

Horse Agribusiness in Rio de Janeiro, Brazil: Mangalarga Marchador horse's breeding systems

Agronegócio equino no Estado do Rio de Janeiro, Brasil: sistemas de produção de equinos Mangalarga Marchador

Agronegocio equino en el estado de Río de Janeiro, Brasil: sistemas de producción de equinos Mangalarga Marchador

Received: 11/04/2020 | Reviewed: 11/13/20 | Accept: 11/16/2020 | Published: 11/20/2020

Grasiele Coelho Cabral

ORCID: <https://orcid.org/0000-0002-4560-0355>

Universidade Federal Rural do Rio de Janeiro, Brasil

E-mail: grasiccabral@gmail.com

Ana Carla Chaves Dias

ORCID: <https://orcid.org/0000-0002-6204-3618>

Universidade Federal Rural do Rio de Janeiro, Brasil

E-mail: anacarladias@gmail.com

Afonso Aurélio de Carvalho Peres

ORCID: <https://orcid.org/0000-0001-9037-0715>

Universidade Federal Fluminense, Brasil

E-mail: lelo_uff_tec_pec@hotmail.com

Maria Izabel Vieira de Almeida

ORCID: <https://orcid.org/0000-0002-9292-8310>

Universidade Federal Rural do Rio de Janeiro, Brasil

E-mail: almeidamiv@yahoo.com.br

Wagner de Souza Tassinari

ORCID: <https://orcid.org/0000-0002-3799-1261>

Universidade Federal Rural do Rio de Janeiro, Brasil

E-mail: tassinari@gmail.com

Fernando Queiroz de Almeida

ORCID: <https://orcid.org/0000-0002-0418-2775>

Universidade Federal Rural do Rio de Janeiro, Brasil

almeidafq@yahoo.com.br

Abstract

This work aims to describe the Mangalarga Marchador horse's breeding systems in the Rio de Janeiro. The geographic distribution of the farms in the mesoregions of Rio de Janeiro State were defined, and the commercial and social importance the Mangalarga Marchador horse's business is described in this study. Mangalarga Marchador horse breeders were interviewed through a survey. Sampling of the farms was stratified by the mesoregions. The state of Rio de Janeiro has 1,573 members Horse Breeder Association, with 92,162 registered horses, corresponding to 15.43% of the total of Mangalarga Marchador horses in Brazil. Approximately 95.2% of farms have their own area and more than half ranging between 100 to 500ha. Horse breeding is the main activity on 79.2% of the farms, and the main goal is the sale of horses (39%), followed by sports (32.7%) and leisure (18.6%). The properties have, on average, five registered employees. Most of the owners (90%) are male. The average number of horses at these farms is 100 heads, with an average number of 53 mares, maintained mainly on an extensive production system. About 39.9% of pastures are formed by the *Brachiaria* spp. grass, and Napier grass, also known as Elephant grass, the most used forage supplement. The average monthly consumption of forage and commercial concentrate feed is 12,866kg and 2,800kg respectively per farm. About 90% of breeders declared that the unskilled labor force is the biggest obstacle to the increase of the horse breeding in the Rio de Janeiro.

Keywords: Equine; Horse's breeding; Production system.

Resumo

Este trabalho objetivou estudar o sistema de produção de equinos Mangalarga Marchador no Estado do Rio de Janeiro, definindo a distribuição geográfica da criação e a população total de equinos nas mesorregiões, a importância comercial e social e o seu perfil produtivo. Os produtores entrevistados foram selecionados através de amostragem estratificada por mesorregião, com base em dados coletados na Associação Brasileira de Criadores. Os resultados mostraram que o Estado do Rio de Janeiro possui 1.573 associados e o efetivo de 92.162 animais registrados, o que corresponde a 15,43% do total nacional de equinos dessa raça. Aproximadamente 95,2% dos criatórios possuem área própria e mais da metade variando entre 100 e 500 hectares. A equinocultura é atividade principal em 79,2% dos criatórios, que têm como objetivo a comercialização da produção (39%), seguido do esporte (32,7%) e do lazer (18,6%) e empregam, em média, cinco funcionários fixos registrados. Os proprietários são 90% do sexo masculino e possuem outra atividade profissional como fonte de renda. O número médio de animais nos criatórios é de 100 cabeças, com média de 53

fêmeas, criadas preferencialmente em sistema extensivo, onde 39,9% das pastagens são formadas por gramíneas do gênero *Brachiaria ssp.* O capim Napier é o mais utilizado na suplementação volumosa, em média mensal de 12.866kg e a ração concentrada comercial é utilizada, em média, 2.800kg/criatório/mês. Para 90% dos criadores, a mão-de-obra pouco especializada é o maior entrave do crescimento da equinocultura no Rio de Janeiro.

Palavras-chave: Cavalos; Equinocultura; Sistema de produção.

Resumen

El objetivo de este trabajo fue estudiar el sistema de producción del caballo Mangalarga Marchador en el Estado de Rio de Janeiro, se definió la distribución geográfica de la cría y la población equina total en las mesorregiones, la importancia comercial, social y su perfil productivo. Los criadores entrevistados fueron seleccionados mediante muestreo estratificado por mesorregión, con base en datos recolectados en la Asociación Brasileña de Criadores. Los resultados arrojaron que el estado de Río de Janeiro cuenta con 1.573 afiliados y 92.162 animales registrados, lo que corresponde al 15,43% del total nacional de caballos de esta raza. Aproximadamente el 95,2% de las granjas tienen su propia superficie y más de la mitad varía entre 100 y 500ha. La industria equina es la principal actividad en el 79,2% de las explotaciones, que tienen como objetivo comercializar la producción (39%), seguida del deporte (32,7%) y el ocio (18,6%) y emplean, en promedio, cinco empleados fijos registrados. En un 90%, los propietarios son hombres y tienen otra actividad profesional como fuente de ingresos. El promedio de animales en las granjas es de 100 cabezas, con un promedio de 53 yeguas, preferentemente criadas en un sistema extensivo, donde el 39,9% de las pasturas están formadas por el género *Brachiaria ssp.* La pastura Napier es la más utilizada en la suplementación voluminosa, con un promedio mensual de 12,866 kg y el concentrado comercial se utiliza, en un promedio de 2,800 kg / granja / mes. Para el 90% de los productores, la mano de obra no calificada es el mayor obstáculo para el crecimiento de la equinocultura en Río de Janeiro.

Palabras clave: Caballos; Equinocultura; Sistema de producción.

1. Introduction

The horse population puts Brazil in first place with the largest equine herd in Latin America and the third around the world. Combining the population of mules and donkeys, there are an estimated 8 million heads of equids that make up the so-called 'Equine business

industry' and this involves more than 30 business sectors distributed among basic inputs, breeding and final destination (Lima et al. al., 2015). In 2016, Brasil (2016) divided the horse herd in Brazil as 1,100,000 heads for sport, leisure and breeding and 3,900,000 heads of working horses. As reported in the first study on the horse breeding industry as an agribusiness in Brazil (Lima et al., 2006), breeding was carried out on 41.97% of the total area of the property in question and was almost always a secondary activity, managed by the owner, who had another professional activity and did not live on his farm. About 75% of the farms used hired labor force, of which 85.3% were registered employees. Most breeders received technical support from specialized professionals such as veterinarians and animal scientists, purchased inputs from private companies, and paid the costs from their own resources. These farms had various objectives: commercial (breeding horses for sale); professional (providing services to third parties, such as riding schools); and private (for own use). The same study was updated in 2016 (Brasil, 2016) and it was observed that there was a strong growth of the breeding aimed at the urban areas, both for leisure and for sports. Unlike working animals, which are usually associated with cattle, the sport or leisure horse requires more care and expense. They are animals that require more from the pharmaceutical industry to cosmetics and accessories. The number and size of events also grows such as exhibitions, barrel and trail competitions, rodeos, and bull-roping, among others.

The growth of the Brazilian middle class, especially in recent years, which brought millions of Brazilians into a larger market, also contributed to explain this strong growth of equine husbandry (Lima et al., 2015). According to a survey conducted by the World Tourism Organization (UNWTO) in Latin America, horseback riding stands out among the activities (43%) most desired by tourists in rural areas. Lima et al. (2006) estimated that there were 100,000 potential horseback riders for around 500 small business undertakings, mostly without adequate structure.

