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ANALYSIS OF LAND USE AND NATURAL RESOURCES IN BEEF CATTLE IN BRAZIL: A STUDY WITH MULTIVARIATE TECHNIQUES

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Abstract: Brazil occupies a position of respect at the national and global levels in the beef livestock ranking, since it has had a significant share in this market in the last 50 years. Effectively, the beef production chain in Brazil has a real impact on the agribusiness economy and the country. The regional contrasts observed along this business chain make it possible to carry out a qualitative and quantitative analysis, in order to understand the practice of land occupation in Brazil, making it possible to record the real exploratory action and its models of use. For the diagnosis of the current situation of the stage of occupation of the territory for the livestock activity in Brazil, information of secondary base was systematized with the aid of techniques of multivariate analysis. The present study proposed a delimitation of the research sample, based on the Federation Units. A heterogeneous regional situation was detected for the occupation of spaces used for this activity, in addition to suggesting the existence of different production systems with different symptoms that point, in general terms, to the modernization of beef cattle in the country in recent decades.
Keywords: Arc of deforestation, beef cattle, agricultural frontier, land use, natural versus planted pasture.

INTRODUCTION

Currently, Brazil occupies a position of respect at the national and global levels in the beef livestock ranking, since it has a significant share in this market. It is one of the main segments of Brazilian agribusiness (CARRER, 2000, p. 9.

The present study was also supported by official statistical data offered by several other surveys (such as the municipal, state and sectoral databases), in addition to the collection of information in scientific literature that made it possible to better analyze the "state of the art" for the different production systems. due to temporal disparities in the business environment for the Brazilian beef cattle chain.

Through the study of the beef production chain in Brazil, with data from the 2006 Agricultural Census, compared to more recent partial surveys, it is recommended to understand, over time, the production dynamics of the different regions and their Federation Units. For that, Variables were constructed with parameters that inform the type of occupation of the territory and pattern of the pastures, in addition to other factors consequently intertwined, aiming, through the interpretation of the data, to understand the dynamics of this production chain with a direct impact on the occupation of a large part of the land. Brazilian territory.

The aim of this work was to generate possibilities to study, from an analytical point of view, the problem facing the exploitation of large agropastoral areas in the country, seeking to portray the scenario as close as possible to the current one.

With this, the research sought answers to the current situation of part of the resources applied to the segment, in order to realize the potential of the use of these areas for the beef cattle of the future, which is desired sustainable and economically, socially and environmentally viable.

THEORETICAL REFERENCE

At the end of the 1970s, livestock farming began to be used by large landowners for land tenure, aiming at exploitation with an extractive profile, without any concern with investments or corrective measures of technological origin (FRANCO et al., 2014).

From 2004 to the present day, the country has consolidated itself among the largest beef exporters in the world, with sales in more than 180 countries (BRASIL, 2013), second only to

India (ABIEC, 2017).

> The expressive importance of the socioeconomic aspect of this livestock activity in the national territory has been gaining more evidence and appreciation in recent decades, precisely because it meets a large part of the demand of the foreign market, in addition to concentrating consumption in the domestic sphere. It is estimated that around 82% of what is produced in beef in the national territory is equivalent to local consumption (BARBOSA, 2014a, p. 134).

According to Barcellos et al. (2004), beef cattle has undergone intense transformations, resulting in expressive results in production and productivity, however, without abandoning its traditionalist profile of generating new areas for pasture from the creation of new agricultural frontiers. This observation directs the present study to the central objects of analysis, which have as their essence a cautious and critical look at the use of productive space due to the interference of producers on the existing pasture areas in each region or intra-regional production system.

It seeks to understand how the spatial occupation that provides such pastures takes place and, as the most important themes, what is the correlation between the pasture area and its peculiarities of use, as well as the results and pointed out through the amount of meat obtained, since, at the same time that positive production and productivity data are recorded, the projections of conflicting relationships between producers and the preservation of the environment's potential in the long term also grow.

According to Barbosa et al. (2014a, p. 327), it is possible to verify that 88% of cattle production in Brazil is carried out exclusively on pasture, which is formed almost exclusively by exotic species. In this regard, it is necessary to take into account what Zanine & Macedo Jr. (2006), that, since the use of pasture is the most economical and practical method for beef cattle, it becomes a priority to intensify the use of forages by improving the availability and consumption of its nutrients.

