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Horse Agribusiness in Rio de Janeiro, Brazil: trade and economic aspects of Mangalarga Marchador farm production

Agronegócio equino no Estado do Rio de Janeiro, Brasil: aspectos comerciais e econômicos da produção de Mangalarga Marchador

Agronegocio equino en el estado de Río de Janeiro, Brasil: aspectos comerciales y económicos de la producción del Mangalarga Marchador

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Abstract

This study aimed to assess the economic and commercial performance of the Mangalarga Marchador horse breeding, and production costs in the Rio de Janeiro. Data was collected from the ABCCMM archives and from associated breeders**,** selected through stratified sampling by the mesoregions of the State of Rio de Janeiro. The main means of marketing the animals is selling on the farm. The average of horse's sale per stud farm in the Rio de Janeiro is 14.92/year with the average of R$16,628.46/horse, generating an estimated sale at the farms of around R$192,026,783.88/year. The sale of mating (8.77 mating/year) and weaned foals (5.44 foals/year) contributed to the largest volume of sales at the stud farms. Donor mares (R$57,318,908.50) and mares (R$42,958,357.20) represented the highest in terms of market value throughout the Rio de Janeiro. The Coastal Lowlands mesoregion had the highest average of animals sold per stud farm/year (40.57 animals) and the Central Fluminense mesoregion had the lowest average (25.39 animals). The average commercialization per farm/year corresponds to R$385,667.90 and the average total value traded in the Rio de Janeiro is R$465,880,252.32/year. The average is 6.52 hired employees, which is equivalent to an average monthly labor gross cost of R$11,286.00. Rio de Janeiro employs around 5,584 people directly, the greatest numbers in the Metropolitan mesoregion (1,833 employees), and the lowest concentration in the Northern Fluminense mesoregion (530 employees). Together with the production costs, Mangalarga Marchador horse's business turns over more than R$650 million per year in the Rio de Janeiro.

Keywords: Equine; Production costs; Production system.

Resumo

Este estudo objetivou dimensionar a atuação econômica e comercial do agronegócio do cavalo Mangalarga Marchador, bem como os custos de produção no Estado do Rio de Janeiro. Foram coletados dados nos arquivos da ABCCMM e em entrevistas com criadores associados, os quais foram selecionados através de amostragem estratificada pelas mesorregiões do Estado do Rio de Janeiro. O principal meio de comercialização dos animais é a venda na fazenda, onde a média do Estado é de 14,92 animais com valor médio de R$16.628,46/animal, gerando uma estimativa de vendas na fazenda em torno de R$ 192.026.783,88/ano. A venda de coberturas (8,77 coberturas/ano) e de potros desmamados (5,44 potros/ano) contribuem com o maior volume de comercialização dos criatórios. As éguas doadoras (R$57.318.908,50) e matrizes (R$42.958.357,20) representam os maiores montantes em valores comercializados em todo Estado. A mesorregião das Baixadas

Litorâneas possui a maior média de vendas por criatório/ano (40,57 animais) e a região Centro Fluminense a menor média (25,39 animais). A média de comercialização por criatório/ano corresponde a R$385.667,90 e de valores totais comercializados no Estado a R$ 465.880.252,32/ano. A média é 6,52 funcionários contratados, com um custo mensal médio com mão-de-obra de R$ 11.286,00/criatório. São empregados, diretamente, em torno de 5.584 pessoas, com maior número na região Metropolitana (1.833 empregados) e o menor na região Norte Fluminense (530 empregados). O agronegócio do cavalo Mangalarga Marchador movimenta mais de 650 milhões de reais por ano no Rio de Janeiro.

Palavras-chave: Custo de produção; Equinos; Sistema de produção.

Resumen

Este estudio tuvo como objetivo medir el desempeño económico y comercial de la industria del caballo Mangalarga Marchador, así como los costos de producción en Río de Janeiro. Los datos fueron recolectados en los archivos de la ABCCMM y en entrevistas con criadores asociados, los cuales fueron seleccionados mediante muestreo estratificado por las mesorregiones del Estado de Río de Janeiro. El principal medio de comercialización de los animales es la venta en la granja, donde el promedio estatal es de 14,92 animales con un valor promedio de R $ 16.628,46 / animal, generando una estimación de ventas en la finca de alrededor de R $ 192.026.783,88 / año. La venta de cubriciones (8,77 cubriciones / año) y potros destetados (5,44 potros / año) contribuyen al mayor volumen de comercialización de las granjas. Las yeguas donantes (R $ 57.318.908,50) y las yeguas madres (R $ 42.958.357,20) representan el valor más alto en términos de mercado en todo el Estado. La mesorregión Baixadas Litorâneas tiene el promedio más alto de ventas por explotación / año (40,57 animales) y el más bajo corresponde a la región Centro Fluminense (25,39 animales). La comercialización promedio por cría / año corresponde a R $ 385.667,90 y de los valores totales vendidos en el Estado a R $ 465.880.252,32 / año. En relación a los empleados contratados, el promedio es de 6,52 lo que corresponde a un costo laboral mensual de aproximadamente R $ 11.286,00 / explotación agropecuaria. Se emplea directamente alrededor de 5.584 personas, con el mayor número en la Región Metropolitana (1.833 empleados) y el menor en la Región Norte Fluminense (530 empleados). El industria del caballo Mangalarga Marchador genera más de R $ 650 millones al año en Río de Janeiro.

Palabras clave: Caballos; Costo de producción; Sistema de producción.

1. Introduction

The evolution of production systems and the emergence of modern industrial parks that supply goods and inputs to the countryside are the so-called "pre-gate" activities or upstream industries for the farm, and the formation of storage, transportation, processing, industrialization and distribution are the so-called "post-gate" activities or downstream industries for the farm. These activities have narrowed the relationships between industry, services, and agriculture (Lima et al., 2006). Thus, studies of the productive structures began to be made based on an interconnected system of production, processing, and commercialization of the products of agricultural and livestock origin, going on to study the Complex of Agribusiness.

According to Lima et al. (2015), unlike many agricultural activities, the horse agribusiness does not fit into the standard structure of the linear productive chain, but there are a series of intertwined chains, forming what is denominated agricultural complex. Given these specific characteristics of the horse agribusiness, the authors chose not to follow the traditional sequence: upstream industry, agriculture, and downstream industry. Instead, the authors began with the upstream industry and, from then on, the various activities are divided based on the functional aspects of the horse, and not exactly on livestock and industrial activities. The income generated in the Horse Agribusiness Complex in Brazil, in values of April 2015, totaled R$16.15 billion, and employed 607,329 people directly. Since each direct employment creates four other indirect jobs, then one can estimate that there were also 2,429,316 indirect jobs. Thus, the Complex is responsible, directly, and indirectly, for the employment of 3 million people (Brazil, 2016).