The Mangalarga Marchador horse breed has received the title as the National Horse of Brazil by the Federal Congress. Moreover, there are more associated members and breeders of Mangalarga Marchador than any other horse breed in Brazil and this is reflected in the state of Rio de Janeiro. Therefore, this research aimed to study the production systems of Mangalarga Marchador horses throughout the state of Rio de Janeiro, to define the geographical distribution of horse breeding in the state, and to determine the total population of Mangalarga Marchador horses distributed in the mesoregions of the State. Furthermore, this work collected data on the commercial and social importance as well as the productive profile of these stud farms. At the same time, the factors that influence this distribution,

characterizing the production of the Mangalarga Marchador horses were verified along with identifying the main production systems within each mesoregion.

2. Methodology

The methodology used in this exploratory and descriptive study was divided into two stages: 1 - Consultation with the Brazilian Association of Mangalarga Marchador horse breeders (ABCCMM) in order to collect the number of associated breeders and the means to contact them. 2 - Field research, through a questionnaire to conduct structured and specific interviews with the owners of Mangalarga Marchador horses in the State of Rio de Janeiro. The interviews were carried out with breeders, at equestrian centers, and at riding schools, among others to collect the data concerning the production system of the horses. The research was approved by the Research Ethics Committee of UFRRJ, under No: 972/17.

The interviews were conducted during visits to properties, exhibitions, auctions, competitions, and other events related to horses. The producers were selected through sampling, based on the data from the Brazilian Association of Mangalarga Marchador Breeders. Sampling was stratified into the six geographic mesoregions of the state of Rio de Janeiro: Northwestern, Northern, Central, Coastal Lowlands, Metropolitan and Southern mesoregions. Stratified sampling was obtained by dividing the study population into exclusive groups (strata) and then the random samples were extracted from the individual strata. Stratification can improve sample accuracy because it outweighs the tendency of simple random sampling in the over or under representation of the sample spectrum (Thrusfield, 2004).

The sample size was defined considering the level of precision desired, at a 95% confidence interval (95% CI), for the estimation of some parameters of interest at different levels of geographical disaggregation and specific population groups (Souza-Junior et al., 2015). The data obtained from the Mangalarga Marchador Breeders Association were used to define the population groups. The level of precision desired for each indicator is based on the 95% confidence interval. And then the standard error was calculated based on this. In order to determine the sample size, based on the estimated population proportion, for a finite population, the following calculation was used:

$$n = \frac{N \times \hat{p} \times \hat{q} \times (Z_{\alpha/2})^2}{\hat{p} \times \hat{q} \times (Z_{\alpha/2})^2 + (N-1) E^2}$$

where:

n = sample size.

$Z_{\alpha/2}$ = critical value that corresponds to the desired degree of confidence.

\hat{p} = population proportion of individuals belonging to the category of interest.

q = population proportion of individuals not belonging to the category of interest ($q = 1-p$).

E = margin of error or Estimated Maximum Error. Identify the maximum difference between the sample proportion and the true population proportion.

When using the confidence level of 0.95, $Z_{\alpha/2}$ corresponds to 1.96. For "p" and "q" the value of 0.5 was adopted when these were unknown, according to Levine (2000). The questionnaire was based on the models used by Lima et al (2006), Oliveira (2012) and Oliveira (2013), with quantitative and qualitative questions, to conduct a formal interview in order to characterize the breeding systems within the State of Rio de Janeiro. The qualitative questions were inserted in the questionnaire to allow breeders to express their realities and opinions. These questions we believe would help us to interpret the answers to the structured questions, as well as to discover the need for some question that may have escaped our perception when formulating the questionnaire and which is of common interest among the producers. The questionnaire was developed using Google Drive®, a tool available on the internet at www.google.com. A link was generated, through which the breeder and the interviewer could access, through the computer or smartphone and answer the questions "online". When finished, the answers were immediately transferred to an MS-Excel® sheet.

Before starting the data collection, a pre-test was carried out *a priori* questionnaire to test the use of this research tool. The interviews were timed, noting the abilities and difficulties in answering the questions, the most frequent doubts and taking into consideration the appearance of relevant questions that had not been included in the questionnaire. Thus, the questionnaire could be adapted to minimize data collection failures. According to Hulley et al. (2008), the pre-tests should be conducted with the aim of clarifying, refining, and measuring the duration of the application of the tool. The interviews were carried out from July 2017 to June 2018. The average duration was 30 to 40 minutes, but some of them exceeded 60 minutes. A total of 202 breeders, managers and/or advisors, both men and women, were interviewed in the different regions of the State. Many equestrian events were used to contact the breeders, with an emphasis on regional exhibitions and presental horse auctions.

The official data provided by ABCCMM were collected directly at the headquarters of Association in Belo Horizonte, Minas Gerais, with the authorization of the competent

management. The results obtained from the Association and the answers from the questionnaires applied to the breeders were analyzed by descriptive statistics and processed in the software Statistical Package for Social Science (SPSS), version 24.0.

3. Results

The total number of members of the Brazilian Association of Mangalarga Marchador horse breeders (ABCCMM) of the State of Rio de Janeiro is 1,573. The two main categories, individual contributors, and individual users have 68.9% and 24.3%, of members, respectively. An expressive number of horses (87.26%) were registered as the individual partner, which corresponds, together with the corporate partner, to breeders who produce horses, that is, where the animals of the breed are born. In June 2018 there were a total of 848 active stud farms in the state of Rio de Janeiro (Table 1), and this was adopted as the basis for this research. The active breeding farms corresponds to the breeding farms that had registered horses in the ABCCMM Pedigree Registration Service over the past two years.

Table 1. Registered breeders (Suffixes), associated breeders with up to 5 years and active breeders over the last two years, in the state of Rio de Janeiro distributed by mesoregions.

Breeders	Rio de Janeiro	Mesoregions					
		Coastal Lowlands	Central Fluminense	Metropolitan	Northwestern Fluminense	Northern Fluminense	Southern Fluminense
Registered (Suffixes)	4338	431 9.94%	688 15.86%	1773 40.87%	527 12.15%	326 7.51%	593 13.66%
Associate with up to 5 years	814	48 5.90%	112 13.76%	383 47.05%	90 11.06%	74 9.09%	107 13.14%
Active	848	92 10.85%	144 16.98%	292 34.43%	134 15.80%	89 10.50%	97 11.44%

Source: Authors.

The results show that the Metropolitan mesoregion, with 292 active stud farms, had the highest concentration representing 34.4% of the statewide stud farms, followed by the Central, Northwest, Southern, Coastal Lowlands and Northern Fluminense regions with 16.9; 15.8; 11.4; 10.9 and 10.5% respectively.

According to the data collected at the ABCCMM, there are currently 15,000 associated stud farms (Affixes), and the state of Rio de Janeiro represents 28.9% of the total of breeders. The Southeast Region of Brazil has most horses of the Mangalarga Marchador

breed with 72.9% of the total in the country. The state of Rio de Janeiro contributes with 15.4% of this percentage with 92,162 horses, and it's the second in number of animals behind Minas Gerais state that has 235,281 horses, which represents 41% of the total of this horse breed registered in Brazil. Following by Bahia state with 11.1% of the total horses and São Paulo, with 10.8% of horses of Mangalarga Marchador breed.

About 4.8% of the breeders in the state do not have their own land, which increases to 8.3%, 5.9% and 7.5% in the Metropolitan, Northern and Southern Fluminense mesoregions, respectively. Approximately half of the breeders have their own properties with up to 100 hectares, except for the Central Fluminense region, where 53.8% of the stud farms have between 100 and 500 hectares. On the other hand, the Metropolitan mesoregion has the smallest sized properties with an average area of 142.9 hectares and the highest percentage of properties with less than 100ha (65.5%). The general average for the Rio de Janeiro is 207.1ha, and the mesoregion with the highest average size is Northwestern Fluminense with 277.3ha (Table 2).