In view of this, it is interesting to carry out an analysis of the pre-judgments carried out in the past by entrepreneurs, for the adoption of the most viable soil, pasture and animal management practice for each temporal result found (CANDIDO & CARRER, 2014).

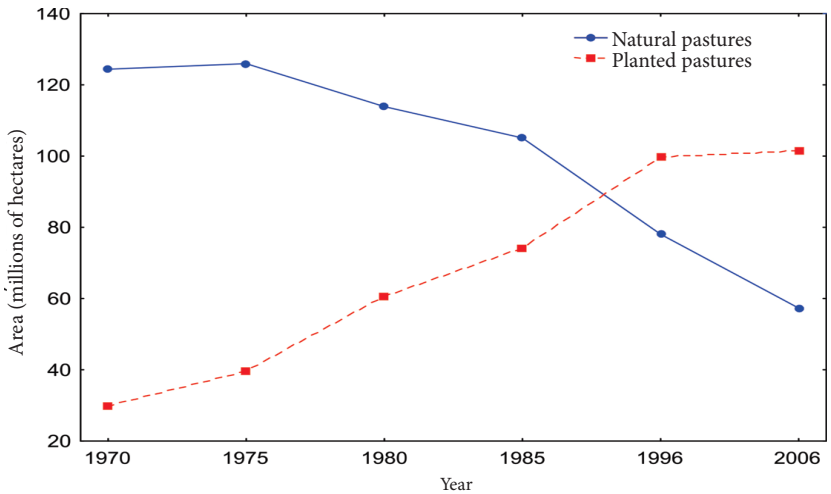

Figure 1 - Evolution (in millions of hectares) of natural and planted pasture areas in Brazil between 1970 and 2006.

Source: Adapted from IBGE (2007).

According to Barbosa et al. (2014b, p. 337), as it is a pastoral ecosystem, the proper management of the pasture area requires knowledge and mastery of systemic factors from the producer, with the soil element being the basic structure for sustainable production. It is necessary to consider that soil degradation requires spending on pasture recovery, thus increasing investments to make production viable. In the absence of these conservative investments, the sustainability of the production system is directly compromised (FERREIRA & ZANINE, 2007).

More and more facts are evidenced that can be used as justifications that demonstrate the need for a critical look at the act of producing beef on pasture, at the same time that attitudes of concern with questions and data before not much considered within the beef cattle universe, such as aspects linked to the sustainability of the process with animal welfare tactics throughout the entire business chain. This new scenario evidences the consolidation of a productive structure that is gradually making its effectiveness clear through the results obtained and leaving behind its archaic past and resistant to changes.

His way, a conflicting reality is configured, between assumptions for the creation of new agricultural fronters that advance as a result of the need to expand areas and the optimization of livestock competitiveness. This ends up directly interfering in the methodology adopted in the spatial occupation of the soil and in the search for new solutions to meet an intensification of the sector, without necessarily harming environmental aspects and contextual heritage, also influencing the economy that is directly related to the production chain. Therefore, it is possible to observe that (CARRER & CARRER, 2014, p. 645):

> The form of expansion of modern livestock, up to the current stage of development, seems to establish deep links with the historical process of occupation of our agricultural frontiers, strongly influenced by the extensive exploitation of large properties, with clear reflections on the land and labor market. The idea that Brazilian beef cattle maintains the characteristics of stagnation, resistance to innovations and archaic management, which marked the activity in the recent past, is opposed, when one observes the repositioning that the activity has been undergoing [...] in the last years.

In summary, the Brazilian territory has a total area of 851,487,659 hectares, with the Legal Amazon occupying 61% of this total. Based on what was exposed in the literature review, answers were sought that help to understand the dynamics of spatial occupation of the territory (considering the aspects of area extension and predominant vegetation type) versus the resultant in the beef cattle activity in the recent past.

MATERIAL AND METHODS

They were systematized, in this work, from the data found in different sources of the Brazilian agribusiness segment (ABIEC - Associação Brasileira das Indústrias Exportadoras de Carnes, ANUALPEC - Anuário da Pecuária Brasileira, CNA - Confederação da Agricultura e Pecuária do Brasil, CONAB - Companhia National Supply, FAO - United Nations Food and Agriculture Organization, MAPA - Ministry of Agriculture, Livestock and Supply, MMA - Ministry of the Environment and PPM - Municipal Livestock Production), information that aims to combine a systemic view of the current situation for the exploitation of these natural resources.

