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## **Mapping and Quantification of the Beef Chain in Brazil**

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### **Abstract**

GESis (Neves 2008) is a practical process for developing strategic plans for production chains and was applied in several projects in Brazil. One of the initial steps is mapping and quantification of production chains. This step provides knowledge of the size of the chain analyzed, in terms of social and economic magnitude. Using the method GESis, the main objective of this article was to estimate the financial transactions for one of the most important production chains to Brazil, the beef chain. In this research, the gross value of the beef sector in Brazil was estimated at \$167.5 billion in 2010. This material can serve as a stimulus to public and private decision-making and it shows the intimate interconnection between the links in the chain and its ability to generate revenues, taxes and jobs.

**Keywords:** beef, mapping, quantification, production chain, Brazil.

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## Introduction

The mapping and quantification of agribusiness chains in Brazil has been the subject of several studies. The first focused on the wheat chain by Rossi and Neves (2004), followed by the orange juice sector (Neves and Lopes 2005), the milk chain (Consoli and Neves 2006), the sugarcane chain (Neves et al. 2010), the citrus chain (Neves and Trombin 2011), the cotton chain (Neves and Pinto 2012), and the beef production chain—the findings of which are presented in this paper.

These studies aim to generate detailed information concerning the magnitude of economic and social development of the production chains in the country. The analyses range from orchard inputs to the products offered to consumers.

This study answers the following questions:

- how significant is the sum of sales of the various links in the supply chain?
- how much tax revenue is generated by the production chain?
- how many direct and indirect jobs are generated in Brazil?
- how significant is the sum of wages paid to workers during a season?

A complete overview of a production chain is essential to providing greater transparency to the sector, clarifying and questioning fallacies, as well as adding value to the image of the chain. The information collected contributes to the market intelligence that can support structuring a strategic plan in order to identify innovations in business and explore new opportunities that can raise the competitiveness of the sector. This information may also be used to support decision-making in both the public sector and with companies operating individually or collectively. The objective of this study is to estimate the financial transactions of the beef chain in Brazil, thereby providing further insight into this sector.

## Theoretical Framework

Two traditional approaches to studying chains can be found in the literature. The commodity system approach (CSA) which was developed by Goldberg (1968) studying citrus, wheat, and soybean production systems. The CSA methodology emphasizes the sequence of product transformations in the system. The merit of Goldberg's method is that it changed the focus of analysis so it was applicable to the entire system, thereby allowing researchers to consider the agricultural sector without isolation from the overall economy.

The second approach, proposed by Morvan (1985), considers a chain (“filière”) linked through operations in the transformation of goods. The chains are influenced by technology and have complementary interdependences, according to Batalha (2001). According to Morvan (1985), the filière analysis is an important tool for describing systems, defining the role of technology in the framing of production systems, organizing integration studies, and in analyzing industrial policies, firms, and collective strategies.

The supply chain is viewed as a system that integrates raw material suppliers, factories, distribution services, and consumers (Stevens apud Omta et al. 2001). Because efficient management is critical to the survival of productive chains, Folkerts and Koehorst (1997) proposed a model for managing supply chains that specifically focused on the linkages between the actors in the chain. The model highlighted two key aspects: system performance and factors critical to success. Furthermore, there is a network concept in which organizations are involved in different stages of the processes and add value from the development phase of goods and services until they reach the consumer (Christopher apud Omta et al. 2001). Lazzarini et al. (2001) integrate chain and network concepts in a study on net chains. According to these authors, integrating these approaches enable existing organizational interdependences in a network to incorporate different mechanisms of coordination: managerial plans, process standardization, and adjustments, and sources of value into production through operation optimization, transaction cost reduction, diversity, and "co-specialization" of knowledge.

To Fearn, Martinez, and Dent (2012), the value chain analysis (VCA) should be used to identify the current state of a value chain and possible improvements for the future. The authors propose three facets essential to creating a sustainable value: limits of analysis (intra-firm, inter-firm and external stakeholders), values considered (cost reduction, consumer value and shared value) and type of governance.

Gereffi, Humphrey and Sturgeon (2005) proposed a model containing five different forms of governance and ascertain that those closest to the reality faced by specific sectors are important not only for the development of policies, but also to anticipating possible changes in the chains. Their model does not quantify financially productive chains, but can complement other models which are more quantitative and the combination of the two can be a more powerful tool. Korzeniewicz and Gereffi (1994) also consider governance and the study of the relationships between actors to be fundamental in the analysis of value chains.

