

Cattle traceability: from the pasture to the port³

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Abstract—Agribusiness for thirteen consecutive years, since 2001, has fueled the Brazilian economy, a growing sector that needs investment in infrastructure and technologies to strengthen it and make it more competitive. To keep up with the current global scenario, which together with the ease of transmission of information, the consumer is becoming increasingly aware and demanding in relation to food.

This scenario stimulates the reorganization of activities of the meat supply chain, by tracking technology across all links in the chain. Allowing the entire chain to receive accurate information and quality, for fast information responses and offering the consumer an assurance where the meat is obtained, so that it is ensured quality.

The objective of this work is to present the economic importance of the export of beef to the economy of Brazil, the progress in this sector, the growth projections for the coming years and the need to insert traceability technology into the livestock sector. Traceability technology will contribute to safer and more efficient growth, increase the chances of competitiveness in foreign markets and ensure the quality of the product in the domestic market.

Keywords—agribusiness, cattle ranching, logistics transportation, slaughter not supervised, traceability.

I. INTRODUCTION

AGRIBUSINESS contributes significantly to economic growth in Brazil, with an average of 25% of the country's total Gross Domestic Product (GDP). Of the 10 main products exported, seven are agribusiness [1-2].

Cattle raising is a growing sector, with great commercial importance. The market for this sector has proven more favorable every year. And for the sector to get new buyers and develop safely, we must face challenges with increasing production meat, estimated at 2% year by 2024 with the totaling 13,1milhões tons, ensure environmental sustainability and product quality (cattle) provided by the end user [3].

The foreign market consumed on average 20% of the total meat production in Brazil and requires strict sanitary protocol, contributing to the surveillance. The balance of 80% of production is destined for domestic consumption, and the monitoring does not follow a pattern. Throughout the country,

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³ This paper is a extended version of Cattle traceability: from the pasture to the slaughterhouse

75% of the slaughter of the Brazilian beef production is subject to Federal control for marketing of meat for export, 17% of slaughter is subject to State control for marketing of meat within the limits of each state and 8% of slaughter has Municipal control for marketing meat within the limits of the municipality. The lack of a unified sanitary protocol for supervising the slaughter decreases the credibility of the quality of meat offered for consumption internally [4].

The Transport logistic beef supply chain is a known bottleneck for export competitiveness as the costs incurred with the logistics of transport are transferred to the final product decreasing competitiveness and buyer confidence. The corresponding costs are: (i) delays and waits, equivalent to 0.60% of the revenues of the manufacturing industry, which means a total cost of \$10.2 billion a year; (ii) costs of storage, in turn, equivalent to 0.04% of revenues annually and add a cost of \$675.0 million and (iii) high extra expense with fleet maintenance: 0.36% of revenues, which means an annual cost of \$6.2 billion in the manufacturing sector. " [5-6]

The objective of this study is to present the importance of a pattern in the Brazilian supply chain of beef, in the transport process of the product (cattle) provided to producer (refrigerator) and trade (retailer / exporter), tracking all routes of transport from the departure of the pasture until the cargo arrivals at its destinations.

Included in the proposal is the automation of the logistics chain in transportation between the macro steps of supply and production in order to: (i) guarantee the origin of the product, promoting reliability; (ii) auxiliary in the process of the cargo's release; (iii) cooperate with the reduction of the production cost and (iv) reduce the incidence of illegal refrigerators.

This paper is divided into six sections, including this introduction. The second section is an analysis of the economic importance of beef exports to Brazil. In the third and fourth section presents studies on logistics in the livestock Brazilian as well as the cost of transport logistics within the beef production chain. In the fifth section presents studies ab

out traceability and its contribution to improving the transportation of the product and the slaughter studies not inspected in Brazil and the proposal to reduce this incidence. In the sixth section contains the conclusion and final considerations.

II. ECONOMIC IMPORTANCE OF THE EXPORT OF BEEF TO BRAZIL

Macroeconomic events in 2014 impacted the Brazilian economy in a negative way. withinflation close to the ceiling

of the target set, a slowdown in industrial activity and trade balance at uncomfortable levels [7].