We sought to complement the research information based on sectoral surveys with

a more spatially localized reach (such as the Municipal Livestock Research - PPM and the Survey of Agricultural Production Units in the state of São Paulo - LUPA) or data sources generated by unofficial entities that reinforce and support this study, such as CEPEA and LAPIG. It must dalso be noted that the research was carried out entirely based on secondary data (already published) and that it did not require prior authorization from the Research Ethics Committee of the Faculty of Animal Science and Food Engineering (FZEA) of the University of São Paulo, Pirassununga Campus.

These sources served as a comparative and guiding basis to investigate aspects of the sector in two temporal moments, such as the capacity of each Federation Unit for the production of bovine meat, from the characterization of its pasture areas, namely: the) The bovine herd of each Federation Unit and its participation at the national level; b) The "Number of Establishments" (QET) with beef cattle activity, their area dedicated to the sector and their "Location Rate" (TL); c) "Areas of Pastures" (AP), "Areas of Degraded Planted Pastures" (APPD), "Areas of Pastures Planted in Good Condition" (APPBC), "Areas of Pastures Planted in Good Conditions x Rate Areas" (APPBxTL), "Areas of Natural Pastures" (APN), "Areas of Natural Pastures x Stocking Rate" (APNxTL), "Areas Planted with Forages for Cutting" (APFC), and, "Areas of Livestock and breeding of Other Animals" (APOA).

The observations presented by the Variables were applied to the twenty-seven (27) individuals considered in the present study and represented by the National Federative Units (STATES). The analysis was conducted using the methodology of multivariate techniques, with emphasis on observation in Principal Component Analysis (PCA). For this, the computer program called "STATISTICA", version 13.0, from Dell Inc., USA, 1984-2015 was used.

RESULTS AND DISCUSSION

After the selection of the study data, the visible expression of the factors and their respective eigenvalues gave rise to the following variances shown in Table 1.

It is possible to observe the importance and participation of three factors that were obtained in the analysis "Factor in Principal Components", passing these to express greater representation in the percentage of variance, with 55.1%, 18.9% and 9.1% respectively, causing an explanation of 83% in the total variance of the data.

Therefore, these first three factors allow for the explanation of most of the variance of the data highlighted in figure 2. This level of explained variance in relation to the total

Factors	Eigenvalues	Variance (%)	Accumulated values	Accumulated Variance (%)
1	8,261453	55,07635	8,26145	55,0764
2	2,833043	18,88696	11,09450	73,9633
3	1,366852	9,11235	12,46135	83,0757

Table 1 - Results of the calculation of eigenvalues and percentage of total and accumulated variances, for the three factors of the 27 individuals (STATES) and 15 variables related to the beef cattle panorama for the 27 STATES of the country.

Source: Study data.

sample variance allows for sufficient-scientific accuracy to seek answers to the study and dispense with the use of other factors calculated at from the fourth factor.

After extracting the elements obtained in the "Factor in Principal Components" analysis, it is possible to observe the correlation indices obtained between the Variables and their factors in Table 2. They were considered as positive and existing to try to explain the phenomena interpreted in this analysis, correlations that exceeded 60% of expression.

Factor 1 explains 55% of the total variance of the data and has positive correlations with the variables: "Area of Establishments" (AE); "Pasture Areas" (AP); "Areas of Degraded Planted Pastures" (APPD); "Areas of Pasture Planted in Good Condition" (APPBC); "Pasture Areas Planted in Good Condition x Stocking Rate" (APPBxTL); "Natural Pasture Areas" (APN); "Natural Pasture Areas x Stocking Rates" (APNxTL); "Areas Planted with Forage for Cut" (APFC); and, "Areas of Livestock and Breeding of Other Animals" (APOA).

It is possible to infer that Factor 1 defines the EXTENSIVE PRODUCTION SYSTEM of the beef cattle production chain in Brazil, being intrinsically linked to the use and extension of pasture areas, as well as their characterization as a system mostly used, even because, As it was already observed in the information from ANUALPEC (2015), it is possible for the rancher who uses the formation of pastures in an "extensivist" character, to consume lower investments for this purpose. So, if extensive livestock farming is more practical to produce quality meat (FERREIRA & ZANINE, 2007), more economical (ZANINE & MACEDO JR., 2006) and relatively successful (DIAS-FILHO, 2014), the importance of given the "extensivist" behavior that beef cattle has historically demonstrated, allied to the low cost necessary to achieve production objectives; these being expressive results in agreement with what Barcellos et al. (2004).

