54.3	18	51.4	20	36.3	24	39.3
Financed purchase	10	4.4	4	16	3	6.5	2	5.4	1	1.8	0	0
Inheritance	81	36.1	6	24	19	41.3	8	21.6	17	30.9	31	50.8

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Settlement	25	11.1	6	24	0	0	1	2.7	0	0	5	8.1
Other	17	7.5	3	12	2	4.3	7	18.9	4	7.2	1	1.6
Family workforce (man/day)												
up to 2	169	74.7	24	92.3	37	78.7	27	73	35	63.6	46	76.6
3	26	11.5	1	3.8	6	12.7	5	13.5	6	10.9	8	13.3
> 3	31	13.7	1	3.8	4	8.5	5	13.5	15	27.2	6	10
Hired labor (man/day)												
1	144	63.7	21	80.7	19	40.4	16	43.2	37	66.1	51	85
2	31	13.7	2	7.6	7	14.8	9	24.3	9	16.1	4	6.6
> 2	51	22.5	3	11.5	21	44.6	12	32.4	10	17.9	5	8.3
Activity training												
Yes	80	39	-	-	8	17	19	51.4	20	39.2	31	51.6
No	125	60	-	-	9	19.1	18	48.6	31	60.7	29	48.3

N = number of questionnaire replies; % = percentage of questionnaire replies.

Although women were not shown to be significantly frequent property managers, they have an ever-present role in goat farming and in supporting property activities, a very common trait in family agriculture that is complementary to the masculine work in the property (ALMEIDA et al., 2014). This situation emphasizes the need to attract and work on this segment of the public, since the presence of women in goat farming is an aggregating factor in income, safety, and positive influence on the activity. This is a favorable condition found in goat dairy farming, animal husbandry, diversification, and added value increases of the enterprise production and management (FELISBERTO et al., 2016). Moreover, the activity of women in goat farming may also increase the acceptance of goat farming within families by their greater influence among the younger generations, improving their interaction with the productive and commercial activity of the property.

The majority of the producers have been involved with livestock farming for 26 years or less (59.7 %), of which 71.9 % had up to 20 years in goat farming (Table 2); however, the majority of farmers were involved for less than 14 years. The importance of goat farming has grown among farmers over time, demonstrating that the market and financial incentives offered by goat farming programs and projects in the NE yielded positive outcomes with the entry of more producers. Furthermore, most farmers acquired the property by spot purchase or inheritance (41.9 % and 35.2 %, respectively), reflecting both the interest and the traditional aspects in these States. These conditions favor the strengthening and expansion of goat farming in the region - the greater experience in the activity, the greater the chances of effectiveness in the productive performance of the property (FARIA et al., 2004; LIMA et al., 2010).

A family-constituted workforce was more frequently observed than contracted labor. When present, contracted labor complemented the family workforce employed in most cases. When questioned about the level of training of the workforce employed in the property, 39 % of producers stated that they had been given some training (more frequently in the states of PB and CE with 51.6 % and 51.4 %, respectively) (Table 2). The higher training frequency observed in the aforementioned states stems from the presence of research, teaching, and extension institutions, with better technical support and access to information by producers, as well as

the influence of programs aimed at the development of goat farming in these states, such as the "*Pacto do Novo Cariri*" and the "*Leite da Paraíba*" in Paraíba (BANDEIRA et al., 2007). However, pasture production and conservation, sanitary management, and zootechnical records were the least frequently trained aspects in the majority of properties of all states. This condition provides evidence for a lack of knowledge of the actual value of these subjects by goat farmers, which are important for production viability and maintenance of long-term herds (GOMES et al., 2007; NASCIMENTO et al., 2013).

An evaluation of the facilities showed a higher frequency of sheepfolds in the properties (80.2 %), indicating an interest in the use of technologies that favor goat productive management by the producers (Table 3), since its construction assumes the application of technical recommendations and enables the most appropriate management of the activity (DINIZ et al., 2011). The use of sheepfolds in goat farming has the goal of optimizing the existing workforce labor, benefiting the man-animal-environment relationship throughout the daily activities, providing animal safety and comfort, facilitating sanitary control of the herd, and reducing costs of food waste and stress in productive management. These facilities were cleaned weekly (46.3 %) or daily (25.1 %) without the presence of manure pits on most properties; farmers used manure for culture management within their properties. The cleaning of the facilities and the proper directing of goat manure indicate that owners understand that its inappropriate disposal is an enabling factor for the occurrence of diseases within the herd, with a concomitant incurrence in treatment costs and loss of animals and productivity.