But among all these difficulties, agribusiness in Brazil in 2014 had reason to celebrate. Last year Brazil celebrates 100 years of beef exports. The first export took place in 1914, 200 tons of frozen meat was shipped to England, from the port of Santos through the Companhia Frigorifica e Pastoral [7-8-9].

The export of Brazilian beef, in 2014 closed the year with \$ 7.2 billion in revenue, according to data released by the Brazilian Association of Meat Exporters (Abiec - acronym in Brazil) on January 08, 2015. Compared to 2013, there was an increase of 7.7% in revenue; 3.3% in the volume exported totaling 1.56 million tons; 9% growth in exports to Hong Kong, totaling 400.5 tons and 3% for Russia, total of 314.6 tons, our main buyers account for some 50% of exports. As in Table1. [10-11]

Table 1 - Results for the top 10 exporting countries [10].

Ranking	Country	Billing US\$ (January to February 2014)	Volume in tons (January to February 2014)
1	Hong Kong	1.711.839.321,14	399.973,89
2	Rússia	1.314.093.693,40	314.672,41
3	European Union	928.514.318,35	127.442,31
4	Venezuela	900.806.593,06	169.599,51
5	Egypt	611.331.607,82	165.831,77
6	Chile	286.924.277,34	55.225,52
7	Iran	274.764.475,21	61.570,59
8	USA	231.357.572,53	22.214,31
9	Angola	118.374.094,78	37.442,68
10	Algéria	100.531.196,77	21.044,52

jobs created in the country and on average 25% of GDP (Gross Domestic Product).[10-13-14]

In 2014, Brazil grew by 0.1% of Gross Domestic Product (GDP) the sum of the wealth produced in Brazil totaled R\$ 5.52 trillion, the agricultural sector contributed 0.4% in economic growth, totaling 262 billion. [15]

In the same period, agriculture accounts for the herd with approximately 210 million cattle head, which ranks Brazil as the largest commercial herd in the world, second largest beef producer, with production of 10, 07 million tons, and the first in export with 2, 09 million tons, maintaining its leadership since 2008. [15-16]

Cattle ranching continues to grow, even with the drop of 3.2% of agribusiness products in the total export, which closed the year 2014 at \$ 96.5 billion [17].

According to data published on December 08, 2014 by the Ministry of Agriculture (MAPA - acronym in Brazil), agribusiness contributed \$ 6.13 billion, for Brazilian economy, 40% of the total Brazilian exports in the period between December 2013 and November 2014. [18]

In this period, the meat sector ranked first in terms of export value, with \$ 1.43 billion. Of this total, US \$ 555.98 million were to the beef [18].

Brazilian cattle raising is favorable for investments over the next nine years. According to studies conducted by the Ministry of Agriculture, Livestock and Supply (MAPA - acronym in Brazil): "Agribusiness Projections: Brazil 2013/2014 to 2023/2024", released in September, 2014, the results are very favorable for the period of 2013/2024; the projection of total growth of meat production is 30.3% and outlook of the grow for beef is 22.8% of production, 15.6% for consumption and 39.7% for export [49]. As in figure 1.[3-19]