About 1% of the stud farms in the Rio de Janeiro do not have pasture areas and 6.1% do not have an area for crops. The average area for pasture in horse's farms at Rio de Janeiro State is 144.85ha, which corresponds to 69.9% of the total area of the properties. The mesoregion with the highest average area of pasture is the Central Fluminense with 216.72ha of mean and standard deviation of ± 238.8 ha. The Metropolitan mesoregion has the lowest average pasture area with a mean of 103.56ha and standard deviation of ± 177.5 ha (Table 3). The total area for crop production has a mean of 15.8ha and a standard deviation of 77.3ha throughout the Rio de Janeiro state, corresponding to 7.61% of the total area of the farm, with emphasis on the Metropolitan mesoregion, which presented the highest average of 25.6 ha and a standard deviation of ± 140.9 ha, corresponding to 17.9% of the total area of this mesoregion.

The average built-up area was 5,583.8 m² with a standard deviation of 7,998.6 m² throughout the State, with more than 50% of the properties presenting up to 10,000 m² of built-up area. This trend can also be observed in the mesoregions, with the exception of the Northern Fluminense mesoregion, which has the highest percentages for the smallest areas and the largest built-up areas, 43.8% of properties with from 200 to 1,000 m² and 25% of the properties with built-up area greater than 20,000 m².

Table 2. Own total area, area occupied with horses, leased area and area occupied with cattle, in averages and percentages, of properties throughout the state of Rio de Janeiro and in the mesoregions.

Variable (n=848)	Area (ha)	Rio de Janeiro (%)	Mesoregions (%)					
			Coastal Lowlands	Central Fluminense	Metropolitan	Northwestern Fluminense	Northern Fluminense	Southern Fluminense
Own total area	0	4.8	4.8	-	8.3	-	5.9	7.5
	0.1 - 100	52.9	52.4	38.5	65.3	45.5	52.9	52.5
	100.1 - 500	31.1	33.3	53.8	19.4	40.9	17.6	27.5
	>500	11.1	9.5	7.7	6.9	13.6	23.5	12.5
Mean/SD		207.12±302.1	204.05±290.8	237.48±225.0	142.91±254.2	277.36±338.3	221.79±287.6	217.14±396.7
Area for horses	0	4.8	4.8	-	8.3	-	5.9	7.5
	0.1 - 100	68.2	76.2	73.1	72.2	63.6	64.7	57.5
	100.1 - 500	25.5	9.5	26.9	19.4	36.4	29.4	32.5
	>500	1.4	9.5	-	-	-	-	2.5
Mean/SD		110.46±170.5	110.43± 161.5	119.0±99.3	75.53±100.8	154.54±151.5	72.97±72.0	146.91±318.3
Leased area	0	76.5	76.2	80.8	69.4	81.8	76.5	80.0
	0.1 – 50	11.5	14.3	-	18.1	9.1	17.6	7.5
	50.1 – 100	7.2	4.8	7.7	8.3	9.1	5.9	5.0
	>100	4.9	4.8	11.5	4.2	-	-	7.5
Mean/SD		25.27±96.5	12.38 ±28.9	76.40±217.7	19.67±43.5	10.00±25.3	10.59±22.74	18.18±48.22
Area for beef cattle	0	60.6	38.1	46.2	77.8	54.5	52.9	70.0
	0.1 - 100	11.7	28.6	7.7	6.9	4.5	23.5	12.5
	100.1 - 500	22.3	33.3	34.6	13.9	36.4	5.9	15.0
	>500	5.3	-	11.5	1.4	4.5	17.6	2.5
Mean/SD		105.90±202.3	108.19±147.1	190.20±275.9	52.17±133.9	122.82±208.8	148.82±246.8	73.78±178.6

*SD – Standard deviation. Source: Authors.

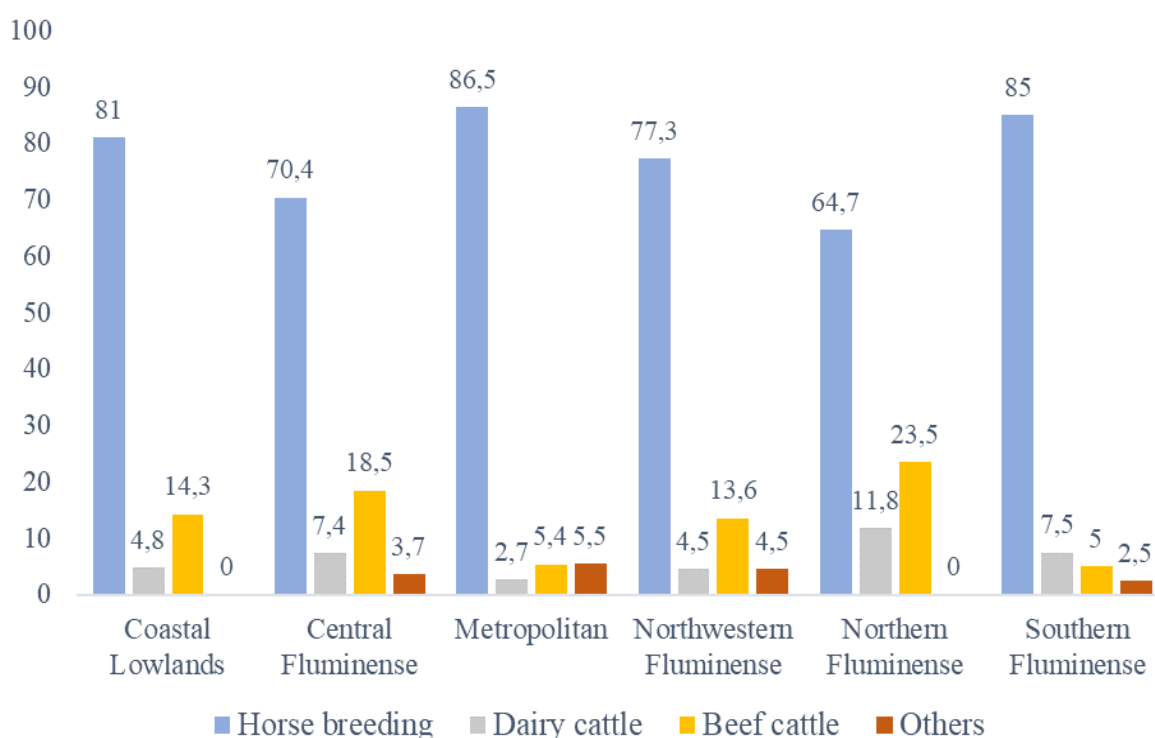
Table 3. Total area for pasture, crops (hay, maize, sorghum, sugarcane) and constructed, averages, standard deviation and percentages in levels, on properties throughout the State of Rio de Janeiro and in the different mesoregions.

Variable (n=848)	Area (ha) (levels)	Rio de Janeiro (%)	Mesoregions (%)					
			Coastal Lowlands	Central Fluminense	Metropolitan	Northeastern Fluminense	Northern Fluminense	Southern Fluminense
Area for Pasture	0	1.0	-	-	1.4	-	5.9	-
	0.1 - 100	67.7	66.7	46.2	75.0	63.6	76.5	75.0
	100.1 - 500	25.2	33.3	42.3	20.8	27.3	11.8	17.5
	>500	6.0	-	11.5	2.8	9.1	5.9	7.5
Mean (ha)		144.85±215.1	117.09±118.5	216.72±238.8	103.56±177.5	166.73±215.1	140.53±191.1	148.82±288.1
Area for crops	0	6.1	4.8	3.8	5.6	9.1	5.9	7.5
	0.1 – 10	64.9	71.4	50.0	70.4	72.7	64.7	57.5
	10.1 – 20	17.3	19.0	26.9	14.1	9.1	17.6	20.0
	>20	11.7	4.8	19.2	9.9	9.1	11.8	15.0
Mean (ha)		15.77±77.3	8.93±7.5	16.56±13.8	25.64±140.9	8.34±8.7	11.76±13.25	11.80±13.3
Built-up Area	200 -1000	31.2	42.9	30.8	27.1	27.3	43.8	27.0
	1000.1–10000	58.6	52.4	61.5	62.9	63.6	31.3	64.9
	>10000	10.1	4.8	7.7	10.0	9.1	25.0	8.1
Mean (ha)		5583.8±7998.6	4766.7±8506.5	6008.0±7537.1	5992.57±8323.1	5386.36±6595.06	7118.75±10244.3	4118.92±6911.4

SD – Standard deviation. Source: Authors.