Data reported by the work entitled Horse Agribusiness Complex, requested by the National Confederation of Agriculture (CNA) and carried out by Lima et al. (2006), which was updated in 2016, showed that in 2006 the gross annual revenue was R$7.5 billion and in 2015 this value reached R$16 billion. Guerra e Medeiros (2006) pointed out that the work segment turned over around R$4.0 billion per year and generated more than 500,000 direct jobs on rural properties, 85.0% of them formal. Lima et al. (2015) estimated that the labor segment employed 433,333 workers per year and was responsible for handling R$8.58 billion annually within the Horse Agribusiness Complex.

Lima et al. (2006) estimated that the feed market had an annual turnover of R$53.44 million and was concentrated on the breeding and sports segments in the Southeastern mesoregion (58%). The market for saddlery and accessories had a turnover of about R$174.6

million/year and saddles corresponded to 50% of the billing. The other operations, such as hoof trimming and shoeing, transportation of equines, advertising, and publications, together had an annual turnover of around R$240.04 million. With the updating of the horse agribusiness study, Brazil (2016) verified that, despite the strong and recent world crisis, which started in 2008, the veterinary drug industry presented a growth in recent years in Brazil. Even correcting for inflation for the period (deflated by the IGP-DI of the FVG), there was a real growth of 3.7% per annum (9.5% pa in nominal values) in the period between 2008 and 2013, when billing was estimated at R$197.8 million for veterinary drugs for horses. The updated value of the revenues in the segment, in the year 2015, totaled R$220.5 million. The same study revealed that, in the segment for sports and leisure, total food expenses (forage + concentrate + supplement), totaled R$959 million in 2015, corresponding to 16.4% of the total cost of the horse breeding.

According to Lima et al. (2006) within the downstream activities of the farm, virtual auctions became very popular, and were broadcasted on agribusiness-related TV channels, due to the lower costs and the ability to reach a much larger number of consumers throughout the country. The number of animals, coverages and embryos auctioned increased by 123% from 1995 to 2004, and the financial volume recorded grew even stronger, reaching 430% in the same period, jumping from R$22.5 million to R$111.4 million, and at the same time the average value of the business more than doubled, from R$4,827.23 to R$11,500.43. In that same period, the volume of Brazilian exports of live horses increased considerably, going from around US$260,000 in 1996 to over US$2 million in 2005, presenting a growth of 692%, at an approximate average rate of 26% per year. Brazil ranked 31st in both world exports (0.11% of the market) and world imports (0.06% of the market).

The Brazilian Association of Mangalarga Marchador Horse Breeders - ABCCMM is the largest breeders association of horses of the same breed in Latin America, with approximately 15,000 members and about 600,000 registered animals, the state of Rio de Janeiro is the second largest producer (ABCCMM, 2016).

The objective of this study was to assess the economic and commercial performance of the Mangalarga Marchador horse agribusiness in trading, income generation and employment in the state of Rio de Janeiro.

2. Methodology

The methodology used in this exploratory and descriptive study was divided into two stages: 1 - Consultation with the Brazilian Association of Breeders of Mangalarga Marchador Horses (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 related to the agribusiness complex of Mangalarga Marchador horse in the state of Rio de Janeiro, with the objective of collecting data concerning the commercial and financial aspects of the production system in the State. The research was approved by the Research Ethics Committee of UFRRJ, under the number: 972/17.

The interviews were conducted during visits to the stud farms, exhibitions, auctions, competitions, and other events related to horses. The breeders were selected through sampling, based on the data from the Association. The sampling selection considered breeders who were active over the last two years. Sampling was stratified by the six graphic mesoregions of the state of Rio de Janeiro. A total of 202 stud farms owners were interviewed, distributed as follows: Northwestern Fluminense (22), Northern Fluminense (17), Central Fluminense (28), Coastal Lowlands (21), Metropolitan (85) and Southern Fluminense (29). The sample size was defined according to the level of precision desired, which was a 95% confidence interval ($CI_{95\%}$), for the estimation of some parameters of interest at different levels of geographical disaggregation and specific population groups (Souza -Junior et al., 2015). To determine the sample size, based on the estimate of the population proportion, for a finite population, the following equation was used:

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

where:

n = sample size.

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

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

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

E = margin of error or Maximum Error of Estimation. 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 developed based on the questionnaires used by Lima et al (2006), Oliveira (2012) and Oliveira (2013), and was developed using Google Drive; a tool that is available on the internet at www.google.com. A link was generated, through which the breeder or the interviewee could access with a computer or smartphone and answer the questions "online". On finalizing the answers, the data were immediately transferred to a MS-Excel spread sheet.

Before starting the data collection, a pre-test was performed using *a priori* questionnaire to evaluate the research tool. The interviews were timed to detect facilities and difficulties in answering the questions and noting the most frequent doubts as well as considering any questions of relevance that had not been included in the questionnaire. This pre-test enabled the questionnaire to be adapted to minimize data collection failures, if needed. According to Hulley et al. (2008), pre-tests should be conducted to clarify, refine, and measure the duration of the whole procedure. The interviews were carried out from July 2017 to June 2018. The average time of each interview was 30 to 40 minutes; however, some of them exceeded 60 minutes. A total of 202 breeders, managers and/or advisors were interviewed, whether men or women, in the different mesoregions of the State. Many equestrian events were used to contact the breeders, with emphasis on regional exhibitions and on-site horse auctions. The official data, provided by the ABCCMM, were collected directly at their headquarters in Belo Horizonte, Minas Gerais, with the authorization of the competent management. The results obtained from the Association along with the questionnaires applied to the breeders were analyzed by descriptive statistics processed in the Statistical Package for Social Science (SPSS), version 24.0.

3. Results

The average number of animals traded in live auctions per stud farm in the state of Rio de Janeiro is 4.28 (± 9.037) animals, with an average value of R$35,314.35 (± 28,815.76). However, this average varies greatly between the mesoregions of the State, from 2.55 to 6.52 animals in the Southern and Central Fluminense mesoregions, respectively, with values varying between R$25,909.09 and R$45,000.00 in the Central Fluminense and Costal Lowlands mesoregions, respectively. The total value of annual sales at live auctions is estimated to be approximately R$88,027,078.86, in the State (Table 1).