Water availability occurred in 70.9 % of properties (Table 3), with the majority of animals having direct access to the source all year round, mainly from reservoirs (58.4 %) and artesian wells (30.4 %). This result is in agreement with that observed in the Northeastern Semi-arid region by Alencar et al. (2010) in properties in the Hinterland in the State of Pernambuco, where the main water resources used in goat farming were reservoirs or wells. The authors drew attention to the necessity of applying technology that enables rainwater storage to meet the demand for the activity throughout most of the year. Most of the farmers in the present study claimed to have this concern, as prolonged drought periods can compromise activity.

Table 3. Analysis of the qualitative variables of the technological aspects favorable to goat farming activities in the Northeast region - Brazil, 2010-2012.

Variables	Total (230)		Sergipe (27)		Piauí (48)		Ceará (37)		Rio Grande do Norte (56)		Paraíba (62)	
	N	%	N	%	N	%	N	%	N	%	N	%
Facilities												
Sheepfold	183	80.2	20	76.9	24	50	26	72.2	54	92.9	61	98.4
Pig pen	43	18.8	0	0	22	45.8	19	52.7	2	3.6	0	0
Forage Silo	14	6.1	0	0	2	4.2	10	27.7	2	3.6	0	0
Manure pit	10	4.3	1	3.8	2	4.2	6	16.6	1	1.8	0	0
Cleaning of facilities												
No cleaning	11	5.3	0	0	2	4.4	4	11.1	3	6.5	2	3.3
Weekly	96	46.3	5	25	18	40	13	36.1	24	52.1	36	60
Monthly	34	16.4	3	15	14	31.1	4	11.1	10	21.7	3	5

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Annually	14	6.7	4	20	6	13.3	1	2.7	3	6.5	0	0
Daily	52	25.1	8	40	5	11.1	14	38.8	6	13	19	31.6
Main water source in the property												
Protected hand dug well	19	8.6	0	0	3	6.8	25	71.4	6	11.3	0	0
Reservoir	128	58.4	18	69.2	19	43.1	16	45.7	32	60.3	43	70.4
Well	71	32.4	1	3.8	12	27.2	4	11.4	23	43.3	31	50.8
Cistern	13	5.9	4	15.3	1	2.2	2	5.7	4	7.5	2	3.2
Artesian well	18	8.2	0	0	11	25	2	5.7	4	7.5	1	1.6
River	33	15.0	8	30.7	5	11.3	10	28.5	0	0	10	16.3
Distribution of water in the premises												
Yes	156	70.9	27	100	17	38.6	27	79.4	37	69.8	48	77.4
No	64	29	0	0	27	61.3	7	20.5	16	30.1	14	22.5

N = number of questionnaire replies; % = percentage of questionnaire replies.

The semi-intensive system predominated among the adopted management systems (62.8 %), except in PI (85.3 %) and SE (47.8 %), where the extensive system predominated (Table 4). Generally, farming systems adopted in the NE vary according to the technology level adopted by the producers; the extensive system is more limiting in goat farming, owing to its low technological level and dependence on rainfall distribution (COSTA et al., 2008; DINIZ et al., 2011). In this context, Guilherme et al. (2017) warned about behavioral changes in the State of PB, considering that the higher frequency of extensive farming would be expected under normal rainfall conditions in NE. However, due to the long drought period the region suffered in recent years, this scenario changed, with farmers being forced to migrate to the semi-intensive management to enable the maintenance of their productive systems. This demonstrates that goat farms managed within the semi-intensive system may be becoming a trend in the Brazilian NE, not only by choice but also by necessity to maintain a viable activity.

Table 4. Analysis of qualitative variables related to facilities and food management that are favorable to goat farming activity in the Northeast region of Brazil, 2010-2012.