Mangalarga Marchador stud farms are predominantly individual in the state of Rio de Janeiro, with percentages of 83.8, 11.6 and 4.6 for individual, family and in partnership ownership, respectively. Mangalarga Marchador horse-breeding is the main activity in 79.2% of these properties in the state of Rio de Janeiro, while for 18.7% breeding is a secondary activity and in 2.1% horse breeding is the third activity, in order of priority (Figure 1).

Figure 1. Main activity of the breeding properties of Mangalarga Marchador, shown as a percentage in each mesoregion of the Rio de Janeiro State.

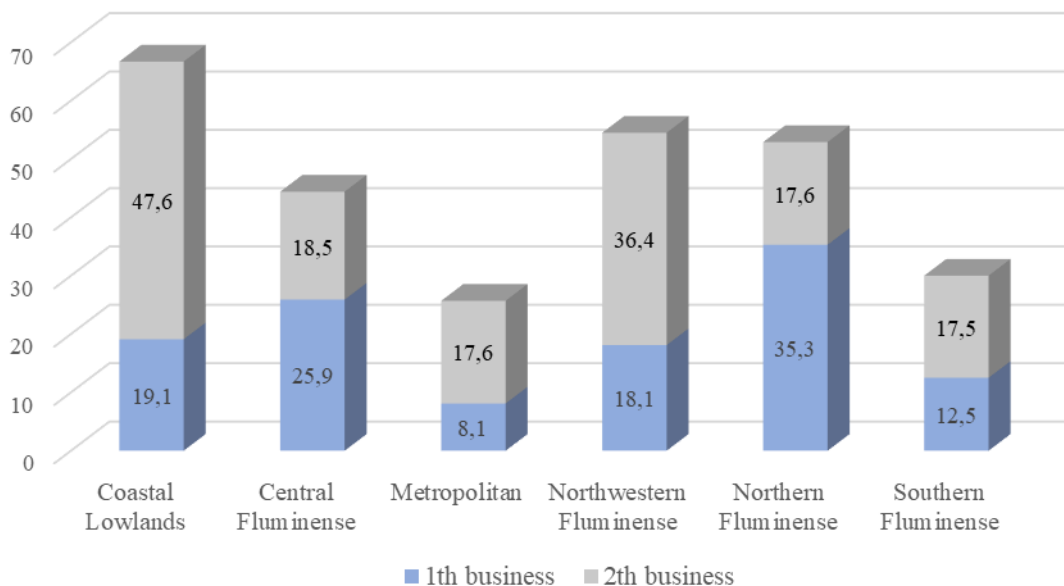


Source: Authors.

In the Rio de Janeiro state, 20.8% of properties that do not have horse breeding as the principal activity, 11.7% are for beef cattle, 5.7% are for dairy cattle, 1.4% are industrial, 1.1% are pig farmers, and 0.8% have another principal activity. Analyzing the mesoregions separately, there is an increased percentage of farms with beef cattle as their primary activity in Northwestern Fluminense (13.6%), Low costal lands (14.3%), Central Fluminense (18.5%) and, mainly Northern Fluminense (23.5%). On the other hand, the Metropolitan region, due to the higher percentage of properties dedicated primarily to horse breeding, and South Fluminense, due to the higher inclination for dairy farming, have a reduced percentage of properties for beef cattle as a priority. Combining the beef and dairy activities, cattle farming is the main activity of 35,3%, and as a secondary activity of 47,6% of the Mangalarga

Marchador horse-breeding properties in Northern Fluminense and in Low costal lands, respectively (Figure 2).

Figure 2. Mangalarga Marchador horse-breeding properties that present cattle as a first or second option, shown as a percentage in each mesoregion of the State of Rio de Janeiro.



Source: Authors.

The main objective of Mangalarga Marchador horse breeding in the state of Rio de Janeiro is the sale of horses (39%), followed by sports (32.7%) and leisure (18.6%). This breakdown is the same for the Metropolitan, Central and Northwestern Fluminense mesoregions, (Table 4). However, in the Coastal Lowlands and Northern Fluminense mesoregions, the main breeding objective is for sport, followed by sale of horses and leisure, while at the farms in the Southern Fluminense mesoregion sport (47.5%) is the main activity, followed by leisure (25%) and sales as direct trade (20%). The high percentage (21.7%) of direct trade is highlighted as the second option among the breeders in the Central Fluminense mesoregion, highlighting the average of the state and other mesoregions in this category of breeding. Leisure stands out as the third breeding option in 47.8% of breeders throughout the State, reaching an average of 75% in the Northern Fluminense mesoregion.

The use of the Mangalarga Marchador horses as working animal is the third option of 10.8% of the breeders in the Rio de Janeiro. This average is close in the mesoregions, however, with a higher percentage in the Northwestern Fluminense (15.8%) and lower

Table 4. Order of priority of the aims of Mangalarga Marchador stud farms, in percentages of properties in state of Rio de Janeiro and in each mesoregion.

Variable (n=848)	Order of priority	Rio de Janeiro (%)	Mesoregions (%)					
			Coastal Lowlands	Central Fluminense	Metropolitan	Northwestern Fluminense	Northern Fluminense	Southern Fluminense
Sport ¹	1 st Option	32.7	57.1	25.9	29.7	27.3	47.1	47.5
	2 nd Option	33.6	19.0	30.4	30.9	50.0	25.0	42.1
	3 rd Option	11.7	6.3	27.8	12.0	-	-	20.0
Commercialization of production ²	1 st Option	39.0	23.8	48.1	35.1	40.9	35.3	2.5
	2 nd Option	32.5	47.6	26.1	38.2	20.0	37.5	26.3
	3 rd Option	17.1	18.8	22.2	14.0	26.3	-	16.7
Direct sale ³	1 st Option	5.7	4.8	3.7	9.5	4.5	5.9	20.0
	2 nd Option	7.7	4.8	21.7	4.4	10.0	-	5.3
	3 rd Option	9.5	12.5	5.6	10.0	10.5	8.3	10.0
Leisure ⁴	1 st Option	18.6	14.3	18.5	21.6	22.7	5.9	25.0
	2 nd Option	22.4	23.8	21.7	23.5	15.0	31.3	21.1
	3 rd Option	47.8	50.0	33.3	50.0	47.4	75.0	40.0
Working ⁵	1 st Option	2.2	-	3.7	1.4	4.5	-	2.5
	2 nd Option	2.9	4.8	-	1.5	5.0	6.3	2.6
	3 rd Option	10.8	12.5	11.1	10.0	15.8	8.3	6.7
CTE ⁶	1 st Option	1.4	-	-	2.7	-	5.9	-
	2 nd Option	0.4	-	-	1.5	-	-	-
	3 rd Option	-	-	-	-	-	-	-
Hosting ⁷	1 st Option	0.4	-	-	-	-	-	2.5
	2 nd Option	0.4	-	-	-	-	-	2.6
	3 rd Option	3.1	-	-	4.0	-	8.3	6.7

1 - Expositions, championships for dressage, sport competitions

2 – Production of animals for sale

3 – Buy and Sell animals

4 – Cavalcades or Trekking on horseback, tourist rides, horseback riding on the farm

5 – Working with cattle

6 - CTE: Equine Training Center

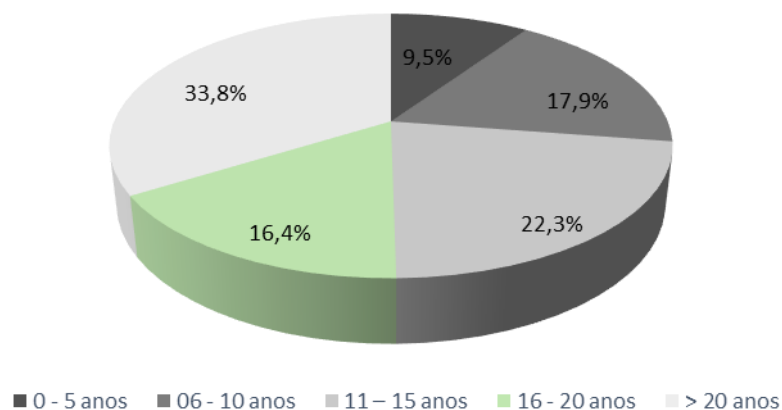
7 – Stable, picket or pasture rental

Source: Authors.

percentage in Southern Fluminense (6.7%).