In virtual auctions, the averages range from 1.76 to 7.93 animals traded per year in the

Northern and Central Fluminense mesoregions, respectively. The average values range from R$14,750.00 to R$24,833.33, in the Central and Northern Fluminense regions, respectively. The virtual auctions turnover an estimated total amount of R$31,035,288.96 per year in the state of Rio de Janeiro (Table 2). The breeders in the Costal Lowlands mesoregion commercialize, on average, more animals in online auctions (5.48), while those of the Southern Fluminense mesoregion have the lowest average number of animals traded annually (0.65). The average values have a lower variation between the mesoregions, from R$10,000.00 (Central and Northern Fluminense) to R$13,250.00 (Northwestern Fluminense). Online auctions sell around R$2,579,438.70 a year, in the state of Rio de Janeiro.

The main sales of animals throughout the State and in the mesoregions are carried out at the stud farms. The State average is 14.92 animals and for the Metropolitan and Northwestern Fluminense it varies from 11.97 to 20.86 animals per year, respectively. The average values per animal vary from R$11,727.00 to R$39,352.00 in the Metropolitan and Northern Fluminense mesoregions, respectively, and the average in the State is R$16,628.46 per animal. Sales on the farm are estimated to turnover around R$192,026,783.88 per year in the state of Rio de Janeiro. Figure 1 shows, in percentages, the total number of sales and the total value of sales within each marketing category.

The sale of live mating (8.52 mating/year) and weaned foals (5.35 foals/year) contribute the highest volume of sales at the stud farms (Table 3). The categories of donor mare and stallion represent the highest values of unit sales, with averages throughout the State of R$90,124.00 and R$67,658.00, respectively (Table 4).

The Coastal Lowlands mesoregion has the highest average sales per stud farm/year (40.57 animals) and the Central Fluminense region has the lowest average (25.39 animals) (Table 3). The average sale of animals/stud farm/year in the state of Rio de Janeiro is R$385,667.90, ranging from R$629,477.27 to R$278,705.88, respectively in the Northwestern and Northern Fluminense regions (Table 4).

Mare donors (R$57,318,908.50) and mares (R$42,958,357.20) represent the highest amounts in market values throughout the State (Table 5). Figures 2 and 3 show, in percentages, the behavior of each category in relation to the number of animals sold and the market values.

Table 1. Mean number, mean values and standard deviation of animals sold by Mangalarga Marchador horse breeders annually, within each category of commercialization, in the state of Rio de Janeiro and in the mesoregions.

Category		Rio de Janeiro (Mean/SD)	Mesoregions					
			Coastal Lowlands	Central Fluminense	Metropolitan	Northwestern Fluminense	Northern Fluminense	Southern Fluminense
Live auction	Quantity	4.28 ± 9.037	2.95 ± 4.122	6.52 ± 13.525	3.54 ± 6.706	6.41 ± 11.902	3.53 ± 7.621	2.55 ± 5.386
	Value	35314.35 ± 28815.76	45000.00 ± 43103.45	25909.09 ± 9811.10	34166.67 ± 20607.42	36250.00 ± 23445.89	28833.33 ± 20159.32	43000.00 ± 46019.24
Virtual auction	Quantity	5.13 ± 9.504	4.62 ± 8.347	7.93 ± 11.898	4.88 ± 9.882	5.91 ± 9.479	1.76 ± 4.204	4.38 ± 8.337
	Value	19390.27 ± 10934.55	20666.67 ± 8118.72	14750.00 ± 6724.78	19791.67 ± 5779.62	24833.33 ± 18109.66	15000.00 ± 4218.87	16363.63 ± 4952.52
Auction Online	Quantity	1.94 ± 6.359	5.48 ± 10.397	3.00 ± 9.258	1.01 ± 2.860	2.32 ± 6.877	0.59 ± 2.366	0.65 ± 3.249
	Value	11267.86 ± 2432.43	11666.67 ± 2176.67	10000.00 ± 0.00	10500.00 ± 1772.45	13250.00 ± 3095.29	10000.00 ± 0.00	11500.00 ± 3791.67
Sale at events	Quantity	0.74 ± 1.809	0.76 ± 1.833	1.00 ± 2.427	0.88 ± 2.004	0.27 ± 0.689	0.53 ± 1.296	0.80 ± 1.606
	Value	38936.93 ± 26125.10	25000.00 ± 4579.14	41250.00 ± 30375.00	51533.33 ± 28160.17	43333.33 ± 26995.89	30000.00 ± 8437.75	29000.00 ± 24531.71
Sale on the farm	Quantity	14.92 ± 12.82	16.90 ± 11.128	13.44 ± 10.376	11.97 ± 10.359	20.86 ± 18.625	15.35 ± 11.798	14.55 ± 12.013
	Value	16628.46 ± 41949.22	16904.76 ± 20215.73	12363.64 ± 6037.30	11727.27 ± 5293.30	15904.76 ± 19424.78	39352.94 ± 115887.07	13805.56 ± 15152.52

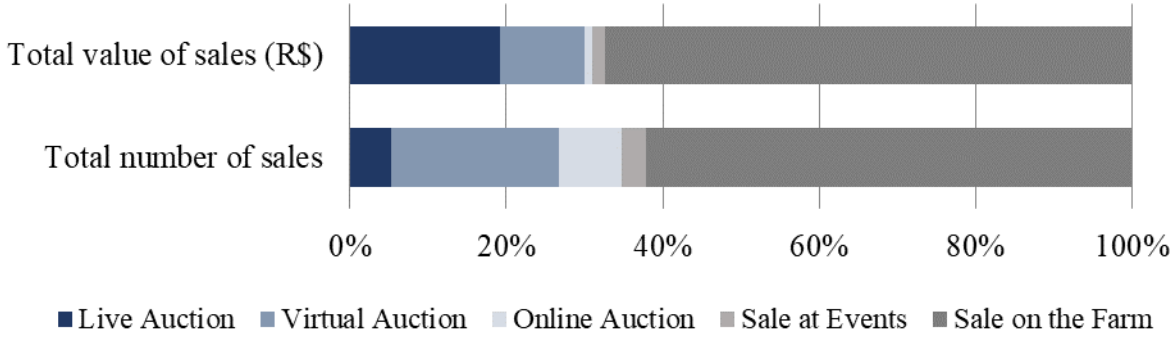
FGV 1.00 U$ = 3.72 R$ (October/2018). Source: Authors.

Table 2. Total number of animals sold and total annual sales, by sales category throughout the state of Rio de Janeiro.

Category	Total number of sales	Total value of sales (R$)
Live Auction	1,085.44	54,412,351.20
Virtual Auction	4,350.24	31,035,288.96
Online Auction	1,645.12	2,579,438.70
Sale at events	627.52	4,667,757.84
Sale on the Farm	12,652.16	192,026,783.88
Total	20,360,48	465,880,252.32

FGV 1.00 U$ = 3.72 R$ (October/2018). Source: Authors.

