Mapping and Quantification of the Beef Chain in Brazil

MARCOS FAVA NEVES
Corresponding author
Professor, School of Economics and Business (FEARP) University of São Paulo
Av dos Bandeirantes 3900, Ribeirão Preto (SP), 14.040-900, Brazil.
mfaneves@usp.br / 55 16 3602-3903

VINÍCIUS GUSTAVO TROMBIN
University of São Paulo
FEA - School of Economics, Business and Accounting
Researcher of Markestrat (Marketing & Strategy Projects and Research Center).
R. Maestro I. Stabile, 520 - Ribeirão Preto (SP), 14.020-640, Brazil.
vinicius.trombin@gmail.com / 55 16 3456-5555

TÁSSIA GERBASI
University of São Paulo
FEA-RP - School of Economics, Business and Accounting of Ribeirão Preto
Researcher of Markestrat (Marketing & Strategy Projects and Research Center).
R. Maestro I. Stabile, 520 - Ribeirão Preto, 14.020-640, Brazil.
tgerbasi@markestrat.org / 55 16 3456-5555

RAFAEL BORDONAL KALAKI
University of São Paulo
FEA-RP - School of Economics, Business and Accounting of Ribeirão Preto
Researcher of Markestrat (Marketing & Strategy Projects and Research Center).
R. Maestro I. Stabile, 520 - Ribeirão Preto, 14.020-640, Brazil.
rkalaki@markestrat.org / 55 16 3456-5555

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Abstract

The CHAINPlan Method (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 analysed, in terms of social and economic magnitude. Here this method is presented with adjustments, in order to be useful to researchers worldwide interested in mapping and quantifying a chain. Subsequently, we present the results of applying the method in one of the most important agribusiness chain in Brazil, the beef sector. In this research, the Gross Value of the Beef Sector in Brazil was estimated at $ 167.5 billion in 2010. This material should serve as a stimulus to decision-making public and private, besides 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.

Mapping and Quantification of the Beef Chain in Brazil

Executive Summary

The cattle industry in Brazil, although as old as the very colonization of the country, ceased being a strictly rural activity only in the last five decades. The activity has undergone profound changes and is no longer carried out on isolated, virtually self-sufficient ranches, because it has become interdependent on a complex of goods and services, geared primarily toward serving the consumer.

Such interdependence was observed based on the mapping and quantification recently undertaken for the production chain of Brazilian beef, whereby one can identify the magnitude of this economic and social supply chain.

Through this study, it was determined that the financial transactions generated by the sum of sales of the various links in the beef supply chain reached US$167.5 billion in 2010. The overview shows that nearly three quarters of this value are generated after the cattle leave the farm. The "before-the-farm" and "on-the-farm" production links account for the remaining 26%. This fact is because the gross value of production considers the sales made, and not the value of each sale. Thus, cattle that is sold once by the rancher turns into several sales in the form of beef products along the distribution chain, i.e., the same piece of meat can be sold by the slaughterhouse, the wholesaler, and the retailer.

The mapping and quantification of this sector was carried out by the method called CHAINPlan developed in 2008 by Professor Marcos Fava Neves. This method establishes the flow of products, summarizing the chain in a diagram that is reproduced below. The data are obtained by crossing information on purchases and sales obtained from interviews with managers and directors of companies that make up the production chain.

Mapping and Quantification of the Beef Chain in Brazil

Introduction

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), then orange juice by Neves and Lopes (2005), next milk by Consoli and Neves (2006), sugarcane by Neves, Trombin and Consoli (2010), in 2010, citrus by Neves and Trombin (2011), cotton by Neves and Pinto (2011), and the beef production chain, whose findings is presented in this paper.

These studies aim to generate detailed knowledge about the magnitude of economic and social development of the production chain in the country. The analyses range from orchard inputs to the products offered to consumers. This study addressed 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?

The complete overview of a chain of production is justified since it provides greater transparency to the sector, clarifies and questions fallacies, as well as adds value to the image of the chain. The information collected allows for gaining market intelligence that can support the structuring of a strategic plan in order to identify innovations in business, and for exploring new opportunities and raising the competitiveness of the sector. The information may also be used to support decision-making in the public sector and companies operated individually or collectively. The goal of this paper was provide are more indepth and extensiver overiew of the Brazilian Beef Market to date.

Theoretical Framework

Two traditional approaches to studying chains can be found in the literature. The commodity system approach (CSA) was developed by Goldberg (1968) in the USA in studies of 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 from the orchard to the entire system, which prevented researchers from considering the agricultural sector in isolation from the overall economy.

The second approach, proposed by Morvan (1985), considers a chain ("filière") as linked operations in the transformation of a good. 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, for defining the role of technology in the framing of production systems, for organizing integration studies, and to analyse 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). Furthermore, there is the network concept in which organizations are directly involved in different processes that add value

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in the development 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, the integration of these approaches allows for considering existing organizational interdependences in a network, as well as the different mechanisms of coordination (managerial plans, process standardization, and adjustments), and sources of value (production and operations optimization, transaction cost reduction, diversity, and "co-specialization" of knowledge).