As expected more than 90% of the owners are male, who do not reside on the property and have another professional activity other than horse breeding as a source of income. However, in the Metropolitan mesoregion 10.8% of the owners use the horse breeding as their main source of income. Furthermore, more than 90% of properties have only one owner. The highest percentages belong to the 41 to 60-year-old age group, with a mean age ranging from 47 to 53 years old among the mesoregions. The main income of the farm owners of Mangalarga Marchador horses in the state of Rio de Janeiro are Company (40.4%), Commerce (21.1%) and Service Providers (18.6%). The time horse farm activities have been going on is well distributed, mainly in the Northwestern mesoregion. Farm activities of over 20 years are predominant in all mesoregions, except in the Coastal Lowlands, where most have been active for only 16 to 20 years (Figure 3).

Figure 3. Average time of breeding among Mangalarga Marchador horse owners in the Rio de Janeiro State.



Source: Authors.

Management of the farm throughout the state of Rio de Janeiro is divided between owner management (51.7%), contracted management (44.7%) and family management (3.6%). Family management of the farms was not registered in some mesoregions, such as Costal Lowlands and Central Fluminense. In approximately 50% of horse breeding farms in the Rio de Janeiro, as well as in the mesoregions, the age of the managers ranges from 41 to 60 years old, with an average of 45 years old. The level of education of the managers ranges from a low educational level to Graduate level, but with a higher prevalence for Completed

Higher Education (32%), Completed High School Education (28.8%) and Completed Primary School Education (15.3%).

The labor force that does not require any specific specialization, that is manager, trainer, handler, and general services have fixed contracts on most of the farms, and in each mesoregion of the Rio de Janeiro. The averages for fixed employees are 5.35 registered (± 4.23) and 0.28 unregistered (± 0.64); for temporary staff are 0.02 (± 0.24) registered and 0.53 unregistered (± 1.13); for family employees are 0.01 registered (± 0.08) and 0.05 unregistered (± 0.42), throughout the state of Rio de Janeiro. In all the mesoregions, except Central Fluminense, more than 50% of the farms have 1 to 5 hired employees, with an average of around 5 fixed employees (Table 5). In the Central Fluminense region, 50% of the properties have 6 to 10 employees, with an average of 5.75 ± 2.9 . Throughout the Rio de Janeiro, 90.1% of employees receive some type of non-financial benefit, including housing (85.2%), basic food basket (26.2%), transport (4.3%), health insurance (0.4%) and others (14.4%). Among the other benefits reported are milk supply, sales commission, and awards for championships etc... Most of the farms receive specialized technical advice from Veterinarians (83.5%), while few calls on Animal Scientists (4.2%) and Agronomists (5.4%), and most of the contracts are temporary. Only the North Fluminense region presents a higher percentage of fixed contracts for the Veterinarians (53.8%).

Most of these stud farms have between 51 and 150 animals, with an average of around 100 head per farm both throughout the State and in the mesoregions. The Northern Fluminense mesoregion has the lowest mean (86 animals), despite presenting 23% of the properties with more than 150 animals. The Northwestern Fluminense mesoregion presented the highest average number of heads per farm (120 animals) and 22.7% of the horse breeding properties had more than 150 animals (Table 6). Around 50% of the properties have 31 to 100 female heads for reproduction, with an average of 53.3 females per stud farm. Among the mesoregions, the averages ranged from 43.06 in the Northern Fluminense to 64.09 females in the Northwestern Fluminense.

On analyzing categories of the production system only the category of stallions is kept, predominantly, in a stall system, with an average of 69.2% for the State while the Northern Fluminense mesoregion reached 88.2% (Table 7). However, for the mares the field production system is predominant for the categories: mares, and recipients foaled mares. Only the donor mares have a higher percentage for the semi-stable and stable systems.

Table 5. Percentage distribution by category and average number of employees contracted at Mangalarga Marchador stud farms in the state of Rio de Janeiro and in each mesoregion.

Quantity/ category (n=848)	Rio de Janeiro (%)	Mesoregions (%)					
		Coastal Lowlands (n=91)	Central Fluminense (n=145)	Metropolitan (n=254)	Northwestern Fluminense (n=134)	Northern Fluminense (n=89)	Southern Fluminense (n=135)
0	0.7	-	-	-	4.5	-	-
1 to 5	56.8	61.9	46.4	56.8	50.0	70.6	62.5
6 to 10	37.4	28.6	50.0	39.2	36.4	29.4	32.5
11 to 15	5.1	9.5	3.6	4.1	9.1	-	5.0
Mean	5.43	5.76	5.75	5.28	5.82	4.94	5.08
Standard deviation	2.96	2.96	2.90	2.87	3.31	2.61	3.023

Source: Authors.

Table 6. Distribution by categories and numerical average, of the total number of animals of Mangalarga Marchador horse breeders in the state of Rio de Janeiro and in the mesoregions.

Quantity/ categories (n=848)	Rio de Janeiro (%)	Mesoregions (%)					
		Coastal Lowlands (n=91)	Central Fluminense (n=145)	Metropolitan (n=254)	Northeastern Fluminense (n=134)	Northern Fluminense (n=89)	Southern Fluminense (n=135)
1 – 10 animals	4.1	-	-	5.4	4.5	5.9	7.5
11 - 50 animals	25.6	19.0	17.9	23.0	27.3	35.3	35.0
51 - 150 animals	49.9	71.4	53.6	52.7	45.5	35.3	40.0
> 150 animals	20.4	9.5	28.6	18.9	22.7	23.5	17.5
Mean	99.85	98.10	111.93	91.34	120.14	86.00	93.08
Standard Deviation	80.78	70.03	74.47	67.37	111.49	62.71	87.30

Source: Authors.

Table 7. Production systems, by animal category, of Mangalarga Marchador stud farms in the state of Rio de Janeiro and in the mesoregions.

Variable (n=848)	Production System	Rio de Janeiro (%)	Mesoregions (%)					
			Coastal Lowlands	Central Fluminense	Metropolitan	Northeastern Fluminense	Northern Fluminense	Southern Fluminense
Stallions	In the field	0.8	-	-	1.4	-	-	2.6
	Semi-stabbling	30.0	38.1	42.3	27.5	23.8	11.8	34.2
	Stabbling	69.2	61.9	57.7	71.0	76.2	88.2	63.2
Mares	In the field	52.9	57.1	62.5	50.7	42.9	60.0	50.0
	Semi-stabbling	41.0	42.9	33.3	43.7	42.9	33.3	45.0
	Stabbling	6.1	-	4.2	5.6	14.3	6.7	5.0
Pregnant mares Foaled mares	In the field	55.4	47.6	68.0	49.3	55.0	60.0	56.8
	Semi-stabbling	44.2	52.4	32.0	49.3	45.0	40.0	43.2
	Stabbling	0.4	-	-	1.4	-	-	-
Weaned foals	In the field	28.1	25.0	25.0	26.4	35.0	33.3	27.0
	Semi-stabbling	54.7	70.0	54.2	61.1	35.0	33.3	64.9
	Stabbling	17.1	5.0	20.8	12.5	30.0	33.3	8.1
1 year old foals	In the field	44.4	47.6	42.3	39.7	47.6	57.1	43.2
	Semi-stabbling	50.3	52.4	50.0	54.8	38.1	42.9	56.8
	Stabbling	5.3	-	7.7	5.5	14.3	-	-
2 years old foals	In the field	46.7	50.0	40.0	48.6	47.6	43.8	48.6
	Semi-stabbling	41.8	45.0	48.0	38.9	33.3	43.8	45.9
	Stabbling	11.5	5.0	12.0	12.5	19.0	12.5	5.4
Gelding horses	In the field	59.0	62.5	55.0	54.5	52.9	55.6	76.7
	Semi-stabbling	18.8	18.8	15.0	20.0	29.4	11.1	13.3
	Stabbling	22.3	18.8	30.0	25.5	17.6	33.3	10.0
Donors mares	In the field	16.7	22.2	-	17.7	16.7	18.2	27.3
	Semi-stabbling	44.9	44.4	61.9	41.9	38.9	45.5	39.4
	Stabbling	38.3	33.3	38.1	40.3	44.4	36.4	33.3
Recipients mares	In the field	78.9	78.9	81.0	75.9	70.6	100.0	80.0
	Semi-stabbling	20.6	21.1	19.0	22.4	29.4	-	20.0
	Stabbling	0.5	-	-	1.7	-	-	-

Source: Authors.