The competitiveness of an agribusiness system can be analyzed from three different fronts: private strategies, collective strategies and public policies that contribute either collectively or separately to create value in the system (Zylbersztajn and Neves 2000). An important focus in creating value chains is the attempt to transfer value to products economically treated as commodities. Kaplinsky (1998) identifies nine critical areas in value chain assessment: basic resources, policies, technology, human resources, organizational, relational, and product marketing, infrastructure and financial.

Kaplinsky and Fitter (2001) sought to identify how value is generated along the production chain. They analyze the global coffee chain, employing a method for mapping and quantification of this sector. Their subscribed method is interesting as it incorporates the variable geographic location, showing clearly which steps are essentially developed countries producers and which are made in consumer countries. According to the authors, to achieve a more equal global distribution of income in the coffee chain, consumers should be educated to recognize that better coffees are directly linked to their place of origin rather than to their brand names.

A study by Hardman et al. (2002) provides an example demonstrating the possibility of increasing the competitiveness of South African apple chain exportations through cooperation

among producers, packers, and exporters. From the ideas of CSA and the *filière*, it is possible to develop tools and managerial activities to improve the chains' efficiency. Thus, the concepts of Supply Chain Management (SCM) and the set of networks and net chain ideas are important theoretical concepts and empirical notions for the development of food and bioenergy chains (Batalha and Silva 2001). Gripsrud, Jahre and Persson (2006) state that SCM can be considered as an attempt toward joining two current studies known as "business logistics" and "marketing channels."

Kaplinsky and Morris (2000) point out that the methods of quantification on supply chains tend to result in a tree of input-output flows, which carry all the information gathered. The data can be found in different primary and secondary sources, such as annual reports, balance sheets, and interviews with key respondents in each link of the chain involved in research and other areas.

In this work, the GESis method of quantification was chosen. The steps of the GESis quantification method are presented in detail in the methodology section. From the bibliography and thorough analyzing the method, some advantages and disadvantages concerning use are highlighted. In terms of the operating method, the phases of GESis is clearer and better defined.

The initial in-depth interviews that are used seek to validate the design of the agribusiness system in question, give more credibility and veracity to the final outcome. Also, the experts can see the schematic view of the whole process and can discuss it. The result of the interviews with experts to estimate the total amount sold by companies is compared with the data declared by the following link, giving greater accuracy to the estimates. So, the amount declared by the vendors is compared with the amount declared by the buyers. For example, the amount declared by the Packing Industry about the sales of packing to the meat sector was compared with the amount declared by the slaughterhouses with this item.

Another advantage in using the GESis method occurs in the steps following the interviews with experts. In these steps there are two validations of the estimated values. The data is first sent to the companies involved to obtain their approval. Then, a workshop is organized where the values are presented to experts for discussion until a consensus is reached.

Thus, to avoid any direct influence on data that a researcher could have, the method adds steps to validate the data with experts, giving greater credibility to the study.

A disadvantage of the GESis method compared to the method proposed by Kaplinsky and Fitter, (2001) or the method proposed by Fitter, Robert and Kaplinsky (2001), is that GESis does not make the drivers of values to the productive chain explicit and does not show which link in the production chain benefits the most from the added value.

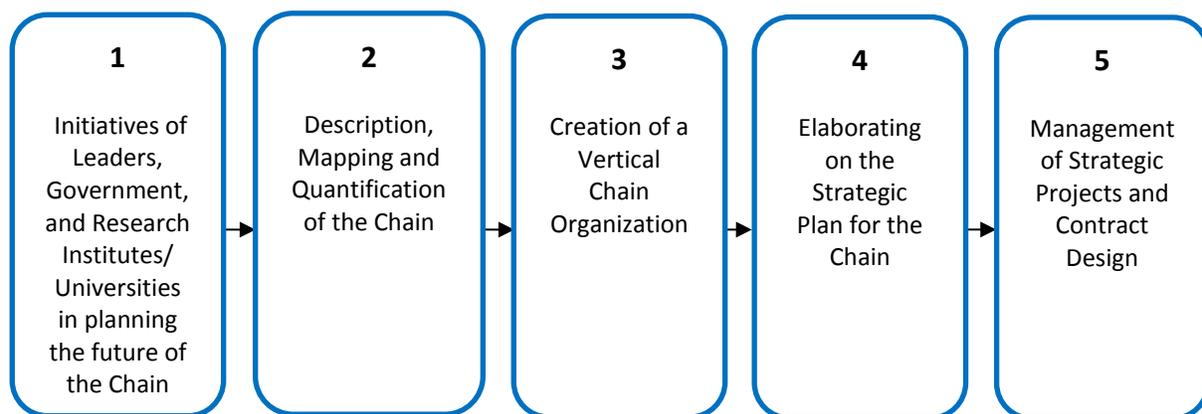
Moreover, some authors (Fearn, Martinez and Dent 2012; Gereffi, Humphrey and Sturgeon 2005; Gereffi and Korzeniewicz 1994) consider the analysis of governance essential to the completing the understanding of the value chain. The GESis method does not include this type of analysis, but for the purpose of this manuscript the method is sufficient.