Figure 1. Number and total value of sales, carried out within each marketing category (%).



Source: Authors.

Table 3. Animals sold annually by breeders, by animal category, in the State of Rio de Janeiro and in the mesoregions.

Category	Rio de Janeiro (mean/SD)	Mesoregions					
		Coastal Lowlands	Central Fluminense	Metropolitan	Northwestern Fluminense	Northern Fluminense	Southern Fluminense
Stallion	0.60 ± 1.218	0.43 ± 0.732	0.78 ± 1.577	0.55 ± 1.119	0.73 ± 1.457	0.53 ± 0.983	0.55 ± 1.075
Mares	2.93 ± 3.589	3.71 ± 4.477	3.11 ± 3.708	2.65 ± 3.614	3.23 ± 3.863	2.47 ± 2.784	2.73 ± 2.785
Donor mares	0.75 ± 1.363	0.67 ± 0.948	0.52 ± 1.035	1.03 ± 1.759	0.95 ± 1.528	0.47 ± 1.201	0.48 ± 0.709
Weaned foal	5.35 ± 5.70	4.81 ± 5.308	5.22 ± 5.191	4.96 ± 5.081	7.55 ± 8.068	5.71 ± 5.148	4.73 ± 4.583
Weaned filly	3.32 ± 4.209	3.33 ± 4.606	3.48 ± 4.313	2.95 ± 4.196	4.45 ± 4.647	3.06 ± 2.426	3.53 ± 4.199
Foal of 6/36 months	3.03 ± 3.109	3.14 ± 3.061	2.48 ± 2.667	2.77 ± 3.60	2.68 ± 2.557	3.76 ± 3.057	3.60 ± 2.967
Filly of 6/36 months	2.46 ± 3.055	2.10 ± 2.557	2.04 ± 2.465	2.31 ± 3.240	2.82 ± 3.081	3.06 ± 3.388	3.05 ± 3.205
Gelding horse	0.64 ± 1.498	0.48 ± 0.911	0.44 ± 1.201	0.95 ± 1.962	0.41 ± 0.720	0.47 ± 1.893	0.65 ± 1.280
Recipients mares	1.57 ± 4.625	3.38 ± 5.650	1.48 ± 5.256	2.16 ± 5.401	0.36 ± 1.673	0.59 ± 2.366	1.40 ± 4.192
Embryo	2.24 ± 5.791	2.76 ± 3.912	0.93 ± 1.494	2.26 ± 5.104	4.82 ± 9.949	1.06 ± 2.426	2.95 ± 6.183
Live Mating	8.52 ± 16.653	17.38 ± 26.206	5.52 ± 7.181	7.28 ± 12.321	9.95 ± 15.599	13.12 ± 29.636	5.20 ± 6.213
Total	31.41	40.57	25.39	29.57	37.36	34.00	27.55

FGV 1.00 U$ = 3.72 R$ (October/2018). Source: Authors.

Table 4. Average value of the animals commercialized annually by breeders, by animal category, in the state of Rio de Janeiro and in the mesoregions.

Category	Rio de Janeiro (mean/SD)	Mesoregions					
		Coastal Lowlands	Central Fluminense	Metropolitan	Northwestern Fluminense	Northern Fluminense	Southern Fluminense
Stallion	67658.15 ± 79747.71	40000.00 ± 22246.33	72272.73 ± 53772.79	65666.67 ± 65431.99	66250.00 ± 55558.93	130000.00 ± 189116.58	42500.00 ± 34056.51
Mare	17289.57 ± 5819.39	18866.67 ± 4989.88	16846.15 ± 6783.82	17405.41 ± 6550.07	17800.00 ± 5546.47	15636.36 ± 6117.69	16923.08 ± 4041.51
Donor mare	90124.07 ± 118262.83	62500.00 ± 27731.03	64166.67 ± 17697.25	69814.81 ± 63109.32	92222.22 ± 48699.75	208750.00 ± 291002.37	116000.00 ± 171346.88
Weaned foal	6722.12 ± 3102.27	7588.24 ± 4272.58	5789.47 ± 1680.92	6754.90 ± 2524.56	7105.26 ± 2645.14	6416.67 ± 1509.73	7250.00 ± 4686.41
Weaned filly	11046.66 ± 9561.22	13142.86 ± 10704.39	10400.00 ± 4451.89	11243.24 ± 8247.26	11058.82 ± 4055.80	8727.27 ± 2757.35	12370.37 ± 17500.16
Foal of 6/36 months	10480.71 ± 4533.48	9571.43 ± 2920.35	10466.67 ± 3597.63	10091.84 ± 3806.71	14066.67 ± 6583.06	7923.08 ± 1215.44	10609.37 ± 4497.75
Filly of 6/36 months	16424.69 ± 10340.75	18583.33 ± 19014.06	15200.00 ± 4736.93	16750.00 ± 11098.89	20615.38 ± 8322.59	14833.33 ± 9849.62	14034.48 ± 5828.04
Gelding horse	9072.74 ± 3349.32	8500.00 ± 2967.62	6500.00 ± 1536.18	9904.76 ± 3855.38	9166.67 ± 2512.29	5000.00 ± 0.00	9409.09 ± 3182.42
Recipient mare	1766.91 ± 572.68	1457.14 ± 291.99	1250.00 ± 262.52	1261.54 ± 393.79	1000.00 ± 0.00	1000.00 ± 0.00	1833.33 ± 1053.71
Embryo	19860.20 ± 6871.97	19538.46 ± 7536.31	18111.11 ± 4082.38	18958.33 ± 4984.15	21615.38 ± 5214.93	25000.00 ± 12016.19	19076.92 ± 9138.38
Live Mating	2973.71 ± 2419.52	3050.00 ± 3325.60	2500.00 ± 1031.24	2530.30 ± 1721.82	4000.00 ± 3547.11	2200.00 ± 691.56	2452.38 ± 1448.70
Total/stud farm/year*	385667.90	379385.71	281857.14	376266.22	629477.27	278705.88	347775.00