The pastures are predominantly *Brachiaria* spp. in all the mesoregions. The Southern Fluminense mesoregion has the highest average and the highest standard deviation (63.25 ± 135.21 ha) for *Brachiaria* spp pastures. There is a higher use of Tifton and Capim Mombaça pastures in the Coastal Lowlands and Northwestern Fluminense mesoregions. This is probably influenced by the flatter topography and by a higher level of investments of the breeders in technology. Also noteworthy is the use of Angola grass in the Central (13.15 ± 56.58 ha) and Northern Fluminense (11.76 ± 26.10 ha) mesoregions. In relation to the types of roughage, bought and produced, Napier grass produced on the property is the most commonly used in Mangalarga Marchador horse roughage in the state of Rio de Janeiro, with a mean of 12,866.18 kg ($\pm 1,8124$) per property/month. The Southern Fluminense mesoregion has the highest number of stud farms using Napier grass produced on the property ($15,535.00 \pm 2,5681$ kg/month), although it is also the region with the highest predominance of *Brachiaria* spp. as the pasture. The number of breeders who buy Napier grass chopped or to chop is small. The second choice for roughage is corn silage, which is a conserved roughage. In this case, purchased silage ($1,399.95 \pm 3,580.8$ kg/month) was more commonly used than the one produced on the property ($876.29 \pm 4,685.60$ kg/month), considering the average throughout the States. Only the Northern and Southern Fluminense mesoregions produce more than they buy. Adding the quantities of corn silage produced and purchased, the Central Fluminense mesoregion was the one with the highest average consumption of 5,314.81 kg/farm/month.

The average consumption of grass hay (produced and bought) is around 1,420 kg/farm/month throughout the State; this value is very low, even considering the high standard deviations. The Northern Fluminense mesoregion, which has larger extensions of flat area and drier climate, has the highest monthly average intake of grass hay produced on the property ($4,023.53 \pm 141.44$ kg) and the Northwestern Fluminense mesoregion has the highest average monthly consumption of purchased grass hay ($1,409.09 \pm 3,406.0$ kg). The average monthly commercial feed consumption varies from $2,080.00 \pm 1,924.31$ kg/farm in the Northern Fluminense mesoregion to $3,080.48 \pm 1,836.57$ kg/farm in the Coastal Lowland mesoregion. Some industrial residues such as citrus pulp and barley were not mentioned by the interviewees. Considering the categories that receive some type of concentrated supplementation, because they are in a stabling or semi-stabling production system, the average consumption of concentrate is 2.68 kg / animal / day.

Sanitary management in the stud farms was difficult to quantify because the interviewees, who were mostly the owners, were not able to give details concerning the amount and frequency of use of anthelmintic, anti-tick and point medications. In addition, the

responses were very varied in relation to the type and the form of the anthelmintic used and the formulas to combat ticks. Some used oral anthelmintic, paste or liquid, while others used an injectable product; however, most used the two procedures, alternating the products. Furthermore, the majority of those interviewed could not quantify the use of anti-tick medicine or how often the animals were treated. However, based on the data acquired, the animals are dewormed on average every 90 days, with different types of products. For the control of ectoparasites, an anti-tick bath was the option most used by the producers, and the frequency of administration varied according to the necessity, that is, with the degree of infestation. Also, many producers used, in alternation with the bath, "pour on" products, which are administered along the dorsal-lumbar region of the animal. In parallel and whenever necessary, the use of the anti-tick powder in the most affected regions such as ears and the base of the tail is applied. Notably, 85.1% of the producers, throughout the State, vaccinated the whole herd against rabies at least once a year.

The lowest percentage of vaccination was in the Northwestern Fluminense mesoregion (77.3%) and the highest was in the Northern Fluminense region (96.1%). Still, 59.6% of the producers, throughout the State, vaccinated the whole herd annually against tetanus, highlighting the Northern Fluminense region, where 82.4% vaccinated the animals. Throughout the State, 19.3% and 16.4% of the producers vaccinate some of the animals, mainly the breeding females, against Leptospirosis and Herpes Viruses, respectively. The triple vaccine, which prevents equine, tetanus, and equine viral encephalomyelitis I and II, is used by 29.4% of the producers throughout the State, mainly in animals that are taken to exhibitions, auctions, fairs, etc... Also, another option, used in these situations, is the Octopla vaccine, which includes equine viral encephalomyelitis, rhinopneumonitis, equine influenza and tetanus, and is used in 19.8% of the stud farms in the State. Throughout the state of Rio de Janeiro, 88.4 and 86.4% of the producers carry out examinations for Equine Infectious Anemia (EIA) and glanders, but only when compulsory.

4. Discussion

The number of registered stud farms, whether referring to the whole State or just the mesoregions, is higher than the total number of ABCCMM members in the State or in the mesoregions. This is explained by the fact that each registered stud farm is represented by an Affix (prefix or suffix) and many associates have more than one Affix registered at the Association. The herd, property, production system, location and employees are the same, but

the breeder uses different suffixes when communicating the animals for provisional registration. Therefore, it was necessary to filter the farm for each associated breeder. This filtering was by stud farm to match the address where the property is located and not the breeder's mailing address. Active breeders correspond to the stud farms, filtered by breeder, who have registered their herd following the protocol of the ABCCMM Genetic Registry Service over the past two years. The category of registered stud farms over the last five years is not only to assess the volume of growth in numbers but also because the ABCCMM publishes a ranking of the best breeders and exhibitors with up to five years of activity, in addition to the overall ranking. This is part of a program to encourage the new breeder who has had a relative short time in activity to receive an award.

The results show that a little more than half of the total area of the properties is occupied with horses, since the relation between the area occupied with horse activities and the total area of the property varies from 50 to 55%. Virtually the whole state is divided this way for both variables; the only exceptions are the Southern Fluminense mesoregion, where a greater percentage of the total area (67.8%) is occupied with horses and horse activities and the Northern Fluminense mesoregion, where only 32.9%, a much smaller percentage of the total area, is taken up by equines and their needs. This can be explained due to the greater number of these properties with more than 500ha, and where cattle (17.6%) are an important activity, take up the larger part of these properties. Lima et al. (2006) reported that 95% of the national breeding of equines was carried out on owned property and only 4% on leased property, with the area effectively occupied by equines corresponding, on average, to 42% of the total area of the property and the remaining percentage 58% occupied with other activities, especially with the raising of beef and dairy cattle. Matos et al. (2010) observed an average size of 376.09 ha for Creole stud farms in the Southern Region of Brazil. Oliveira (2012) observed that 45.1% and 47.5% of equine breeding properties in Southern Brazil and Argentina, respectively, have an average size of 251 and 1000 hectares. According to Vieira et al. (2015), 96.48% of the breeders in the State of Minas Gerais owned their own land for horse breeding, with a mean size of 382.16 hectares, and there the area reserved for horse breeding was on average 31.46% of the total area of the property, while the remainder (68.54%) was used, mainly, for beef and/or dairy cattle.

The relationship between horse breeding and cattle breeding as the main activity of the Mangalarga Marchador breeders in the state of Rio de Janeiro in the mesoregions and the proportions with which the cattle breeding is aligned with the Mangalarga Marchador breeding in the different mesoregions of Rio de Janeiro, corroborate with the aforementioned

data regarding the Northern, Northwestern and Central Fluminense mesoregions that have the highest average areas for cattle breeding. Lima et al. (2006) observed a high correlation between cattle and equine herds throughout Brazil. According to them, the similarity in the growth rates of the two herds in the different states of the Federation confirms this association, showing a correlation index between the annual growth rates of 0.867. Vieira et al. (2015) reported that the majority of Minas Gerais breeders prioritized dairy or beef cattle breeding (59.69%); however, they develop this activity together with horse breeding, which shows a close relationship between horse breeding and cattle breeding in Minas Gerais. On the other hand, horse breeding is the main activity of Mangalarga Marchador breeders in Rio de Janeiro.