## Methodology

According to Malhotra (2006), in order to characterize and analyze a production chain, it is necessary to define its objectives, boundaries and scope, participant subsystems of the production chain, and its environment. Batalha (2001) reports that in order to analyze a chain, the researcher must define certain conditions that are consequences of the objectives to be reached. The most important and difficult definitions are related to the scope of the analysis and levels that should be detailed. Zylbersztajn and Neves (2000) comment that the definition of the agro-industrial systems boundaries shall be dependent on the research purposes, which are generally focused on a product.

The present work was conducted through exploratory research based on secondary data and in-depth interviews using GESis, the method proposed by Neves (2008). According to Malhotra (2006), exploratory research is used when your main goal is to better understand a situation by bringing more information forward about the studied subject. There is no pretension to test specific hypotheses (Hair, Money and Samouel 2005).

The method used below outlines every action performed at each stage of the method. As summarized in Figure 1, the method consists of a five-step process towards implementing strategic management within a production chain.

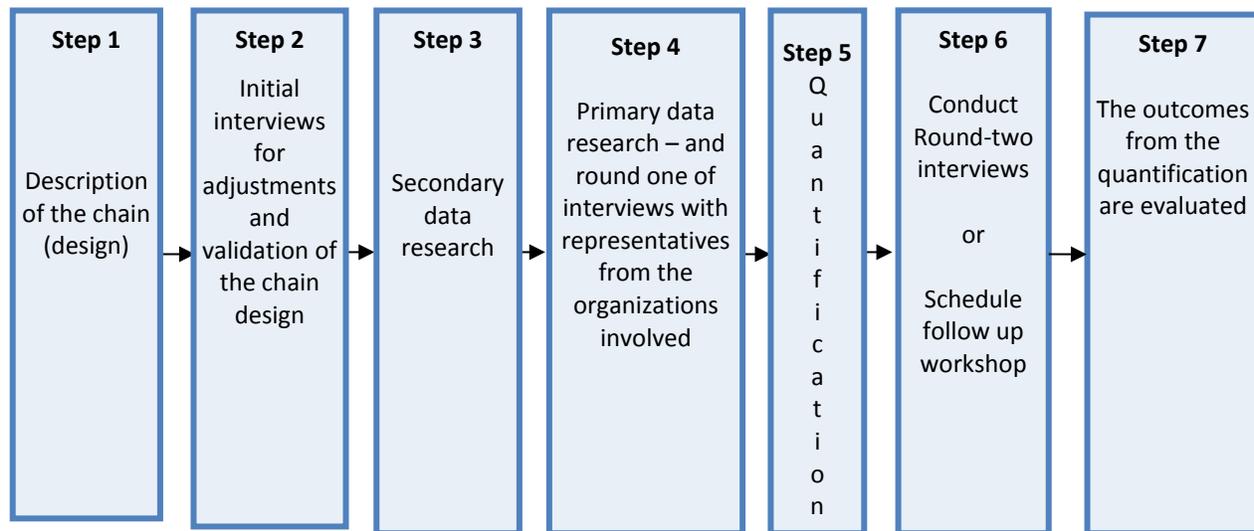


**Figure 1.** The GESis method for strategic planning and management of food and bioenergy chains. **Source.** Neves (2008).

The second step of the method consists of mapping and quantification of chains. This step comprises seven stages, as shown in Figure 2. Its application is relatively straightforward and the collection of information does not depend on public sources of data, which is another advantage of this method. In addition, the figure obtained allows easy visualization of the positioning and relevance of different sectors in an existing value chain.