Variables	Total (230)		Sergipe (27)		Piauí (48)		Ceará (37)		Rio Grande do Norte (56)		Paraíba (62)	
	N	%	N	%	N	%	N	%	N	%	N	%
Facilities with technological level												
Extensive	60	31.4	11	47.8	35	85.3	6	27.2	4	7.2	4	8
Semi-intensive	120	62.8	10	43.4	5	12.1	9	40.9	50	90.9	46	92
Intensive	9	4.7	2	8.6	1	2.4	5	22.7	1	1.8	0	0
Goat Feeding Management												
NP	13	6.4	11	50	1	2.2	0	0	0	0	0	0
NP+C	20	9.8	3	13.6	1	2.2	4	19	6	17.1	6	10
CP+C	74	36.4	0	0	14	31.8	6	28.5	19	52.2	19	31.6
NP+CP	12	5.9	1	4.5	8	18.1	0	0	1	2.8	1	1.6
NP+CP+C	28	13.7	7	31.8	1	2.2	5	23.8	4	11.4	0	0

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Goat Feeding Management												
NP	74	36.4	21	95.4	12	27.2	9	42.8	11	31.4	21	35
CP	140	68.9	8	36.3	42	95.4	12	57.1	25	71.4	53	88.3
Grazing available for animals												
Bufell-grass	39	21.3	1	4.5	2	4.4	0	0	0	0	36	60
White leadtree	8	4.3	0	0	1	2.2	2	9.5	5	14.2	0	0
Native	62	33.8	21	95.4	11	24.4	9	42.8	10	28.5	11	18.3
Elephant grass	50	27.3	2	9	5	11.1	7	33.3	9	25.7	27	45
Tifton	7	3.8	0	0	5	11.1	0	0	2	5.7	0	0
Brachiaria	31	16.9	0	0	10	22.2	4	19	6	17.1	11	18.3
Rhodesian grass	32	17.4	0	0	31	68.8	16	76.1	1	2.8	0	0
Cinodon	72	39.3	5	22.7	24	53.3	8	38	14	40	21	35
Concentrate provided to animals												
Yes	52	92.9	12	44.4	16	36.6	31	86.1	52	92.9	55	88.7
No	4	7.1	15	55.6	28	63.6	5	13.8	4	7.1	7	11.3
Forage conservation practices												
Yes	94	42.9	13	50	16	35.5	18	58	34	60.7	13	21.3
No	125	57	13	50	29	64.4	13	41.9	22	39.3	48	78.6
Conservation type, if used												
Does not use	125	57	13	50	29	64.4	13	41.9	22	39.3	48	78.6
Haymaking	20	9.1	0	0	2	4.4	3	9.6	12	21.4	3	4.9
Pasture	11	5	0	0	6	13.3	4	12.9	1	1.8	0	0
Silage	62	28.3	11	42.3	5	11.1	8	25.8	28	50	10	16.3
Rest of Culture	10	4.5	0	0	0	0	9	29	1	1.8	0	0
Tree Cactus/Mandacaru/Palm	2	0.9	0	0	0	0	2	6.4	0	0	0	0

PN = native pasture, CP = cultivated pasture, FP = forage palm, C = concentrate; N = number of questionnaire replies; % = percentage of questionnaire replies.

Regarding the types of bulky foods and concentrate supplied, the cultivated pasture + concentrate system prevailed, followed by native pasture + cultivated pasture (Table 4). African grasses predominated in cultivated pasture, particularly those better adapted to a semi-arid climate: Bermuda grass (*Cynodon dactylon*), Elephant grass (*Pennisetum purpureum*), Buffel-grass (*Cenchrus ciliaris*), and Ganba grass (*Andropogon gayanus*). The forage mass yield of some grasses cultivated in the semiarid region is modest due to the low volume and irregularity of rainfall, justifying a search for alternatives (better adapted and more productive forage species and techniques) to meet the nutritional needs of the herd. Farmers commonly resort to pasture cultivation of grasses mainly in the more humid areas of the property, such as banks, and downstream of dams. Other alternatives, such as the association between native and cultivated pasture on the properties, preparation and elaboration of white leadtree (*Leucaena leucocephala*) protein banks and their cultivation in conjunction with Buffel-grass or other native species can be used (OLIVEIRA et al., 1988; GUIMARÃES FILHO, 1994; GUIMARÃES FILHO; SOARES, 1999; BANDEIRA et al., 2007), despite it not being the most widely used in the literature. Therefore, the adoption of techniques for the production of intercropped forage species and

other alternatives, which consider the costs involved and property resources, are good alternatives for the productive viability of farms.