Hardman et al. (2002) demonstrated 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).
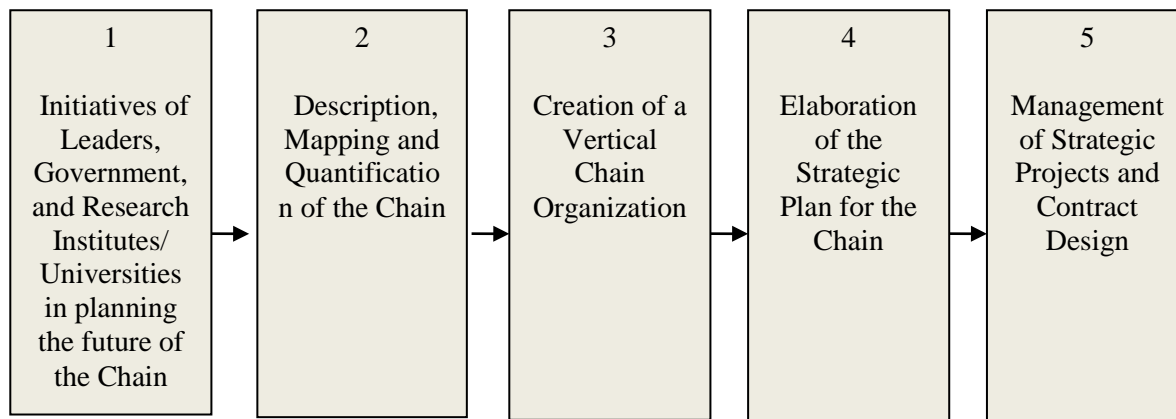
Method

According to Malhotra (2001), to characterize and analyse a production chain it is necessary to define its objectives as well as boundaries and scope, participant subsystems of the production chain, and its environment (Malhotra, 2001). Batalha (2001) reports that for a chain analysis, 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 analysis scope and levels that should be detailed. Zylbersztajn (2000) also comments that the definition of the Sag boundaries shall be dependent on the research purposes, which are generally focused on a product.

The aim of this paper is to present a method for mapping and quantification of production chains and discuss the results of this method in the beef chain in Brazil. To achieve this, the CHAINPlan method was applied, which was developed by Neves (2004) focusing on strategic planning and management of agribusiness systems. As summarized in Figure 1, the method consists of a five-step process towards implementing strategic management in a production chain.

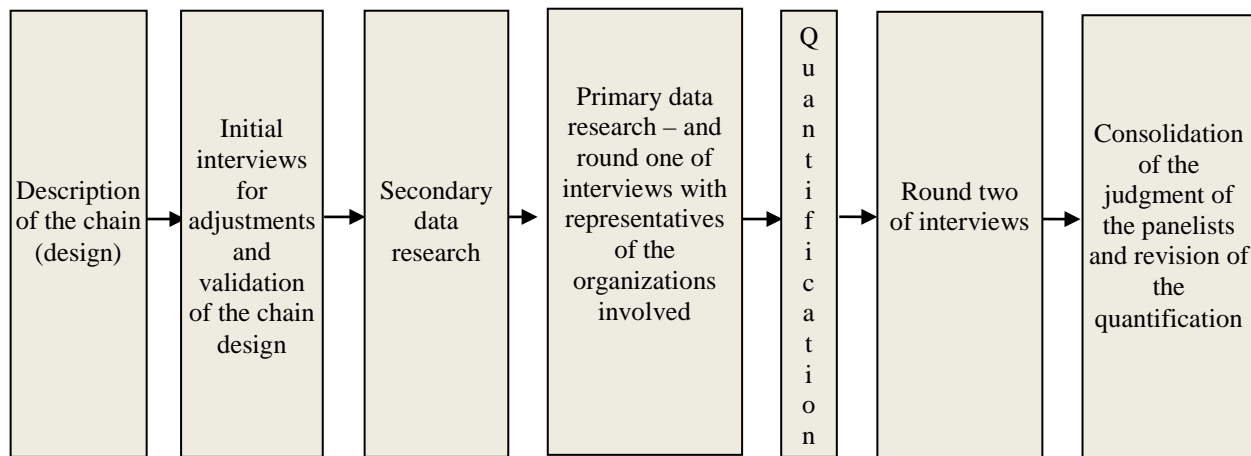| 1	2	3	4	5
Initiatives of Leaders, Government, and Research Institutes/ Universities in planning the future of the Chain	Description, Mapping and Quantification of the Chain	Creation of a Vertical Chain Organization	Elaboration of the Strategic Plan for the Chain	Management of Strategic Projects and Contract Design

Figure 1. The CHAINPlan method for strategic planning and management of food and bioenergy chains.

Source: Neves (2008).

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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 simple and 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 positioning and the relevance of different sectors in an existing value chain.

| Description of the chain (design) | → | Initial interviews for adjustments and validation of the chain design | → | Secondary data research | → | Primary data research – and round one of interviews with representatives of the organizations involved | → | Quantification | → | Round two of interviews | → | Consolidation of the judgment of the panelists and revision of the quantification |

Figure 2. Method for mapping and quantification of the chain adapted.
Source: Neves (2008).