The first of the six steps consists of elaborating a preliminary design of the chain based on theory and the researchers' experience. It is also necessary to define the scope of which segments will be studied, keeping the focus on the central axis of the system, and research objectives. In this paper, following Goldberg's (1968) notion of commodity system approach (CSA) the focus of

this value chain analysis is beef as the raw material, the central object of the system, and the starting point for the system analysis.



**Figure 2.** Method for mapping and quantification of the chain adapted.

**Source.** Neves (2008).

After the production chain is designed, the second step is to submit it to the sector specialists and interview them, as they will have to propose possible adjustments, in order to obtain the current condition of the system.

The third step consists of secondary data research, which according to Malhotra (2006) is collected for outcomes that differ from the research problem. For this step, data was gathered from sources that have academic and statistical credibility, reputation, and integrity.

After gathering the available secondary data, we started collecting the primary data (Stage 4), the data originating from the researcher for the specific purpose of solving the problem in question (Mattar 1993; Malhotra 2006). This included in-depth interviews conducted with representatives from several organizations in the beef sector.

To select and define the interviews, we first identified which data was not found in the secondary research. From this point, agents in the chain were selected for interviews. To be selected, the agent should have certain characteristics. They must have access to the information and data of the sector under investigation. They must have knowledge and experience about the system and they must be willing to collaborate with the researchers and promote communication for future contacts. Finally, they must be able to identify possible contact agents who will contribute with unavailable data.

The fifth step, quantification, determines the turnover of each sector in the chain through company revenues and estimates of several sub sectors of the beef production chain. Therefore, it is important to delineate the period of the research evaluation. In order to ensure confidence in

the data, some secondary and primary data were contrasted, attempting to find incongruous elements. In this process, at least two different data sources were used to check the results and bolster with additional interviews with similar agents as needed.

In the sixth step, a second round of interviews were performed, rather than following with a workshop as recommended in the GESis method. There was great concern about whether interviewing the same agents again in all the links of the chain would generate a good discussion and data validation. In this second round of interviews, the results from the first round were presented, providing the respondents an opportunity to change their answers and to comment on the emerging and collective perspective of the research participants.

The seventh step provided a consolidation and revision of the data and the outcomes from the quantification are evaluated.

## Results and Discussions

For the purposes of comparison, with a didactic aim, the beef production chain was divided into four segments: (1) before the farm, which comprises the links of agricultural and livestock suppliers; (2) on the farm, which encompasses the production of livestock; (3) after the farm, which is composed of the links of industrial supplies, the processing industry, and distribution; and finally (4) facilitating agents. Figure 3 (See Appendix) shows the design of the beef production chain and the values of each link in the chain indicating overall sales in that link, as a function of products or services sold to this production chain.

### *Before the Farm*

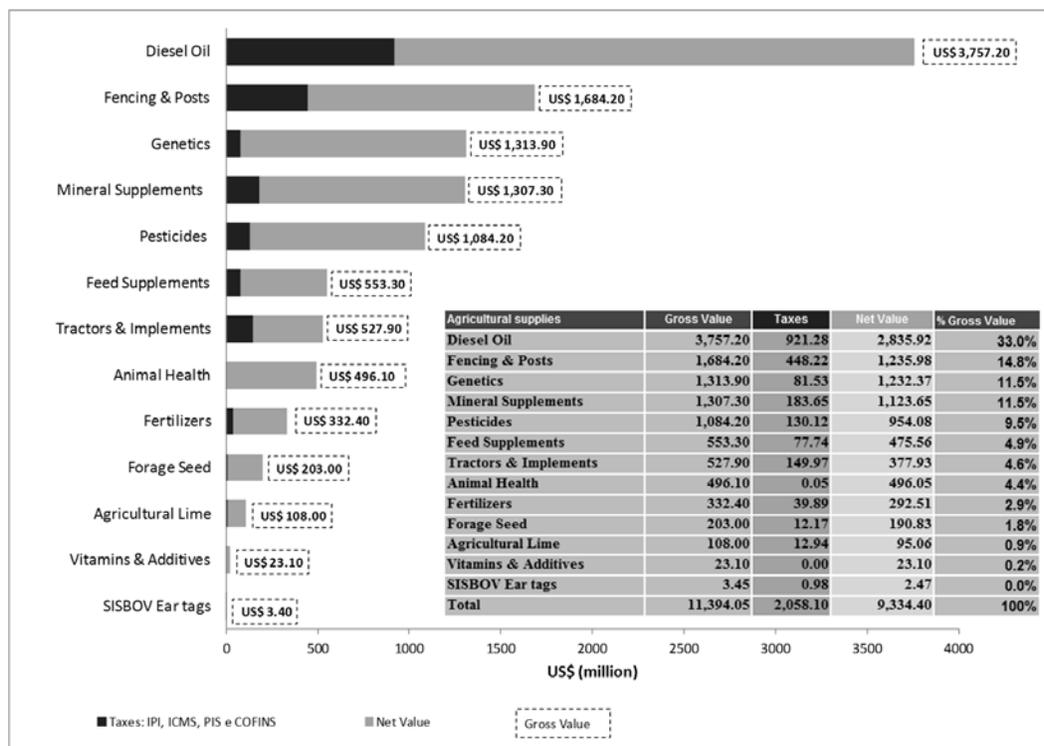
The agricultural and livestock supplies used in the production of beef cattle generated gross revenues of \$11.39 billion in 2010 for each link in the production chain as shown in Figure 4.