It was observed that 57 % of the producers do not adopt forage conservation practices in the property (Table 4). In general, the production of native forage in the Brazilian NE is insufficient to meet the protein and energy demands of goat farms. Some of the produced forage material goes to waste during the rainy season, whereas in the low rainfall period, a limitation of survival and forage productivity occurs for small ruminants (GOMES et al., 2007; NASCIMENTO et al., 2013). In this respect, it is recommended that, in the dry season, farmers should take advantage of the forage surplus by applying pasture management and conservation techniques, such as silage and haymaking, to allow consumption throughout the greatest shortage period. Although silage and haymaking constitute good forage conservation technique options, properties in the Brazilian NE are not concerned at this level; only RN (50 %) and SE (42.3 %) employed silage to feed the herd. The lack of knowledge about the techniques, the cost of extrafamiliar labor in the different phases of production, and the competition with the production of food for human consumption has justified the disuse of these techniques and the lack of tradition in the storage and conservation of forage by part of the producers (RIET-CORREA et al., 2013). In this context, even with the increasing need for techniques that guarantee the farming productivity throughout drought periods in the Brazilian NE region, misinformation and technical limitations have influenced this choice. It should be noted that the use and approach of these techniques needs to intensify and improve, seeking measures that fit the socio-cultural reality of the producers.

Dairy and dual-use breeds such as the Safflower, Anglo-Nubian, and Chamois Colored stand out in the composition of herds; pure breed animals occur in higher frequency - 80.6 % (Table 5). The predilection for exotic breeds over native animals stems from the greater use of breeders and matrices of these races due to their more productive aspects despite their higher nutritional and management demands (SOUZA et al., 2011). This condition helps with understanding the concern of producers relating to food diversification in the property, as an absence of good nutritional support renders the productive expression of these animals impossible.

Table 5. Analysis of the qualitative and quantitative variables on herd composition and type of agricultural exploration of goat farming in the Northeast region of Brazil, 2010-2012.

Variables	Total (230)		Sergipe (27)		Piauí (48)		Ceará (37)		Rio Grande do Norte (56)		Paraíba (62)	
	N	%	N	%	N	%	N	%	N	%	N	%
Genetic composition of the goat herd												
SRD	43	19.3	4	14.8	27	60	4	11.1	6	11.5	2	3.2
CRD	179	80.6	23	85.2	18	40	32	88.8	46	88.4	60	96.8
Goat breeds in the property												
Saanen	125	56.3	21	77.8	3	6.6	16	44.4	37	71.1	48	77.4
Anglo-Nubian	75	33.7	10	37	17	37.7	35	97.2	25	48	8	12.9
Boer	34	15.3	1	3.7	16	35.5	1	2.7	14	31.1	2	3.2
Chamois Colored	68	30.6	7	25.9	1	2.2	3	8.3	15	28.8	42	67.7
Mixed / Crossbreeds	32	14.4	6	22.2	3	6.6	3	8.3	6	11.5	14	22.6
Toggenburg	22	9.9	0	0	0	0	1	2.7	1	1.9	20	32.3

continue

continuation

Moxotó	5	2.2	0	0	0	0	4	11.1	0	0	1	1.6
Canindé	5	2.2	0	0	0	0	4	11.1	1	1.9	0	0
Other	9	4	1	3.7	5	11.1	1	2.7	0	0	2	3.2
Goats involved in research	5003		500		1354		808		1111		1230	
Type of husbandry farming												
Meat	86	39	5	21.7	42	91.3	16	45.7	18	33.3	5	8.1
Milk	68	30.9	8	34.7	2	4.3	13	37.1	3	5.5	42	67.7
Mixed	53	24	5	21.7	1	2.1	0	0	32	59.2	15	24.2

N = number of questionnaire replies; % = percentage of questionnaire replies.

In relation to the type of agricultural holding, properties were predominantly oriented towards meat (39 %), milk (30.9 %), and dual use (24 %) production. The situation differed in PB (67.7 %) and SE (34.6 %), where dairy goat production predominated, and in RN (59.2 %) with more mixed production properties (Table 5). Nevertheless, the majority of farms are not exclusively oriented towards meat or milk production. In the Brazilian NE, the predominance of subsistence production occurs, with a predisposition of farmers to associate milk production with meat production, a common behavior even in dairy goat farming (VESCHI et al., 2016). In this context, the intervention of the State through social programs that stimulate the production of goat milk becomes very important, as it guarantees the purchase of milk and helps complement income, since the dairy goat has a strong impact on the families in the region (BANDEIRA et al., 2007; SILVA, 2014).