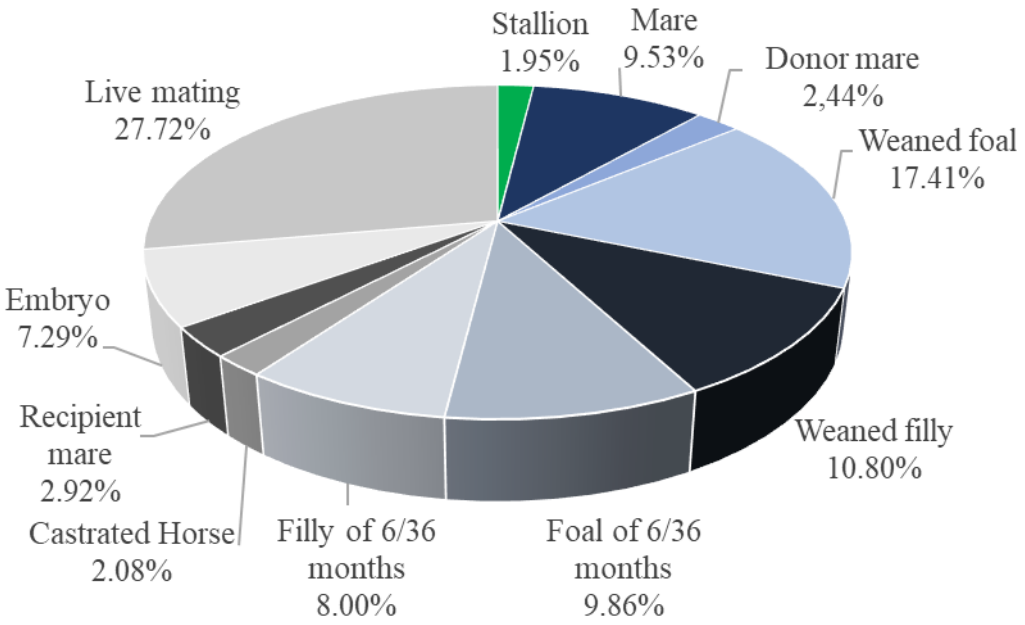
* This value corresponds to the sum of the average market values of each category multiplied by the average number of animals sold per year in each category.
FGV 1.00 U$ = 3.72 R$ (October/2018). Source: Authors.

Table 5. Total number and total value of annual sales, by animal category, throughout the state of Rio de Janeiro.

Category	Total number of sales	Total value of sales (R$)
Stallion	508.80	34,424,390.04
Mare	2,484.64	42,958,357.20
Donor mare	636.00	57,318,908.50
Weaned colt	4,536.80	30,496,914.00
Weaned filly	2,815.36	31,100,324.70
Foal of 6/36-months	2,569.44	26,929,555.50
Filly of 6/36 months	2,086.08	34,263,217.30
Gelding horse	542.72	4,923,957.45
Recipient mare	759.88	1,342,685.16
Embryo	1,899.52	37,724,847.10
Mating	7,224.96	21,484,935.80
Total	26,635.68	465,880,252.32

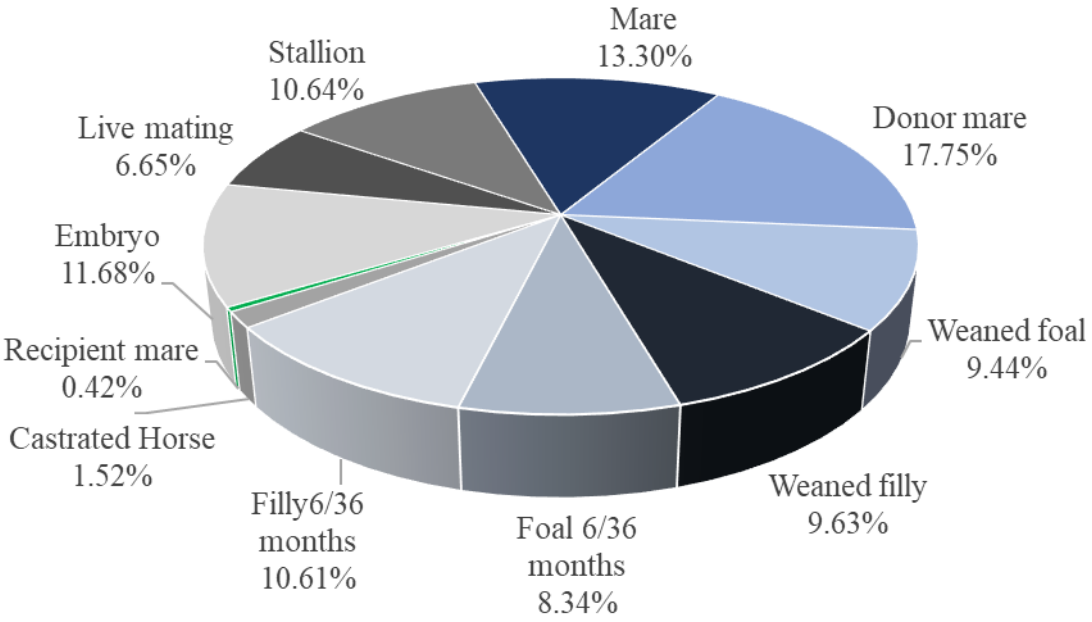
FGV 1.00 U$ = 3.72 R$ (October/2018). Source: Authors.

Figure 2. Percentage share of each category in the total number of annual sales in the state of Rio de Janeiro.



Source: Authors.

Figure 3. Percentage share of each category in the total value of annual sales for the state of Rio de Janeiro.



Source: Authors.

Analyzing the mesoregions according to the total values marketed annually, the Metropolitan region stands out for the total number of animals sold (7,510.78 head) and for a value of R$95,571,619.90, followed by the Northwestern mesoregion of Rio de Janeiro with 5,006.24 animals sold and for a total of R$84,349,954.20 (Table 6).

The state average of contracted employees (permanent and temporary), including Veterinarians, Animal Scientist, Veterinary technicians, Agronomists and Agricultural Technicians, per farm is 6.52 and the total amount of expenses for labor per month is R$11,286.00. (Table 7).

Table 6. Total number of sales and total value of annual sales, by mesoregion and throughout the State of Rio de Janeiro.

Mesoregions	Total number of sales	Total value of sales (R$)
Coastal Lowlands(n=92)	3,691.87	34,524,099.60
Central Fluminense (n=144)	3,681.55	40,869,285.30
Metropolitan (n=292)	7,510.78	95,571,619.90
Northwestern Fluminense (n=134)	5,006.24	84,349,954.20
Northern Fluminense (n=89)	3,026.00	24,804,823.30
Southern Fluminense (n=97)	3.719,25	46.949.625,00
RJ (n=848)	26,635.68	465,880,252.32

FGV 1.00 U$ = 3.72 R$ (October/2018) Source: Authors.

Stud farms in the Central Fluminen.se mesoregion have the highest average monthly cost for labor (R$13,224.33) and those in the Northern Fluminense mesoregion have the lowest average monthly cost (R$9,862.71). The farms that have a contracted manager have one manager per property, with an average salary of R$3,409.14, throughout the State. The average salary of a Mangalarga Marchador trainer in the state of Rio de Janeiro is R$2,244.00, with a minimum of R$500,00 and a maximum of R$7,000.00, found in the Metropolitan mesoregion.