Brazilian Beef Perfil 2014

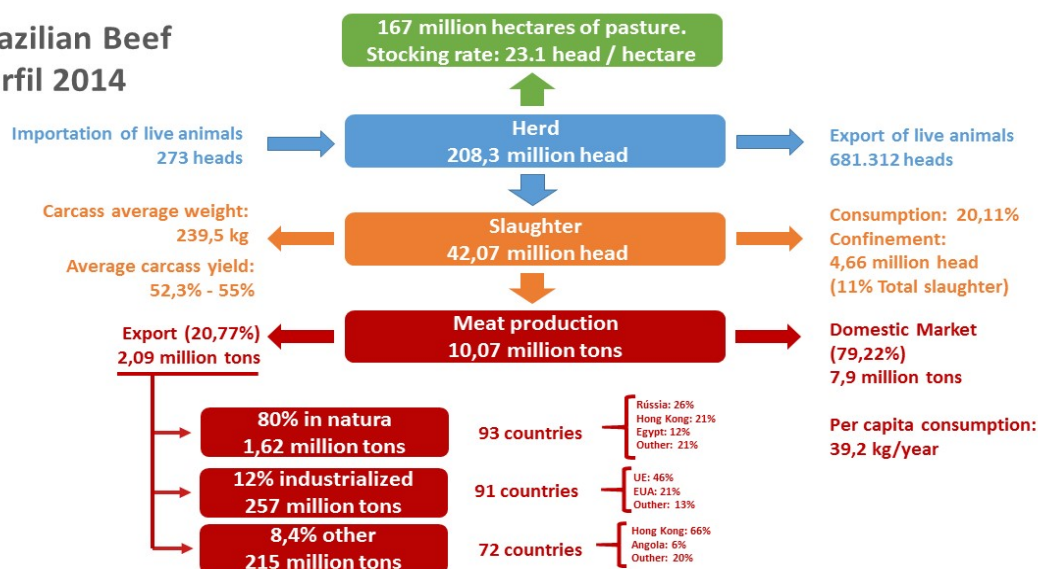


Fig.1-Brazilian Beef Profile 2014 [19].

Agribusiness in Brazil contributes fundamentally to the economy and growth, accounting for 40% of exports, 37% of

The Brazilian agricultural industry is growing and investing in technologies, with a high degree of national content, facilitating the process of communication between all links in

the beef production chain. Technologies aims to promote safety in the production process, the credibility of the quality and value of the product (cattle). These investments boost the Brazilian economy to enhance competition in the market with the conquest of new trade routes to export meat, opening new markets for sale of the product (cattle) and confidence for domestic consumption. In this context, two projects developed with Brazilian technology stand out:

1. CTC 11002, the project developed by National Center for Advanced Electronic Technology (CEITEC - acronym in Brazil), also known as "Chip do Boi", uses integrated circuits that allow you to identify, track and authenticate individual cattle on pasture, recording and monitoring all product development (livestock) to be marketed. The device technology consists of a plastic earring used as a basis for encapsulating the chip with Radio Frequency Identification - RFID 134KHz LF. The project objective, economically, is to reduce the cost of earring, used for cattle identification, between 30% and 35% and the production target of 70 million units per year. Contributing to traceability within the Brazilian beef supply chain. [20-21].



Fig.2 - Kit "Chip do Boi" [21]

2. "Canal Azul", a project developed in partnership with the Brazilian Association of Meat Exporters (Abiec - acronym in Brazil); Polytechnic School, University of São Paulo (EPUSP - acronym in Brazil); Institute for Software Technology (ITS - acronym in Brazil); Financier of Studies and Projects (FINEP - acronym in Brazil); National Center for Advanced Electronic Technology (CEITEC - acronym in Brazil); and the Ministry of Agriculture, Livestock and Supply (MAPA - acronym in Brazil).

The technology used in the project contains, basically: (i) Electronic Seal: Composed of a TAG (chip + antenna) with radio frequency identification (RFID) UHF, with the objective of seals the container loaded ensures the health and integrity load; (ii) Channel Electronic Blue (CA-e): Existing documentation only in electronic form that

contains all the information required for all cargo shipment in Brazilian ports, the producer (refrigerator) records the information on the chip, the electronic seal, which follows with the load to the port and also distributes to the tax agency involved in the operation, streamlining the bureaucratic process in the analysis of the necessary export documentation. [22-23-24-26].

This project's economic potential is the reduction of the average time analysis to document the release of the shipment, reduce operating costs and contribute to increased competition for export.