### *On the Farm*

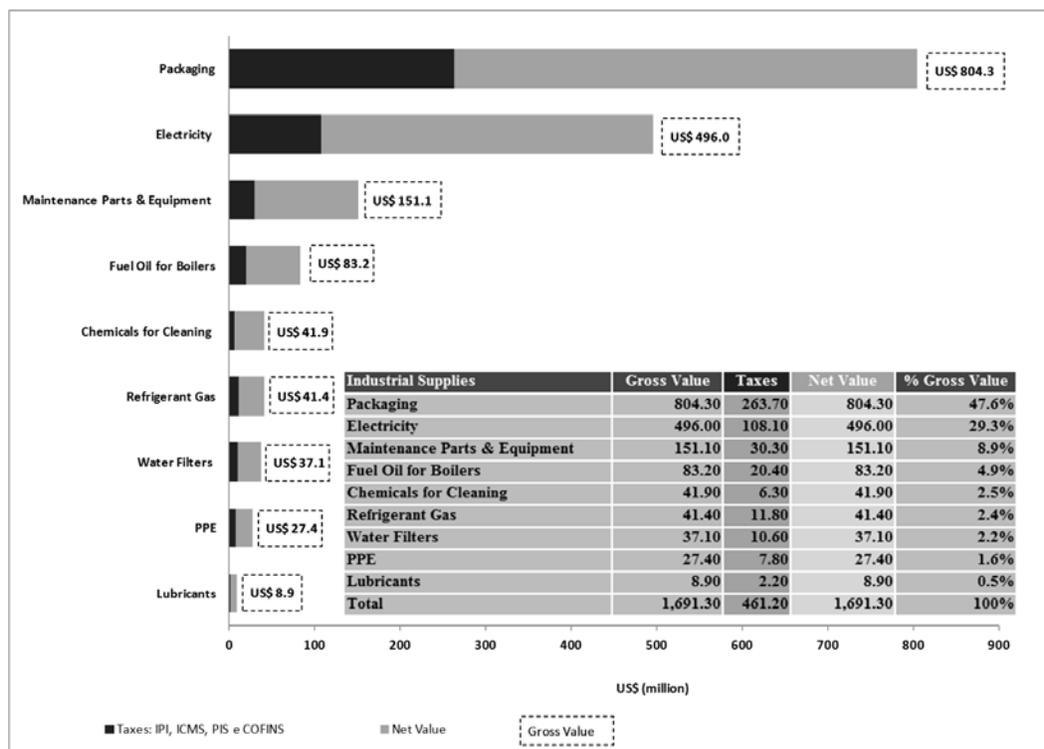
A total of 655,000 head of live cattle was exported in 2010, generating estimated revenue of \$658.7 million. The animals sent to slaughter amounted to 681 million *arrobas* (unit of measure equal to 15 kilos or 33lbs of dressed carcass) generating estimated revenues of \$30.8 billion. Of that total, finished steers (over 36 months of age) represented 62% of overall slaughter; cows accounted for 24%; young bulls (24 to 36 months) 13%; and veal (less than 24 months) less than 1%.