Corroborating with this study, Matos et al. (2010) observed that the main objectives of the Crioulo horse breeders in the Southern Region of Brazil were investment, sport competitions and leisure. Different results were observed by Vieira (2011) in the state of Minas Gerais, which is the main horse breeding state, where 49.49% of the farm breed working horses, especially for work with cattle; 16.57% are bred for leisure activities and sports; and 6.8%, for commercial purposes only. Also 27.13% of the breeders had more than one objective and the Mangalarga Marchador breed stands out as the main horse for breeding in the State for commerce (51.06%) and leisure (47.24%). Brazil (2016) reported that 22% of the horses in Brazil are for sport, leisure, and breeding, and 78% are working animals. Castanho et al. (2006), used georeferencing to study the primary production developed in the Carazinho Microregion (RS), demonstrated, through thematic maps, the concentration of equine breeding in municipalities with a predominance of small holdings with difficult mechanization and a great concentration of small family farms. On these rural properties horse breeding is largely for working animals run by the families.

The average ages of the owners and the time when they began horse breeding shows that they started this activity when they were young. Probably horse breeding is passed on from father to son and is perpetuated through the generations. It was common during the research to find two or more Suffixes (Affixes) for the same property, where the father or grandfather were holders of the oldest Suffix and the children registered other Suffixes to begin their own brand or a selection within the same herd. Another common finding was young breeders taking up a stud farm that were over 20 years old; this is because they were assuming the breeding of horses inherited from their parents or grandparents.

According to Lima et al. (2006), 66.1% of all Brazilian stud farms were managed by their owners, but who also had a city profession, such as: doctor, lawyer, and businessman,

among others. This fact explained the low percentage (33.78%) of breeder owners who resided on their stud farms. Furthermore, 29.5% of the managers were hired and 4.5% were family members, ranging in age from 41 to 60 years old and with a high level of education (close to 40% have completed their higher education). In Minas Gerais, the owners were managers in 72.6% of the stud farms, a fact that justifies the high level of schooling of the managers (30.76% had completed high school and 29.93% had a university degree). Only 10.46% of the owners lived off the farm as their only source of income and 31.85% lived on the farm, according to Vieira (2011). Oliveira (2012) found that 83.9% and 90.0% of the farms, respectively, in southern Brazil and Argentina, were managed by their owners and/or family members. In the South of Brazil 29.0% of the owners lived on their stud farm and 67.7% had other sources of income. While in Argentina, all the owners had another paid activity and only 2.5% resided on their property. Therefore, the profile of the owners of Mangalarga Marchador horses in the state of Rio de Janeiro differs from the other owners observed in Brazil and were more like the profile of Argentine breeders.

Lima et al. (2006) reported that 67.57% of the breeders throughout Brazil receive technical support from specialized professionals, such as veterinarians and equine veterinary technicians; 75.2% of the breeders use only hired labor, while 12.2% use family members as the work force and 12.6% use a combination of contracted labor and family members; moreover 85.26% registered their employees. According to Vieira et al. (2015), in the state of Minas Gerais 60.52% of the labor directly linked to the management of the horses is hired, 28.26% is family, and 11.22% uses both hired and family members; furthermore, 85.19% of the hired labor is registered. The average number of employees dealing directly with the horses is 3.13 ± 3.6 per farm and only 28.63% of the properties are monitored by specialized professionals, 84.21% of which are veterinarians.

Even when the main objectives are related to sports and commercialization, situations that require greater preparation of the animals, as much aesthetic as dressage, the use of stables is not predominant. This can be explained by the effectiveness of the semi-stabling system, widely adopted for donors, a category widely used for sports (exhibitions) and all categories of foals, which are the most used for commercialization. The general production system described here refers to females of reproductive age, that is: mares, foaled mares, donors, and recipients, where the predominant production system for these categories was adopted as the production system of the stud farm. Some factors related to the external environment directly or indirectly influence the equines in their reproductive physiology. Among the environmental variables, there is the daily photoperiod, which allows classifying

horses as long-day seasonal specie. Thus, in the equine specie the hypothalamic-pituitary-gonadal axis is modulated by the action of melatonin that is released in concentrations proportional to solar light intensity (Dias & Veloso, 2020).

It is important to characterize the production systems because they are linked to the type and quantity of feedstuffs used in the nutritional management of the herd. Rocha et al. (2015) evaluated the horse breeding systems in some municipalities of Minas Gerais and Bahia and reported that the most frequent system was semi-intensive, followed by extensive and then intensive with 50%, 41% and 9% respectively. The species of forage most used on these farms were the grasses, *Brachiaria spp.*, followed by *Andropogon gayanus* and *Cenchrus ciliaries*. The Mangalarga Marchador breed, followed by grade (no specific breed) horses, were the most bred among the owners interviewed. Solano et al. (2011) reported that the breeding system of the Campeiro horse in Santa Catarina was extensive (100%), although some animals during periods of exhibitions or daily use on the farm were kept in stables, receiving feed, corn and alfalfa. The others fed on native pastures during the summer and cultivated crops during the winter (45.5%), where 36.4% of the animals were fed exclusively native pastures and 18% of cultivated pastures.

There is a technological delay in relation to the quality of the grasses and forages predominantly used to feed the herds. The pastures of *Brachiaria spp.* are little indicated for horses, since they have low nutritional value and are not well accepted by the animals. According to Dittrich et al. (2010), horses are classified as monogastric animals, grazers with a great ability to select food, feeding predominantly on leaves, stems and shoots. Therefore, the decision of the horse to harvest forage is organized hierarchically in different stages, which comprise the broad environment, the plant community, the site, and the food season, specifically the plant. Information on the preference of forage species suitable for subtropical and tropical horse feeding is scarce.

The most used genera are *Pennisetum spp.*, *Digitaria spp.*, *Chloris spp.*, *Paspalum spp.*, *Cynodon spp.*, *Panicum spp.* and *Brachiaria spp.* for grasses, and *Desmodium spp.*, *Glycine spp.*, *Lotononis spp.* and *Macroptilium spp.* for legumes (Carvalho & Haddad, 1987). Specifically, in the genus *Cynodon spp.*, horses prefer Tifton 85, Coastcross 1 and Jiggs in relation to Tifton 68 and Tifton 44, whereas Purple Star and Puerto Rico are left aside (Dittrich et al., 2005). In order to compensate for the lack of nutrients in pastures, the most commonly used option for Mangalarga Marchador breeders in the state of Rio de Janeiro, as can be seen in the results obtained, was the chopped elephant grass, which also has low nutritional value, high fiber content and high risk of problems with inadequate management,

but is the most common option, due to its resistance and low implantation and maintenance costs; on the other hand it increases the cost with labor and concentrated supplements.

In Brazil, silage is a roughage commonly used to feed cattle herds, mainly dairy or for confined beef cattle. This alternative of using silage in the horse feed came from breeders who also have cattle herds and began to use silage as a way of solving the problem of the low quality pasture and elephant grass, especially during the dry season. The use of preserved roughage, mainly maize, has spread throughout the state of Rio de Janeiro and is marketed in vacuum sealed packs of 30 to 40 kg. In this case it is no longer an option as economical as the one produced on the property, but still, it is an option for those who have little pasture and crop area, especially small farms near urban centers. The consumption of silage as the unique feedstuff was evaluated by Melo (2008) who reported that the time spent by the animals on the consumption of three types of *ad libitum* silage ranged from 8.8 to 10 hours per day, with a longer time in the day period in relation to the nocturnal period. The animals only consumed silage for 27 days and there were no clinical, hematological alterations and biochemical liver and kidney profiles were normal after this period, demonstrating that this conserved roughage can be used to feed horses.

The most appropriate preserved forage for horses is the hay of grasses and legumes, as they present higher nutritional value and digestibility of the fiber and better acceptance by the animals. However, this preserved forage is not the most used by Mangalarga Marchador horse breeders in the state of Rio de Janeiro. The estimated average consumption per animal is 14.2 kg/month, or 473 g/day. Similar values were observed by Vieira (2011), where the average monthly consumption of hay per animal in the Minas Gerais state was around 16.46 kg, which is equivalent to an average of 0.55 kg/animal/day. Lima et al. (2006), however, observed higher values in hay-fed sports horses, where daily consumption was 7.0 kg/animal, and in the national average the consumption was 3.5 kg/animal/day. This fact can be explained by the high market cost of hay and by the climatic and topographic conditions of the state of Rio de Janeiro, which has a very humid climate and few flat areas, making planting and hay-production difficult, and increasing production costs.