Mangalarga Marchador horse breeding in the state of Rio de Janeiro employs around 5,584 people directly (Table 8). The largest number is in the Metropolitan mesoregion (1,833 employees), due to the greater number of stud farms, and the lowest number is in the Northern Fluminense region (530 employees).

The average values per stud farm and the total estimated values spent on roughage, concentrated feed, and mineral supplements, are based on the present prices prevailing in the market. The average monthly cost of bulk feed at the stud farms in the State is R$2,436.77, and ranges from R$1,011.74 to R$3,795.45, between the Northern and Northwestern Fluminense mesoregions (Table 9). Due to the higher concentration of stud farms, the metropolitan mesoregion has a higher value for roughage feed (R$724,565.87/month), while the Northern Fluminense mesoregion presents the lowest (R$90,044.86).

Table 7. Number of employees hired and average salaries (R$), by category, throughout the state of Rio de Janeiro and in the mesoregions.

Category	Options	Rio de Janeiro	Mesoregions (%)					
			Coastal Lowlands	Central Fluminense	Metropolitan	Northwestern Fluminense	Northern Fluminense	Southern Fluminense
Veterinarian	Nº	0.97±0.55	1.19±0.50	1.15±0.53	0.95±0.64	0.82±0.49	0.76±0.43	0.98±0.57
	Mean salary	1800.28±1735.4	1783.33±1324.8	2671.43±1892.3	1667.76±1605.6	1500.00±1529.1	1458.33±1340.79	1771.15±2182.4
Animal Scientist	Nº	0.05±0.23	0.05±0.21	0.04±.19	0.04±0.20	-	0.06±0.24	0.10±0.38
	Mean salary	2982.38±2446.4	-	900.00	5250.00±2975.2	-	1800.00	3250.00±1896.0
Agronomist	Nº	0.05±0.23	0.10±0.29	0.04±.19	0.03±.16	0.14±0.34	-	0.05±0.22
	Mean salary	955.80±53.21	1000.00	-	900.00	-	-	-
Agricultural Technician	Nº	0.02±0.28	-	0.07±0.26	-	-	-	0.03±0.16
	Mean salary	-	-	-	-	-	-	-
Manager	Nº	0.45±0.51	0.48±0.50	0.52±0.50	0.41±0.49	0.41±0.49	0.53±0.50	0.44±0.55
	Mean salary	3409.14±1537.1	3710.00±3007.9	3471.43±914.34	3345.16±1318.6	3500.00±1427.2	2888.89±946.33	3568.75±1367.2
Trainer	Nº	1.49±1.02	1.67±1.13	1.63±0.91	1.34±0.90	1.73±1.06	1.35±1.03	1.33±1.13
	Mean salary	2244.66±915.88	2089.47±870.96	2217.39±565.4	2306.45±1103.6	2290.00±1058.8	2330.77±846.00	2164.52±700.14
Handler	Nº	1.43±0.73	1.57±0.79	1.59±0.56	1.43±0.72	1.36±0.83	1.24±0.73	1.33±0.72
	Mean salary	1353.09±291.94	1300.00±254.45	1342.31±236.47	1349.01±294.00	1372.63±316.95	1453.33±300.51	1327.43±328.21
Cleaner	Nº	1.04±0.82	1.24±0.87	1.22±0.88	1.03±0.75	1.00±1.00	0.88±0.59	0.90±0.70
	Mean salary	1147.59±237.51	1156.47±171.74	1136.19±279.10	1154.44±196.47	1131.67±277.64	1116.15±159.99	1179.20±313.63
General services	Nº	1.02±1.24	0.81±1.10	0.89±1.07	1.05±1.27	1.27±1.29	0.94±1.00	1.05±1.49
	Mean salary	1309.77±290.57	1366.67±248.15	1321.67±298.01	1282.44±323.48	1323.08±273.92	1260.00±313.49	1342.27±231.74
Total/farm/month		11,286.48	12,124.39	13,224.33	10,748.23	11,306.26	9,862.71	10,745.92

Source: Authors.

Table 8. Total number of employees, total amount paid per month and per year, throughout the state of Rio de Janeiro and in the mesoregions.

Mesoregions	Mean monthly values (R$)	Mean annual values (R$)	Total monthly values (R$)	Total annual values (R$)
Coastal Lowlands (n=92)	2,391.76	28,701.17	220,042.30	2,640,507.62
Central Fluminense (n=144)	2,701.35	32,416.20	388,994.40	4,667,932.80
Metropolitan (n=292)	2,481.39	29,776.68	724,565.87	8,694,790.50
Northwestern Fluminense (n=134)	3,795.45	45,545.40	508,590.30	6,103,083.60
Northern Fluminense (n=89)	1,011.74	12,140.88	90,044.86	1,080,538.32
Southern Fluminense (n=97)	1,783.24	21,398.88	172,974.28	2,075,691.36
RJ (n=848)	2,436.77	29,241,24	2,066,380.96	24,796,571.50

FGV 1.00 U$ = 3.72 R$ (October/2018). Source: Authors.

Table 9. Mean and total monthly and annual values per stud farm per mesoregion for expenses of bulk feed in the state of Rio de Janeiro.

Mesorregiões	Total number of employees	Total value paid /month	Total value paid /year
Coastal Lowlands (n=92)	654.12	1,115,443.88	13,385,326.60
Central Fluminense (n=144)	1,042.55	1,904,303.52	22,851,642.20
Metropolitan (n=292)	1,833.76	3,138,483.16	37,661,797.90
Northwestern Fluminense (n=134)	901.82	1,515,038.84	18,180,466.10
Northern Fluminense (n=89)	530.44	877,781.19	10,533,374.30
Southern Fluminense (n=97)	621.77	1,042,354.24	12,508,250.90
RJ (n=848)	5,584.46	9,593,404.83	115,120,585.00

FGV 1.00 U$ = 3.72 R$ (October/2018). Source: Authors.

Concentrated and mineral supplements have a 63% higher expense than roughage feed. The average monthly expenditure per stud farm throughout State is R$3,976.00, varying from R$2,953.60 to R$4,373.60 between the Northern Fluminense and Coastal Lowland mesoregions (Table 10). The total annual investment in supplements ranges from

R$3,154,444.80 to R$14,506,174.60 between the Northern Fluminense and Metropolitan mesoregions, with a total annual amount of R$40,459,776.00 for the whole Rio of Janeiro.