### *After the Farm*

The purchase of industrial supplies used by slaughterhouses in the production of beef and other products accounted for an estimated \$1.69 billion, around 1% of the gross value of the beef production chain. Figure 5 shows the share of each of the inputs used by industries in the production process.



**Figure 4.** Estimated revenue and relative share of the links of agricultural/livestock supplies in the “before-the-farm” segment in 2010.



**Figure 5.** Estimated revenue and relative share of the links of industrial supplies in the “after the farm” segment in 2010.

**Sources.** Figures 4& 5. Neves et al. (2012) prepared with data generated by Markestrat and Scot Consulting.

In 2010, the slaughtering capacity at the establishments registered with the Federal Inspection Service (FIS) was roughly 163,000 head per day. The slaughter capacity of establishments registered with the State Inspection Service (SIE) was estimated at approximately 35,000 head per day (of the 21 states that responded to the survey). Therefore, the annual slaughter volume in Brazil has reached 60 million head of cattle. There are also slaughterhouses and meat-packing plants inspected by the Municipal Inspection Service, whose slaughter capacities are not accounted for due to the difficulty of accessing the appropriate secretariats from all the municipalities. With the slaughter of 43 million head in 2010, we conclude that Brazil used 71% of its installed beef slaughter capacity.

Estimated revenues of slaughterhouses in 2010 were US\$42 billion<sup>1</sup>. Of this, meat sales totaled \$35.8 billion and the sales of other products totaled \$6.2 billion. In relation to sales by market, domestic sales accounted for 89%, while exports represented 11%.

Considering only beef, the domestic market absorbed 91% of all volume produced in Brazil, generating \$31.9 billion in sales for the slaughterhouses.

The products for industrialization on average are comprised of 59% forequarter cuts and 16% hindquarter cuts, 3% plate, and 22% edible byproducts for industrialization (heart, meat around the point of exsanguination, skin, tendinous meat, tongue, flank, as well as tendon and diaphragm membrane). Sales of meat and edible byproducts represented 6% of the volume of slaughterhouse production destined for the domestic market, with estimated total sales of around \$1.9 billion. Of this total, \$322.8 million referred only to edible byproducts for industrialization and \$1.6 billion to beef cuts.

Sales of beef to distributors/wholesalers generated estimated revenue of \$10.5 billion for slaughterhouses. The estimated revenue of slaughterhouses from direct sales to retailers was \$19.9 billion, representing 60% of the volume of beef sold by slaughterhouses on the domestic market. Beef exports generated revenues of \$3.9 billion, resulting from the sale of 953,000 tonnes, establishing Brazil as the world's largest beef exporter, with 20% of the international trade. Figure 6 shows the values of estimated revenues of slaughterhouses from the sale of other bovine products, the respective sales taxes, and the relative share of each item in the sales revenue from such products.

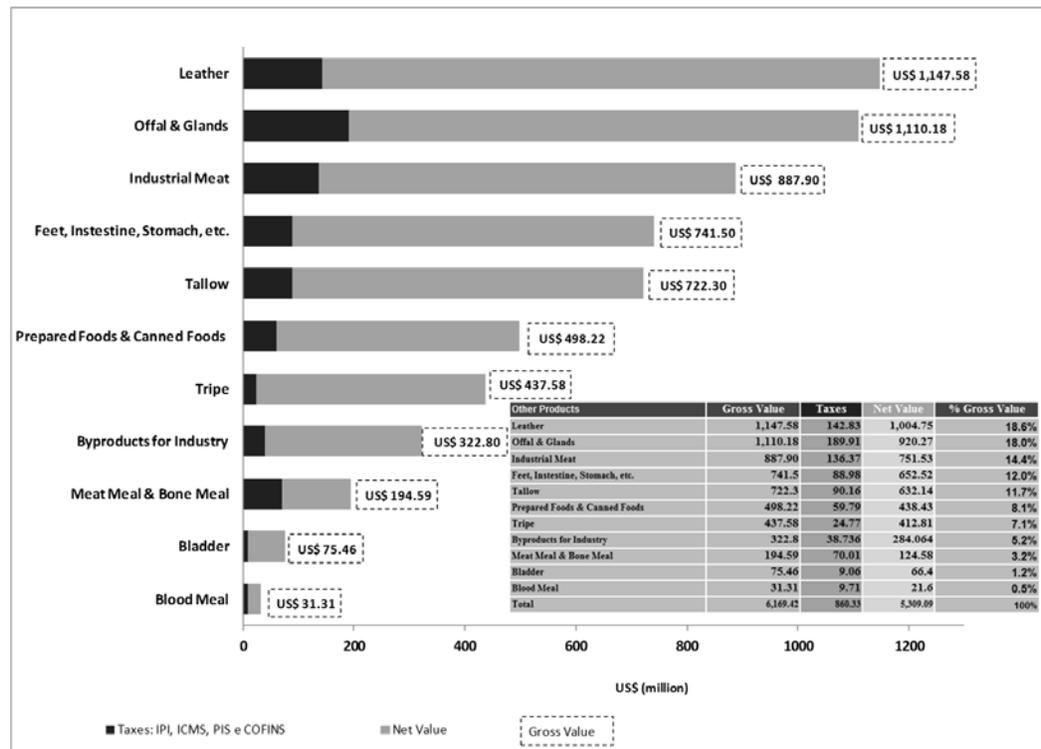
The primary revenue-generating byproduct for the meatpacking industry is rawhide. The sector's estimated revenues from sales of rawhide (also called salted leather) were \$1.1 billion on the domestic market. In 2010, leather exports generated revenues of \$1.7 billion for tanning industry. Brazilian exports of this product represented 6% of worldwide leather exports, ranking Brazil fourth among leather exporting countries.