Process details in: (<http://globo.com/tv-tem-interior-sp/nosso-campo-tv-tem/v/exportacao-de-carne/3163850/>). [27]

III. LOGISTICS IN THE BRAZILIAN LIVESTOCK

Logistics emerged as part of the military art, an activity used since biblical times. The wars were long and distant, and a need for planning, organization and execution of activity for displacement of troops, weapons and food arose. In the twentieth century this art was highlighted by efficiency in two major conflicts, the 2nd World War, globalization designing the logistics in the international framework and the Gulf War, for its location and the special characteristics of the operating environment. [28]

We can reflect the importance of logistics in general scope within the definition used by the Brazilian army:

"On several occasions, logistics, more than other operating systems, was the determining factor of wins and losses, suggesting that the final results of operations are clearly influenced by logistics and by better capacity to manage this system" [28]

In economics, logistics went through five phases to reach the scene experienced today, based on studies conducted by Braz, 2004 [29], the stages are defined as:

The first phase called "Field to Market, beginning in the twentieth century to the 1940s, had as its main focus shipping to flow in agricultural production.

The "Segmented Features was a name given to the second phase which began in the 1940s to early 1970s, with emphasis on functional performance in the flow of materials, storage and transportation of goods.

The third was called "Integrated Functions" with the opening in the 1970s to mid-1980s, it was a period focusing on the integration of industrial operations, noting the practice of logistics linked to integrated management in the transportation activities, distribution, storage, control inventory and material handling.

The fourth phase goes from 1980 to the mid-1990s. "Customer Focus" is marked by the need to meet the expectations of its customers, emphasizing productivity and inventory costs.

The current and fifth phase, beginning in the 1990s, labeled

"Logistics as Differentiator Element", linked phase globalization and information technology and where arises the concept of Supply Chain Management (SCM).

"SCM is based on the belief that efficiency throughout the distribution channel can be improved through information sharing and joint planning among its various agents" [30]

Supply Chain Management aims to integrate the production chain links, planning and controlling the various operational activities so that the production flow between organizations continually occur synchronously, from suppliers to the end customer. Thus fulfilling the goal of integrated logistics in putting the right product in the right place at the right time and on the terms desired by the customer. Contributing to accurate and reliable feedback information, benefiting everyone involved in the chain. [31]. As illustrated in Fig.3.

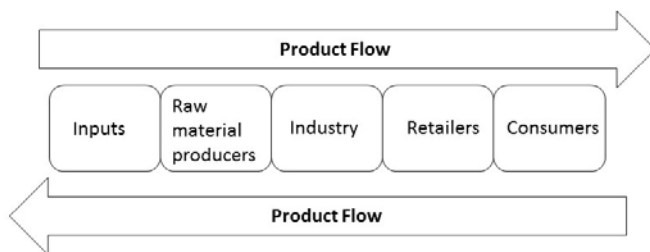


Fig.3 - Adapted by 31.

Brazilian beef cattle stand out internationally, for its competitive potential, and nationally as an important generator of wealth. The inclusion of technology in all operating systems, to cooperate with the coordination and communication between the different links that comprise the meat supply chain it is a necessary way to promote the competitiveness of the supply chain, contributing to the speed of decision-making, thereby reducing costs and adding value to the product (cattle).

The structure of production in the beef supply chain for export is formed by different agents divided into five operating systems: Support system defined by the of basic input suppliers and carriers agents; System of production of the raw material, defined by the of cattle ranchers of creates, recreates and fattening of the product (cattle); (i) System of Industrialization defined by refrigerators agents responsible for the slaughter, cutting, packaging, storage and shipping of the product; (ii) System of Commercialization defined by the exporters agents; (iii) System of Consumption defined by agents responsible for purchasing the product. The main mode of transportation, within the country, between these systems is the highway and for export is the waterway. [32-33-34]

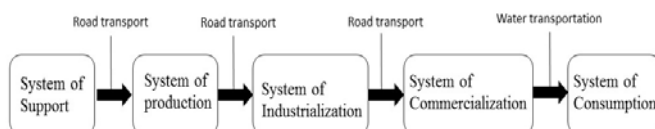


Fig.4 - Adapted by 34

IV. TRANSPORT LOGISTIC: BOTTLENECK IN BRAZIL'S ECONOMIC DEVELOPMENT

The logistics of transporting products within the supply chain of Brazilian beef is one of the bottlenecks hindering economic growth of exports

The costs associated with logistics activities are broken down as logistics costs. Like any other cost, they are computed for determining the price of the good or service, so that, the higher, the greater the participation in the final value of production. [35]