The majority of producers (70.2 %) did not have the habit of annotating productive, reproductive, or economic events. Those who carried out this procedure (29.7 %) usually only took notes about reproduction, production, number of animals, and birth (Table 6). This shows the producers' lack of preparation towards the administration and management of the activity, since these notes are vital for the perception of the herd's production and reproductive pattern, and mainly to obtain information on the profitability of the activity and aid in decision making.

The results indicated that 86.4 % of the producers received some kind of technical assistance, largely carried out by a public institution (42.8 %). In PB, assistance was mostly carried out by cooperatives and unions (68.4 %). The most balanced condition occurred in CE, with Cooperatives/Unions and Public assistance (46.1 %). These aspects highlight the quality of the technical assistance that must be provided to the producers, since basic annotations like the zootechnical control of the herd and the accounting record were not put into practice. The number of farms without reproductive control amounted to 67.6 %. Since 86.4 % of the production units received technical assistance, this situation showcases possible failures in transferring assistance to producers (Table 6). It was observed that a lack of information on technical and scientific aspects of reproductive and sanitary management leads to production losses, which discourages the exercise of the small ruminant husbandry (DINIZ et al., 2011). Thus, improvements to the quality and approach of the technical assistance provided to producers should be implemented to allow innovations that exist in research centers (companies and universities) to be put into practice in the properties, with the goal of improving the productive and economic aspects of the activity.

Table 6. Analysis of qualitative variables of zootechnical aspects of goat farming in the Northeast region of Brazil, 2010-2012.

Variables	Total (230)		Sergipe (27)		Piauí (48)		Ceará (37)		Rio Grande do Norte (56)		Paraíba (62)	
	N	%	N	%	N	%	N	%	N	%	N	%
Performs zootechnical control												
Yes	67	29.7	2	7.4	13	28.2	21	58.3	15	26.7	16	26.6
No	158	70.2	25	92.5	33	71.7	15	41.6	41	73.2	44	73.3
Type of zootechnical control												
Reproduction	38	16.8	2	7.4	5	10.8	17	47.2	11	19.6	3	5
Production	38	16.8	0	0	5	10.8	15	41.6	6	10.7	12	20
No. of animals	33	14.6	0	0	6	13	17	47.2	4	7.1	6	10
Births	42	18.6	2	7.4	3	6.5	17	47.2	11	19.6	9	15
Accounting / revenue / expenditures	18	8	0	0	1	2.1	8	22.2	3	5.4	6	10
Other	15	6.6	0	0	1	2.1	7	19.4	2	3.6	5	8.3
Technical assistance?												
Yes	191	86.4	23	85.1	37	82.2	28	82.3	44	80	59	98.3
No	30	13.5	4	14.8	8	17.7	6	17.6	11	20	1	1.6
Type of technical assistance												
Cooperative/Union	60	31.7	9	40.9	10	25	12	46.1	2	4.5	39	68.4
Private	48	25.3	0	0	5	12.5	2	7.6	17	38.6	12	21
Public	81	42.8	13	59	25	62.5	12	46.1	25	56.8	6	10.5
Type of reproductive technique												
Artificial Insemination	9	3.9	7	25.9	2	4.2	0	0	0	0	0	0
Controlled natural mount	76	33.6	11	40.7	6	12.7	15	41.6	19	34.5	25	40.9
Uncontrolled natural mounds	153	67.6	19	70.4	42	89.3	20	55.5	36	65.4	36	59
Embryo transfer	0	0	0	0	0	0	0	0	0	0	0	0
Combined	1	0.4	0	0	0	0	1	2.7	0	0	0	0

N = number of questionnaire replies; % = percentage of questionnaire replies.