Estimated revenues of distributors/wholesalers from the sale of meat and edible byproducts were \$14.5 billion in 2010, out of which 96% resulted from sales of beef and 4% from sales of byproducts. Approximately 36% of the volume of beef and 41% of beef byproducts sold by

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<sup>1</sup> All revenue reported within this research is calculated in US Dollars.

slaughterhouses on the domestic market passed through a distributor/wholesaler before reaching the final consumer.



**Figure 6.** Estimated revenue of slaughterhouses from sales “Other bovine products.”  
**Source.** Neves et al. (2012) prepared with data generated by Markestrat.

Sales of meat and edible byproducts on the retail market accounted for around 53% of the volume sold by slaughterhouses, amounting to estimated revenues of \$42.9 billion. Major retail chains accounted for 62.2% of total revenues from sales of beef and beef byproducts, i.e., \$26.7 billion, while small and midsize retailers earned \$16 billion, equivalent to 37.4%. The remainder (0.4%) was earned by slaughterhouses selling directly to consumers, through their own stores. The estimated revenue from overall sales of beef by the retail market was \$40.3 billion.

Imports of products of the beef cattle production chain totaled \$246.8 million. The main product imported by Brazil was meat, which represented 66% of the value imported, followed by leather (23%), and other products and byproducts, which accounted for 11%.

*Facilitating Agents*

By the end of 2010, according to the Annual Social Information Report (RAIS), there were 580,500 people employed in activities directly related to the beef sector. This figure includes jobs in cattle raising (65% of the total number), slaughter (19%), manufacture of meat products (9%), and leather tanning (7%). Indirect employment, which represents the number of jobs created by the production chain of the supplies used in raising cattle, accounted for 2.37 million jobs. Induced employment, which represents the number of jobs generated by the income that the

cattle industry provides, accounted for an estimated 3.37 million jobs. In all, the cattle industry was responsible for 6.32 million jobs in 2010. Based on the number of formal employees and average wages, we estimated the sector's payroll at around \$3.9 billion in 2010.

## Conclusions

This paper aims to map and quantify the productive chain of Brazilian beef by the method GESis proposed by Neves (2008). The goal was achieved as expected, but a small adjustment to the original method was required. The modification of replacing the workshop stage for a second round of interviews in which the first round results are presented gave the opportunity to respondents to change their answers and to comment on the emerging and collective perspective of the research participants. Individual interviews in this stage brought important contributions by making participation more convenient to the respondent and providing greater freedom for the display of data and opinions, without constraining the respondent publicly. The need for this change was observed from the application of the method to quantify the beef sector in Brazil.

Thus, the article has reached its goal by presenting the results obtained from applying the method to the beef production chain and noted that the adaptation to the method introduced by Neves (2008) proved to be a suitable alternative to the research. It can further be understood as a possible approach for convergence of data and opinions. The study is limited by the dependence of the method on subjective opinions. In theory, the method can be used for any sector; however, other adjustments may be necessary, depending on their specificity.