Prices of the IEA and glanders vaccines and examinations were provided by the breeders and prices inconsistent with market value were taken from the database. For the variables that are without price in some mesoregions, the average prices of the state were used. Annual costs with vaccines and exams are higher in the stud farms of the Central Fluminense mesoregion (R$6,013.24) and lower in the stud farms in the Northern Fluminense mesoregion (Table 11). The average annual costs per stud farm throughout the state is R$5,331.50. The total annual investment varies from R$246,161.54 to R$1,638,409.08 for the Northern Fluminense and Metropolitan mesoregions, respectively. The total investment with vaccines and exams throughout the State is R$4,521,112.00/year

Table 10. Mean values, per stud farm, and total monthly and annual mesoregion values of the expenditures with concentrated and mineral supplementation in the state of Rio de Janeiro

Mesoregions	Mean monthly values (R$)	Mean annual values (R$)	Total monthly values (R$)	Total annual values (R$)
Coastal Lowlands (n=92)	4,373.60	52,483.20	402,371.20	4,828,454.40
Central Fluminense (n=144)	4,315.38	51,784.56	621,414.72	7,456,976.64
Metropolitan (n=292)	4,139.89	49,678.68	1,208,847.88	14,506,174.60
Northwestern Fluminense (n=134)	3,931.37	47,176.44	526,803.58	6,321,642.96
Northern Fluminense (n=89)	2,953.60	35,443.20	262,870.40	3,154,444.80
Southern Fluminense (n=97)	3,698.51	44,382.12	358,755.47	4,305,065.64
RJ (n=848)	3,976.00	47,712.00	3,371,648.00	40,459,776.00

FGV 1.00 U$ = 3.72 R$ (October/2018). Source: Authors.

The total annual investment in supplements ranges from R$3,154,444.80 to R$14,506,174.60 between the Northern Fluminense and Metropolitan mesoregions, with a total annual amount of R$40,459,776.00 for the whole state of Rio of January.

Prices of the IEA and glanders vaccines and examinations were provided by the breeders and prices inconsistent with market value were taken from the database. For the variables that are without price in some mesoregions, the average prices of the state were

used. Annual costs with vaccines and exams are higher in the stud farms of the Central Fluminense mesoregion (R$6,013.24) and lower in the stud farms in the Northern Fluminense mesoregion (Table 11). The average annual costs per stud farm throughout the state is R$5,331.50. The total annual investment varies from R$246,161.54 to R$1,638,409.08 for the Northern Fluminense and Metropolitan mesoregions, respectively. The total investment with vaccines and exams throughout the State is R$4,521,112.00/year.

Table 11. Mean value, per stud farm, and total value per mesoregion, of the annual expenditure with vaccines and exams, in the state of Rio de Janeiro

Mesoregions	Mean annual value (R$)	Total annual value (R$)
Coastal Lowlands (n=92)	5,449.90	501,390.80
Central Fluminense (n=144)	6,013.24	865,906.56
Metropolitan (n=292)	5,610.99	1,638,409.08
Northwestern Fluminense (n=134)	5,931.35	794,800.90
Northern Fluminense (n=89)	2,765.86	246,161.54
Southern Fluminense (n=97)	4,568.20	443,115.40
RJ (n=848)	5,331.50	4,521,112.00

FGV 1.00 U$ = 3.72 R$ (October/2018). Source: Authors.

The value of sales and some operational costs in the Mangalarga Marchador stud farms in the state of Rio de Janeiro and in each mesoregion can be evaluated separately (Table 12). The Metropolitan mesoregion showed the highest amount both in the sale of the animals and in the operational costs, followed by the Northwestern, Southern, Central, Coastal Lowlands and Northern mesoregions, respectively. Adding all the amounts spent, it is estimated that the Mangalarga Marchador horse breeding, in the state of Rio de Janeiro, has an annual cost of around R$650,778,296.00

Table 12. Total values for sales and expenses with operating costs, annually in Mangalarga Marchador breeders in the whole state of Rio de Janeiro and in each mesoregion.

Mesoregions	Sales	Labor	Roughage	Concentrated supplements/mineral	Vaccines and Exams
Coastal Lowlands (n=92)	34,524,099.60	13,385,326.60	2,640,507.62	4,828,454.40	501,390.80
Central Fluminense (n=144)	40,869,285.30	22,851,642.20	4,667,932.80	7,456,976.64	865,906.56
Metropolitan (n=292)	95,571,619.90	37,661,797.90	8,694,790.50	14,506,174.60	1,638,409.08
Northwestern Fluminense (n=134)	84,349,954.20	18,180,466.10	6,103,083.60	6,321,642.96	794,800.90
Northern Fluminense (n=89)	24,804,823.30	10,533,374.30	1,080,538.32	3,154,444.80	246,161.54
Southern Fluminense (n=97)	46,949,625.00	12,508,250.90	2,075,691.36	4,305,065.64	443,115.40
RJ (n=848)	465,880,252.32	115,120,585.00	24,796,571.50	40,459,776.00	4,521,112.00

FGV 1.00 U$ = 3.72 R$ (October/2018). Source: Authors.

Only 14.9% of the stud farms were setup based on a technical project, and of these, 30.8% of the projects were made by Veterinarians, another 30.8% by the owners themselves and the remainder by Equine veterinary technicians, Agronomists, Architects and others. About 70.4% of the breeders carry out a financial analysis of the breeding, and of these 56% declared that they had already obtained a financial return while 44% declared that they had not obtained a financial return yet.

When asked what was the greatest obstacle to the growth of the horse breeding in Brazil, 87.9% of the answers considered that the lack of skilled labor was the main reason, while 40.5% replied that the lack of technical and scientific knowledge was of importance, and the lack of government support came in 35.1% of the responses, which was followed by the inefficiency of the state, federal and international health aspects and by the lack of investments by private institutions, with 20.3 and 5.1% respectively.

4. Discussion

The main way to sell the animals throughout the State and in the mesoregions is on the farm, followed of the virtual, live, and online auctions, respectively. In the live auction category, the auction takes place in the same place as the animals and the buyers, the bids are received and made in real-time. In the virtual auction category, the trading session takes place via a TV channel, the lots are previously filmed, and the videos are transmitted at the time of the trading session, the bids are received and executed in real time. In the online auction category, the videos of the lots are exposed for a predetermined period on the website and the bids are received on the site, but the purchase is only made at the end of the auction period.