Factor 2, on the other hand, explains 18.9% of the total variance of the data and expresses positive correlations with the variables: "Number of Establishments"

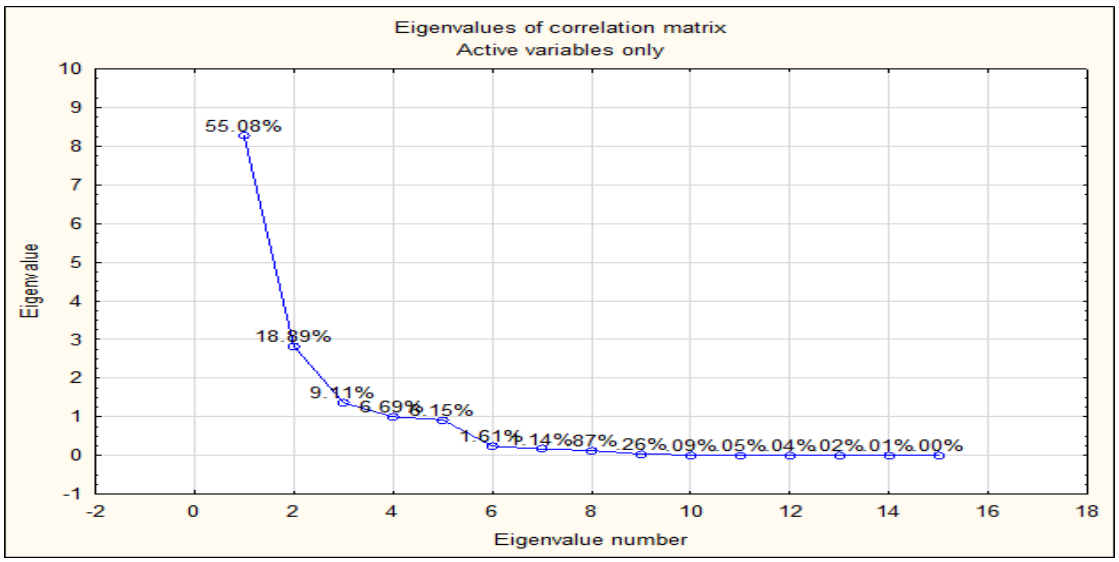

Figure 2 - Eigenvalues Correlation Matrix (active Variables only) - Eigenvalues x Number of Eigenvalues.

Source: Study data.

	Variables	Factor 1	Factor 2	Factor 3
V1	QET	0,432366	**-0,601961**	-0,301695
V2	AE	**0,959098**	-0,092335	-0,122745
V3	AP	**0,985298**	-0,052723	0,013041
V4	AP%	0,527911	0,136502	**0,661078**
V5	APPD	**0,935274**	0,085740	0,000689
V6	APPD%	0,581048	0,498272	0,277266
V7	APPBC	**0,940525**	0,214702	0,037502
V8	APPBC%	0,584980	**0,711650**	0,127947
V9	APPBxTL	**0,908561**	0,291332	-0,060505
V10	APN	**0,777389**	-0,556912	-0,042177
V11	APN%	-0,218968	**-0,778581**	0,474685
V12	APNxTL	**0,724063**	-0,512606	-0,179417
V13	APFC	**0,732435**	-0,448492	-0,065250
V14	APOA	**0,961821**	0,018841	0,017873
V15	TL	0,049064	0,408779	**-0,679252**

Table 2 - Correlation coefficients between the 15 variables related to the beef cattle panorama for the 27 States of the country.

Source: Study data.

(QET), "Pasture Areas Planted in Good Condition in %" (APPBC%) and "Natural Pasture Areas in %" (APN%). It can be defined as IMPROVED GRAZING SYSTEM, and the variable "Number of Establishments" (QET) presents a direct correlation related to "Natural Pasture Areas in %" (APN%), demonstrating that areas with this profile in an increasing number of establishments in Brazil. According to Barbosa et al. (2014a, p.327), pasture with planted (or artificial) species is, for the rancher, the exclusive tool for supplying 88% of the national herd of cattle. Likewise, it is necessary to consider that for an appropriate management of the pasture area, a systemic knowledge of the elements that are part of the context is required (BARBOSA et al., 2014b, p. 337).