This material serves as a stimulus to decision making in the public and private sectors, and shows the strong connection between the links of the production chain and their amazing ability to generate resources, taxes and jobs. The expectations are that studies such as this one – which depict the reality and importance of the agribusiness production chains – will not stop here, but will be broadened and become part of an information system that more frequently promotes critical data to be able to bring more transparency to the sectors and support for strategic decision making.

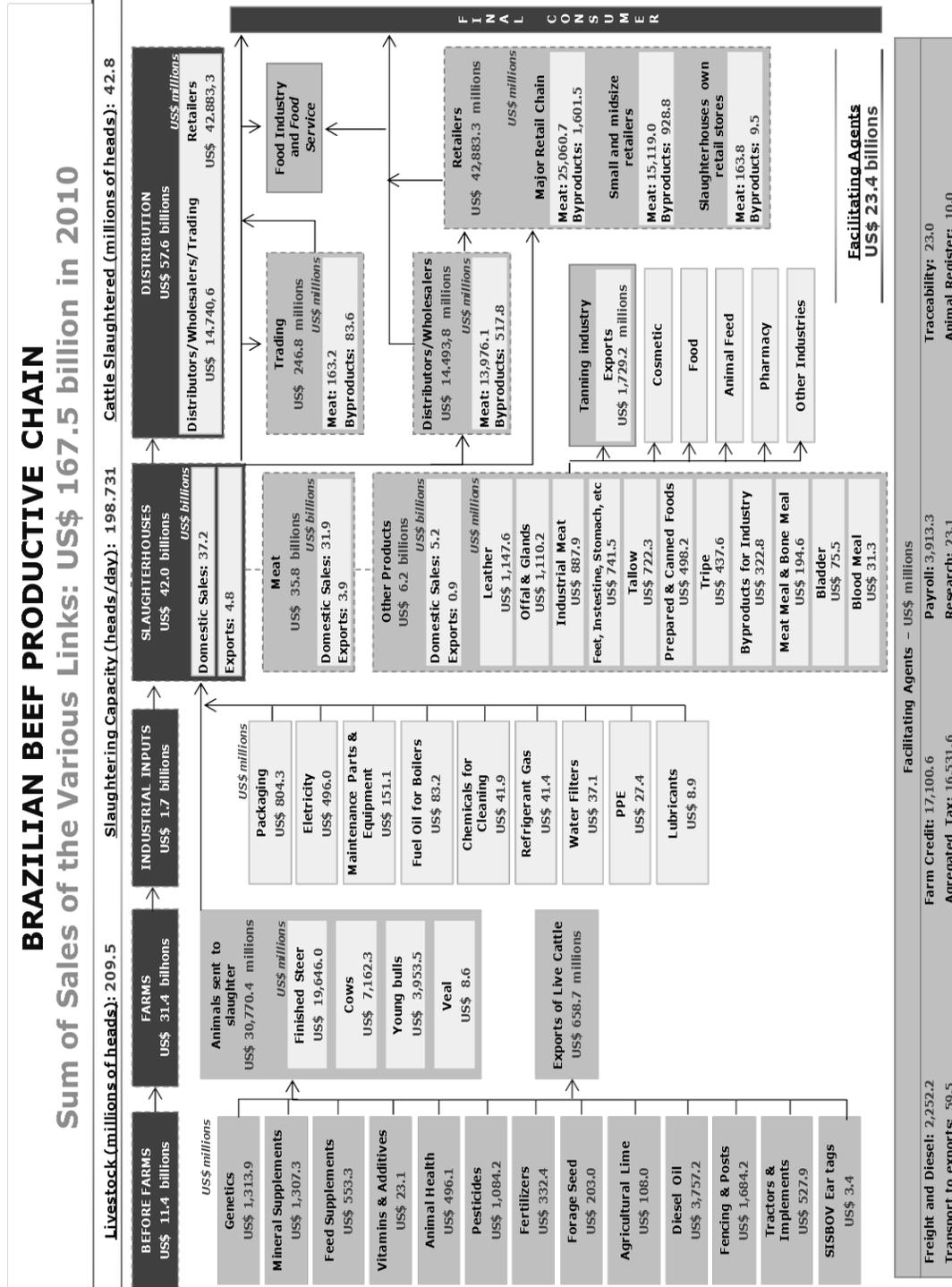
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# Appendix



**Figure 3.** Brazilian beef chain gross revenue from sector products and services. Source. Neves et al. Prepared from data generated from Markestat and Scot Consulting.