Brazil's GDP in 2013 was R \$ 4.8 trillion of this total 19.23%, \$ 923,000 billion, represents what is spent on logistics in Brazil. The impact of logistics in agribusiness is 8% of the Gross Production Value (BPV), which in 2013 was \$ 421.5 billion. [36]

Transportation is a representative activity in the absorption of costs with logistics, accounting for between half and two-thirds of total logistics costs. According to a study conducted by the Logistics and Supply Chain Institute in 2014, for companies about 8.5% of net revenue is intended for logistics costs and 4.6% refers to transportation costs. [37]

According to the Department of Competitiveness and Technology (DECOMTEC) in 2012, the cost of transport logistics are linked, "(i) delays and waits, equivalent to 0.60% of the revenues of the manufacturing industry, which means a total cost of R\$ 10.2 billion a year; (ii) costs of storage, in turn, equivalent to 0.04% of revenues annually and add a cost of R\$ 675.0 million and (iii) high extra expense with fleet maintenance: 0.36% of revenues , which means an annual cost of R\$ 6.2 billion in the manufacturing sector of the universe. " Factors influenced by the inadequate structure of Brazilian highways. [37]

The country has 67% of the total tons per kilometer (TKU) made by highways. Secondly, the railroads represent only 18%, 11% for the waterway , 3% for the pipeline and 0,04% by air. [37]

The Transport Logistics is an essential service in the beef supply chain, by enabling the other links. Without transportation, the product doesn't arrive to the final consumer. Directly affecting production, export and quality assurance for consumption.

V. TRACK TO CONTROL THE SLAUGHTER NOT SUPERVISED AND CONTRIBUTE TO THE LOGISTICS TRANSPORTATION PROCESS IN BRAZIL

Traceability is the possibility that the consumer knows the "past life" of products and can identify potential dangers to public health that the product was exposed to during its production and distribution [33].

The need to implement traceability in the beef supply chain began in 1996, when the BSE (Bovine Spongiform Encephalopathy) disease known as "mad cow disease" appeared. The need to identify and remove product from the

market quickly and needs of the product (cattle) became apparent in case of risk [34].

For greater control of the product (cattle) marketed in each country, the European community by Resolution EC 1760/2000 of June 17/ 2000, provides for the implementation of a traceability program in countries that provide it with beef, through the individual product registration (cattle) for the lifting of all the animal information from birth to consumption of the final product. [39 -40]

To meet this regulation, Brazil began its national traceability program in 2002 by the technical committee formed by the Ministry of Agriculture, Livestock and Supply (MAPA - acronym in Brazil), National Confederation of Agriculture (CAN - acronym in Brazil), Brazilian Association of Export Beef Industry (ABIEC - acronym in Brazil) and the Brazilian Agricultural Research Corporation (EMBRAPA -- acronym in Brazil), through Normative Instruction 1 of January 09/2002 with the project of the Cattle Identification System and Certification and Buffalos (Sisbov - acronym in Brazil) [41-42]

In 2006, faced with the need to adapt the European requirements, made after a rigorous evaluation in the Brazilian traceability system, Normative Instruction 17 of July 13, 2006 was published, the Traceability Service of Supply Chain Cattle and Buffaloes (Sisbov - acronym in Brazil), revoking Normative Instruction 1 [38-41-42]

The Cattle Identification System and Certification and Buffalos (Sisbov - acronym in Brazil) has control and traceability of the production process in the context of rural properties. The voluntary participation of farmers is voluntary becoming mandatory only for producers who adhere to marketing in markets requiring traceability [41].

The chain of Brazilian beef supply consists of sets of interactive links, through systems: production system of raw materials, with subsystems of breeding, rearing and fattening; industrialization system with subsystems of slaughter, cutting, packaging / storage and dispatch; storage systems and port loading systems [43].

According to [43] one of the flaws in the interactive link in the meat production system, shows up at slaughter. For the amount of the refrigerator is relatively small compared to the amount of companies creating cattle. Data released in the 2006 IBGE Census of Agriculture show 2.6 million cattle ranches in the country and only 2 thousand slaughterers.