According to Dittrich et al. (2010), the need to use roughage in the diets of horses is indisputable, even for animals in training when there is high energy requirement and impossibility of access to pastures. Hays are the main roughage used in these situations, but research has been seeking for alternatives such as silage, pre-dried or even industrial by-products such as, citrus pulp and soybean hulls. Probably, the non-use of these roughage is still due to insecurity with the product quality, often inadequately prepared and conserved

(Domingues, 2009). The average consumption of concentrated supplements clearly demonstrates the preference for purchased commercial ration to that produced on the property. Other alternative sources of concentrated supplements, such as corn bran, wheat, oats, or soybeans, are poorly used, mainly because the state is not a commercial grain producer. Lima et al. (2006) reported higher rates of average national consumption of concentrated feed of 5.12 kg/animal/day. According to Vieira (2011), the average monthly consumption of commercial feedstuffs was 22.6 kg/animal and the feed produced on the farm was 9.18 kg/animal, with a mean intake of 1.06 kg/animal/day; a lower value than found in this study.

The IEA and Glanders exams are mandatory for all animals transported within the state of Rio de Janeiro. These exams must be present to receive the GTA - Animal Transit Guide and to access places for equestrian events. These diseases are mandatory notification if the test result is positive. The tests are valid for 60 days, so some animals, which frequently participate in exhibitions or sporting events, must go through these tests more than once a year. The horse breeders declared that the horses only take the exams when required, that is, for transportation or participation in events.

5. Conclusions

There are Mangalarga Marchador breeders spread throughout the state of Rio de Janeiro, with higher concentrations in the Metropolitan and Northwestern Fluminense mesoregions. The properties are mostly of medium size and devote approximately half of their total area to horse breeding. The stud farms are also medium in size, with an average of 100 animals per farm, and the animals are mainly raised using an extensive production system. Pastures are of low quality, leading to the need for roughage and concentrated supplements. Chopped Napier grass and commercial concentrated feed are the most used supplements.

The sanitary management is not standardized; the breeders have been seeking alternative forms, mainly to combat ticks and to reduce the costs with anthelmintics. Vaccinations are carried out, but still at an unsatisfactory level, although there are various obligatory vaccines in the calendar, they are not applied to the whole herd.

The labor force used is unspecialized and the average number is five employees per farm. More than 90% of breeders declared that the unskilled labor force is the biggest obstacle to the growth of horse breeding in the state of Rio de Janeiro.

References

Brasil (2016). Ministério da Agricultura Pecuária e Abastecimento. Retrieved from <<http://www.agricultura.gov.br/assuntos/camaras-setoriais-tematicas/documentos/camaras-setoriais/equideocultura/anos-anteriores/revisao-do-estudo-do-complexo-do-agronegocio-do-cavalo>>

Carvalho, R. T. L., & Haddad, C. M. (1987). *Pastagens e alimentação de equinos*. Piracicaba, SP: Fundação de Estudos Agrários Luiz de Queiroz. 85.

Castanho, R. B. (2006). *Uso do geoprocessamento no estudo da produção agropecuária da microrregião geográfica de Carazinho - RS*. Thesis (D.Sc.). Universidade Federal de Uberlândia, Uberlândia, MG, Brazil.

Dias, J. C. O., & Veloso, C. M. (2020). Seasonality in mammalian reproduction: a review. *Research, Society and Development*, 9 (10), e4249108236. <https://doi.org/10.33448/rsd-v9i10.8236>

Dittrich, J. R., Carvalho, P. C. F., Moraes, A., Lustosa, S. B. C., Silveira, E. O., & Oliveira, E. B. (2005). Preferência de equinos em pastejo: efeito da altura de dosséis de gramíneas do gênero *Cynodon*. *Archives of Veterinary Science* (10) 61-67.

Dittrich, J. R., Melo, H. A., Afonso, A. M. C. F., & Locatelli-Dittrich, R. (2010). Comportamento ingestivo de equinos e a relação com o aproveitamento das forragens e bem-estar dos animais. *Revista Brasileira de Zootecnia* (39) 130-137.

Domingues, J. L. (2009). Uso de volumosos conservados na alimentação de equinos. In: *Anais da 46ª Reunião Anual da Sociedade Brasileira de Zootecnia*. Sociedade Brasileira da Zootecnia, Maringá, PR, Brasil, 259-269.

Hulley, S. B., Cummings, S. R., Browner, W. S., Grady, D. G., & Newman, T. B. (2008). *Delineando a Pesquisa Clínica* (3rd ed). Porto Alegre: Artmed Editora.

IBM Corp. (2016). *IBM SPSS Statistics for Windows*, Versão 24.0. Armonk, Nova York: IBM Corp.

Levine, D. M., Berenson, M. L., & Stephan, D. (2000). *Estatística: Teoria e aplicações usando Excel em português*. Rio de Janeiro: LTC.

Lima, R. A. S., & Cintra, A. G. (2015). *Revisão do Estudo do Complexo do Agronegócio do Cavalo*. Ministério da Agricultura, Pecuária e Abastecimento, Brasília, DF.

Lima, R. A. S., Shiota, R., & Barros, G. S. C. (2006). *Estudo do complexo do agronegócio cavalo*. CEPEA/ESALQ/USP, Piracicaba, SP.

Mattos, P., Rodrigues, R. G., Celia, A. P., Saggin, K. D., Claudia, A., & Padilha, M. (2010). O perfil empreendedor do criador de cavalo crioulo no Estado do Rio Grande do Sul. In: *Anais do 48º Congresso da Sociedade Brasileira de Economia, Administração e Sociologia Rural*. SOBER, Campo Grande, MS, Brasil.

Melo, H. A. (2008). *Consumo, preferência alimentar, monitoramento clínico, hematológico e bioquímico de equinos alimentados com silagem*. Dissertation (M.Sc.). Universidade Federal do Paraná, Curitiba, PR, Brazil.

Oliveira, J. E. G. (2012). *Assimetrias e semelhanças da criação de equinos no Sul do Brasil (RS) e na Argentina: aspectos produtivos, sanitários e comerciais*. Thesis (D.Sc.). Universidade Federal Rural do Rio de Janeiro, Seropédica, RJ, Brazil.

Oliveira, O. C. (2013). *Questionário PNAG*. IBGE. Retrieved from <http://www.ibge.gov.br/home/estatistica/indicadores/prpa/questionario_PNAG_2013.pdf>

Rocha, R. H. F., Mendes, J. L., Pereira, L. D. F. L., Maria, M., Moura, A., Neto, T. M., & Oliveira, L. L.S. (2015). Aspectos sobre a criação e manejo de equídeos. In: *Anais X Congresso Nordestino de Produção Animal*. SNPA. Teresina, PI, Brasil.

Solano, G. A., Silva, M. C., & Sereno, J. R. B. (2011). Aspectos sobre o sistema de criação de cavalo Campeiro no Sul do Brasil. *Actas Iberoamericanas de Conservación Animal*, (1) 405-407.

Souza Júnior, P. R. B., Freitas, M. P. S., Antonaci, G. A., & Szwarcwald, C. L. (2013). Desenho da amostra da Pesquisa Nacional de Saúde. *Epidemiology Service Saúde*, (24) 207-216. Retrieved from <http://dx.doi.org/10.5123/S1679-49742015000200003>

Thrusfield, M. V. (2004). *Epidemiologia Veterinária* (2 ed). São Paulo: Roca. 556

Vieira, E. R. (2011). *Aspectos econômicos e sociais do Complexo Agronegócio Cavalo no Estado de Minas Gerais*. Dissertação de mestrado (M.Sc.). Universidade Federal de Minas Gerais, Belo Horizonte, MG, Brazil.

Vieira, E. R., Rezende, A. S. C., Lana, A. M. Q., Barcelos, K. M. C., Santiago, J. M., Lage, J., Fonseca, M. J. & Bergmann, G. A. G. (2015). Caracterização da equideocultura no Estado de Minas Gerais. *Arquivo Brasileiro de Medicina Veterinária e Zootecnia*, (67) 319-323. Retrieved from <http://dx.doi.org/10.1590/1678-7460>

Percentage of contribution of each author in the manuscript

Grasiele Coelho Cabral – 20%

Ana Carla Chaves Dias – 15%

Afonso Aurélio de Carvalho Peres – 15%

Maria Izabel Vieira de Almeida – 15%

Wagner de Souza Tassinari – 15%

Fernando Queiroz de Almeida – 20%