As for the sanitary aspect, 75.4 % of the productive units carried out vaccinations (most frequently against rabies and clostridiosis) and wormings (99.1 %) (Table 7). Vaccinations were mostly carried out according to the vaccination calendar. It should be noted that vaccination against foot-and-mouth disease were reported in this study. According to Normative Instruction No. 44 of October 2nd, 2007 (BRASIL, 2010), vaccination against foot-and-mouth disease should not be administered to caprine cattle, since they serve as disease sentinels for bovines. Although the majority of interviewees attested to practicing helminthiasis control measures, the disease occurred in most of the properties of the NE region, particularly in SE and CE with a 100 % rate of occurrence (Table 7). It was observed that diarrhea was being interpreted as a problem related to helminthiasis by producers in some States. No consensus was reached among interviewees on the use of worming agents and strategic helminthiasis control in properties, evidencing the impermanence of this management. However, in the current context, it is known that an effective parasitosis control must consider a set of

factors, including the animal species involved, the prevalence of parasites, pasture used, segregation of animals by age group, and rotation of pasture, with the use of worming agents under appropriate professional guidance to avoid the development of resistance to the active pharmaceutical ingredient (VIEIRA, 2005; COSTA et al., 2011). Another useful and easy-to-apply method for the control of gastrointestinal parasites (*Haemonchus contortus*) is the Famacha® method, which is efficient in controlling anti-helminthic resistance, reducing the need for applied treatments (SOUZA et al., 2017). Despite the option of the Famacha® method, this method was applied in only four properties in CE. Under these conditions, the parasitic control adopted by the goat farmers of the NE region may be insufficient, jeopardizing the productive efficiency of the properties.

Table 7. Analysis of qualitative variables of zootechnical aspects of goat breeding in the Northeast region of Brazil, 2010-2012.

Variables	Total (230)		Sergipe (27)		Piauí (48)		Ceará (37)		Rio Grande do Norte (56)		Paraíba (62)	
	N	%	N	%	N	%	N	%	N	%	N	%
Vaccination												
Yes	169	75.4	17	65.3	28	60.8	29	80.5	39	69.6	56	93.3
No	55	24.5	9	34.6	18	39.1	7	19.4	17	30.4	4	6.6
Realization of Wormings												
Yes	224	99.1	27	100	44	95.6	36	100	0	0	61	100
No	2	0.8	0	0	2	4.3	0	0	56	100	0	0
Most frequent diseases												
Helminthiasis	227	100	27	100	0	0	36	100	0	0	0	0
Diarrhea	210	92.5	25	92.6	38	82.6	34	94.4	63	94.6	60	96.8
Caseous lymphadenitis	206	90.7	27	100	36	78.2	28	77.7	0	0	59	95.2
Myiasis	200	88.1	21	77.8	39	84.7	25	69.4	0	0	59	95.2
Bronchopneumonia	181	79.7	27	100	17	36.9	31	86.1	55	98.2	51	82.3
Louse	129	56.8	12	44.4	14	30.4	21	58.3	31	55.4	51	82.3
Infectious ecthyma / Angular cheilitis	119	52.4	11	40.7	9	19.5	21	58.3	33	58.9	45	72.6
Clostridiosis	20	8.8	0	0	10	21.7	10	27.7	0	0	0	0
Anthrax	12	5.2	0	0	2	4.3	9	25	1	1.8	0	0
Rabies	9	3.9	0	0	2	4.3	6	16.6	1	1.8	0	0
Chillblains / Hoof infection	168	74	17	63	30	65.2	22	61.1	46	82.1	53	85.5

N = number of questionnaire replies; % = percentage of questionnaire replies.

Conclusion

The obtained results enable the classification of the goat production system in Northeastern Brazil as family and subsistence, guided towards domestic consumption and local commerce and with low technological levels. The education level of the farmers was considered low, with insufficient or inadequate investment, technical assistance, and training to enable the full development of the activity in the region. Therefore, it is suggested that these aspects should be taken into account in planning future goat farming development policies, particularly those related to financing and

technical assistance, better preparation of farmers, administrative aspects, forage production and conservation, and in the implementation of actions in reproductive control and the most frequent diseases.

Acknowledgements

We thank the Coordination for the Improvement of Higher Education Personnel (CAPES), for granting a graduate scholarship, the Animal Health research group of Embrapa Caprinos e Ovinos/CNPC - Sobral / CE, for the opportunity and cooperation, and Conselho Nacional de Desenvolvimento Científico e Tecnológico / Ministério da Agricultura, Pecuária e Abastecimento through Public Notice 64/2008 for the financial support of the research.

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