Thus, it is possible to infer that the variable "Areas of Pastures Planted in Good Condition in %" (APPBC%) in Brazil has been increasing; characteristic inversely proportional to "Natural Pasture Areas in %" or native (APN%).

It appears, therefore, that despite the instability with regard to livestock costs (ARAÚJO et al., 2012) there is a notable evolution of technical indices in the beef cattle industry, although strongly influenced by economic factors, political, demographic, environmental, behavioral, in addition to strictly technological aspects (CARRER & CARRER, 2014).

It is not possible to state with 100% certainty that a higher rate of "Planted Pasture Areas (exotic or artificial) in Good Condition" (APPBC) is exclusively associated with the increase in beef production in the Brazilian herd, as observed in theoretical framework, but this is a very acceptable trend as one of the results of the application of multivariate data analysis techniques in this work. Data from

IBGE (2007) provided enough information to confirm an improvement in the grazing system, when they pointed to a stocking rate of 0.62 AU/ha in 1975, a significant increase to 1.19 AU/ha in 2006; and finally, these data are compared at the 1.25 AU/ha reported by ABIEC (2016).

It is necessary to reinforce that the growing implantation of artificial pastures in the intertemporal interval that the research qualitatively approaches (year 2006 versus year 2015) is remarkable, to the detriment of the use of natural pastures in productive establishments. This statement supports the quantitative findings of the research in relation to the IBGE Census database for the year 2006.

Factor 3 achieves the explanation for 9.1% of the total variance of the data and expresses positive correlations with the variables: "Pasture Areas in %" (APN%) and "Lodging Rate" (TL). The "Housing Rate" (TL) is considered to be the result of the calculation of the relationship between the number of head of cattle (or animal units = AU) and the area occupied by them (in hectares). Thus, Factor 3 can be characterized as an indication of the level of TECHNOLOGY applied to the beef cattle activity, as it suggests that the percentage of pasture area is inversely proportional to the stocking rate. This record shows that the productive system that contains a higher technological level tends to present a higher rate of stocking in herds in relation to those with a markedly "extensivist" characteristic.

Therefore, a higher stocking rate means that a greater amount of technology is being employed and that, in the sequence of events, it saves the land factor among those important factors of production within a productive system (land, labor, capital, technology and entrepreneurship).

According to Braga (2010), it is not possible to say that all farms are achieving satisfactory productivity, or even presenting a competitive profile demanded by the market, however, many others have been developing an increasing pace of modernization.

To conclude this moment of careful observation about the challenges inherent to the beef cattle activity, it is essential to consider the fact that the country is distinct as a consequence of the territorial extension and that, as a result, attempts to break with the traditionalism in the segment, can be followed by failures taken by heterogeneous content, as a consequence of territorial proportions (MONTAGNER et al., 2014).

FINAL CONSIDERATIONS

The analysis of the various indicators that sought to portray the recent situation of beef cattle in the country, showed that, fundamentally, this activity has sestadosfered, since its historical genesis, a process of differentiation that establishes, at the beginning of this century, a situation of great inter-cultural differences. -regional in relation to the stage of development of this activity in the country. This is a highly heterogeneous situation that has been established by multifactorial interaction, where historical, social, economic and natural aspects are present.

The multivariate analysis of the data also allowed the characterization of three factors trying to explain different production systems or technological level used in the occupation of the territory, namely: a) Extensive System, which was characterized by the existence of large properties, most of the times explored in extensive, with large herds of cattle and normally suitable for cutting; b) Improved Grazing System, which was characterized by the existence of properties that expanded their herds and their scale through the efficient use

of planted and more productive pastures, often of mixed exploitation (meat and milk). This system was characterized by livestock with a lesser "extensivist" characteristic and often exploited in conjunction with agricultural activity, through the use of leftover crops or in the form of cultivated pastures; and, c) Level of Technology Employed, which in a very specific way represents the main improvement indicator (capacity rate) that could be used in this work.

Normally, demographic pressure in many Federation Units results in a large increase in land prices and only allows the exploitation of more intensive cattle ranching in the fattening regime, either in finishing pastures or in systems of confinement of the herds. As a conclusion, it is important to corroborate the fact that, unfortunately, the data studied may sestadosfer great variation in results for the future, due to the recent pressures of deforestation in Brazil after 2018.

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