In relation to the costs of these auctions, the live auctions are more expensive than the virtual ones, which in turn have a higher cost than the online auctions. Therefore, the animals traded in the live auctions tend to have a higher value than those of virtual auctions, which, to a lesser extent, may have higher prices than the animals marketed in the online auctions. Therefore, it is normal for live auctions to have higher gross revenues than the other auction categories. Some breeders are joining a new way to sell on the farm called "shopping" or "animal fair" or "business day". The breeder sets up a ‘socializing event’ on the farm, showing the animals destined for sale. There is no bidding, but there are brokers or business advisors who intermediate the sales. It is a cheaper form of marketing than the auctions because it eliminates the expenses with auctioneers, inscriptions, recording, transportation of animals, sales charge, and other expenses. The brokers receive a commission from the seller,

but it does not reach the percentage of 8.5% of the sale value of the animal, charged not only to the seller, but also the buyer, in traditional auctions. For the buyer it is also cheaper because it frees him from paying the buying commission. On the other hand, the auctions, mainly the virtual auctions, give greater visibility to the production and trading can reach a much greater number of participants in Brazil and even from abroad.

Online auctions take in the lowest amount among marketing categories, despite selling more animals than the live auctions and direct sales at events that sell less than half in the number of animals but bring in almost double that of the online auctions (Figure 1). Online auctions have lower costs, so they sell fewer valuable animals, including discarded animals. While the direct sale at events is based on the interest of the buyer for some animal that has done well at an exhibition, therefore a superior animal. Usually more embryos/ovules or mating are sold of the animals that are competing. In the case of animals of high commercial value, it is common to sell quotas of the animal, where the buyer becomes a partner of the seller with quotas of 50, 33 or 25%. According to Vieira et al. (2015), the average number of horses marketed per farm was 17.4 animals per year, with the average value was R$11,500.00 per animal sold at auctions and R$4,500.00 at the farm. The authors reported that in the years 2008 and 2009, Minas Gerais took in over R$19,295,240.00 and R$16,953,720.00, respectively at horse auctions.

The categories of donor mare and stallion represent the highest values of unit sales. In many situations, stallions are traded in quotas, forming societies of 50, 33, 25 or even 5% of the quotas of the animal. Therefore, the average sales value of stallions may be influenced by this division, which was not accounted for in the survey. In the categories of young animals (foals and fillies), the sale of males is higher in number, both in the State average and in the mesoregions, but the values for females are much higher. This is mainly since there is greater selection pressure from the breeders for the males since they are being chosen for future stallions. The foals that do not pass in the selection are quickly sold to reduce the costs of production. That is why the demand for weaned foals, by dealers who resell animals, is great, since the market for saddle horses, for horseback riding, eventing tests etc ... is very heated. In addition, it occurs that foals that are not classified in the selection of large stud farms may become stallions of smaller breeders. Therefore, the search for foals by small and medium breeders is common and they can be rebranded and become their breeding stock. It is a way to buy a future stallion at an affordable price when still a foal.

The mean value of the recipients varies little between the mesoregions, with a low standard deviation or even zero. However, in the Coastal Lowland and Metropolitan

mesoregions, the sales volume in this category is high. This may be due to the fact that in these regions there is a lot of trade between small breeders, mainly with a profile for recreational activities, and these mares end up being marketed as a saddle animal and not as recipients. The Metropolitan mesoregion has the largest sales volume, since it has the largest number of farms. However, it is important to note that the Northwestern Fluminense mesoregion, which has the second largest sales volume in terms of numbers of animals, has the highest average sales per breed per year, reaching almost double the metropolitan region. In addition to having large stud farms, this mesoregion benefits from the proximity to municipalities in the Zona da Mata of Minas Gerais State, where the Mangalarga Marchador breeding tradition is very strong. The Coastal Lowlands mesoregion has a high average for the total number of animals marketed per stud farm but does not have a high number of stud farms as in the Metropolitan and Northwestern Fluminense mesoregions, so the total sales value is lower.

The total amounts paid to the employees mentioned in this paper do not include labor costs, holidays, and 13th salary. Therefore, by including these items in the calculation, the amount paid would be higher. It should be noted that there is little variability between the average values of wages paid, within the categories, by mesoregions. The average total cost of employees varies between the mesoregions in line with the variation in the average number of employees per farm. Therefore, the cost increases as the number of employees increases. It is important to remember that more than 60% of the contracts of professionals providing technical advice (Veterinarians, Agronomists etc ...) are temporary, which allows them to work at more than one stud farm and even in other activities. Therefore, the mean salary described for these professionals is equivalent to the income in each contract, that is, in each stud farm for which they aid.

Brazil (2016) estimated that the category of sport and leisure horse generated around 125,700 direct jobs. According to Vieira et al. (2015) the activities involving the breeding of horses in Minas Gerais employed around 86,000 people and the average salary was around 1.5 ± 0.51 minimum wages. Vieira (2011) estimated that approximately 514,000 horses consumed commercial concentrate in the state of Minas Gerais, at an annual cost of R$171,979,882.00. In addition, the annual financial turnover for the consumption of salt in the State is around R$22,447,692.00. Brazil (2016) estimated that horse breeding consumes, annually, the equivalent of R$96 million in oats, R$45 million in alfalfa and R$83 million in mineral salt and supplements, and furthermore the formulated feed in the stud farms presents an estimated value of R$220 million per year and hay (except for alfalfa) corresponding to

R$193 million. In addition, it is estimated that the value of the equine feed market is around R$780.8 million/year.

According to the interviewees, the labor force is expensive and does not have the expertise to work in a sector with high investment costs such as horse breeding. In addition, the breeders complain that there is no better transfer of knowledge from surveys to guide production of the stud farmers. According to the interviewees, there are no public or private investment schemes to encourage horse breeding, such as lower interest rates for financing materials and inputs, as exists for other agribusiness sectors. Also, among the actions of government agencies, there is a lack of seriousness with sanitary issues, which is a concern for the producers, because it damages the trade and burdens the market with costs of examinations and certificates.

5. Conclusions

The state of Rio de Janeiro is the second largest producer of Mangalarga Marchador horses in number of breeders, number of exhibitors at national exhibitions of the breed and number of animals registered with the ABCCMM. Sales on the farm, followed by live auctions, are the two top categories for the commercialization of animals, live mating, and embryos. The cost, however, of the live auction is higher. The categories of sale of live mating and weaned foals are responsible for the largest volume sold per year. The categories of mare donor and stallion present the highest average sale values.

The Metropolitan and Northwestern Fluminense mesoregions are the ones that generate the largest financial amounts with the Mangalarga Marchador horse trade. The Northwestern Fluminense mesoregion presented the highest averages per farm, both in income and in investments. The average number of sales per stud farm/year corresponds to R$385,667.90 in the State and the average of total values traded in the state of Rio de January is R$465,880,252.32/year. This study shows that, not considering the cost of the capital invested, the largest expense within a property is labor, followed by concentrated feed, forage, and vaccines/exams. The agribusiness of the Mangalarga Marchador horse in the state of Rio de Janeiro spends more than R$650 million per year and employs more than 5,580 people directly.

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