A study published in September 2014, conducted by the Center for Advanced Studies in Applied Economics (Cepea - acronym in Brazil), linked to the School of Luiz Queiroz (Esalq - acronym in Brazil), the slaughter not inspected is estimated at less than 10%. These numbers are based on 2012 data on the 85% of the total slaughtered. The study did not include 100%, relative the 23.8 million tons of the Brazilian herd of the total slaughtered in 2012 and did not cover all the producing states. The Slaughter not inspected has some variations, as Table 2, according to the analyzed states.[44]

Table 2 - Slaughter not monitored with reference to 2012 production [44].

Slaughter without Sanitary Surveillance (% of supply)	
São Paulo	5,40%
Rio de Janeiro	5,20%
Minas Gerais	15,20%
Espirito Santos	4,10%
Southeast	9,50%
Mato Grosso	5,60%
Mato Grosso do Sul	4,80%
Goiás	5,30%
Distrito Federal	6,80%
Midwest	5,70%
Paraná	5,50%
Santa Catarina	4,80%
Rio Grande do Sul	5,10%
South	5,20%
Bahia	10,40%
Northeast	10,40%
Pará	12,20%
Tocantins	9,20%

As the beef trade grows on average 2% per year, as the graph in Figure 5 shows, it is necessary to keep the slaughter index not inspected under control and close to extinction.

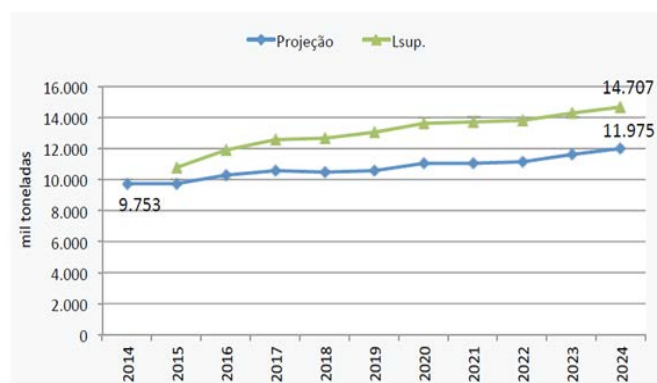


Fig.5 Meat production projection [3]

The automation of traceability within the supply chain of beef production, between the interactive link of the product transportation (cattle) between raw material production system and industrialization system, which is the product output (cattle) of the pasture until the accepted the cargo at destination, for slaughter and later between the commercialization system industrialization and marketing system, defined by output the meat/carcass until the accepted at the destination. . Contributes to unify the production chain in a monitoring and certification system in order to: (i) guarantee the origin of the product, promoting reliability; (ii) to help streamline the transmitted cargo release, (iii) cooperate

with the reduction of the production cost and also (iv) minimize the incidence of illegal refrigerators.

The system of traceability in the beef supply chain, involves communication and transparency between all links in the chain and monitoring product (cattle) at any time of its production cycle. Providing greater safety in food quality, allowing greater economic benefits and confidence to the consumer.

VI. CONCLUSION

It is observed that the lack of road infrastructure and technology in transportation logistics affects significantly the production performance in companies, for failing to comply with the purpose and consequently the performance communication between all the links that make up the beef supply chain.

Invest in technology to the livestock sector is necessary for a coordinated control of meat production systems with sector's projected growth in the period 2013-2023 of 46.4% [3].

Include traceability throughout the supply chain systems of beef, with systemic nature of approach aims to avoid failures in procedures, and therefore, does not undermine the credibility of the final product.

Traceability, in transportation logistics, properly inserted in the systems of beef production chain, integrating all the technologies developed, contributes to the correct flow and coordination of all production processes

The demand for safe food health and known origin has increased considerably in the last year. Whereas every consumer must have access to safe food. The adoption of a comprehensive model of automation of traceability in transportation within the supply chain of allied beef production, among other factors, with existing technologies. Contribute to: (i) the supervision, reducing the levels of illegal slaughterhouses; (ii) increasing the credibility of the agricultural sector and (iii) the growth controlled and insurance sector, allowing greater competition in the market for export and promoting domestic consumption.

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