We will explain further in details the method CHAINPlan as this is one of the objectives of this work. 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 scope which segments will be studied, keeping the focus on the central axis of the system, due to the objective of the research. In this paper, was opted for oranges, lemons/limes and tangerines as raw material and central object of the system, considering the Goldberg (1968) notion of commodity system approach (CSA), as well as emphasizing a product as the starting point for the system analysis.

After the production chain designed, the second step is to submit it to 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 stage consists of the secondary data research, which according to Malhotra (2001) is collected for ends that differ from the problem of the research. For this step, data was searched from sources that have academic and statistical credibility, reputation, and integrity.

After the collection of the available secondary data we started the collection of primary data (fourth step), that is the research of data originated by the researcher for specific purpose to solve the problem in question (Mattar, 1993; Malhotra, 2001). In this work, were done deep interviews with representatives of several organizations in the beef sector.

To select and define the interviews, we first identified which data was not found in the secondary research, and therefore, agents in the chain were selected for interviews. To be selected, the agent should have certain characteristics; i.e., must have access to the information and data of the sector in study, must have knowledge and experience about the system, must be willing to collaborate

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130 with the researchers and promote communication for future contacts, additionally , must be able
131 to indicate possible contact agents who will contribute with unavailable data.
132
133 The quantification (fifth stage) determines the turnover of each sector in the chain, through the
134 company revenues and estimates of several sub sectors of the beef production chain. Therefore, it
135 is important to delineate the period of the research evaluation. In order to ensure confidence in
136 the data, some secondary and primary data were contrasted, attempting to find incongruous
137 elements. In this process, at least two different data sources were used to check the results, with
138 additional interviews with similar agents when needed.
139
140 In the sixth step, was performed a second round of interviews, rather than a workshop as
141 recommended by the method CHAINPlan. There was great concern in interviewing the same
142 agents of all links in the chain that had been interviewed in the first round to provide a good
143 discussion and data validation. In this second round of interviews the results of the first round
144 were presented, giving the opportunity to respondents to change their answers and to comment on
145 the emerging and collective perspective of the research participants.
146
147 In the seventh step there was a consolidation and revision of the data and judgment of the
148 quantification.
149

150 **Results and discussions**

151
152 For the purposes of comparison, with a didactic aim, the beef production chain was divided into
153 four segments: (1) before the farm, which comprises the links of agricultural and livestock
154 supplies; (2) on the farm, which encompasses the production of livestock; (3) after the farm,
155 which is composed of the links of industrial supplies, the processing industry, and distribution;
156 and finally (4) facilitating agents. Figure 1, below, shows the design of the beef production chain;
157 the values below each link in the chain indicate overall sales in that link, as a function of products
158 or services sold to this production chain.
159

BRAZILIAN BEEF PRODUCTIVE CHAIN
Sum of Sales of the Various Links: US$ 167.5 billion in 2010

Livestock (millions of heads): 209.5 | **Slaughtering Capacity (heads/day): 198.731** | **Cattle Slaughtered (millions of heads): 42.8**

BEFORE FARMS US$ 11.4 billions

US$ millions
- Genetics US$ 1,313.9
- Mineral Supplements US$ 1,307.3
- Feed Supplements US$ 553.3
- Vitamins & Additives US$ 23.1
- Animal Health US$ 496.1
- Pesticides US$ 1,084.2
- Fertilizers US$ 332.4
- Forage Seed US$ 203.0
- Agricultural Lime US$ 108.0
- Diesel Oil US$ 3,757.2
- Fencing & Posts US$ 1,684.2
- Tractors & Implements US$ 527.9
- SISBOV Ear tags US$ 3.4

FARMS US$ 31.4 billhons

Animals sent to slaughter US$ 30,770.4 millions
US$ millions
- Finished Steer US$ 19,646.0
- Cows US$ 7,162.3
- Young bulls US$ 3,953.5
- Veal US$ 8.6

Exports of Live Cattle US$ 658.7 millions

INDUSTRIAL INPUTS US$ 1.7 billions

US$ millions
- Packaging US$ 804.3
- Eletricity US$ 496.0
- Maintenance Parts & Equipment US$ 151.1
- Fuel Oil for Boilers US$ 83.2
- Chemicals for Cleaning US$ 41.9
- Refrigerant Gas US$ 41.4
- Water Filters US$ 37.1
- PPE US$ 27.4
- Lubricants US$ 8.9

SLAUGHTERHOUSES US$ 42.0 billions

US$ billions
Domestic Sales: 37.2
Exports: 4.8

Meat US$ 35.8 billions
US$ billions
Domestic Sales: 31.9
Exports: 3.9

Other Products US$ 6.2 billions
US$ billions
Domestic Sales: 5.2
Exports: 0.9

US$ millions
- Leather US$ 1,147.6
- Offal & Glands US$ 1,110.2
- Industrial Meat US$ 887.9
- Feet, Instestine, Stomach, etc US$ 741.5
- Tallow US$ 722.3
- Prepared & Canned Foods US$ 498.2
- Tripe US$ 437.6
- Byproducts for Industry US$ 322.8
- Meat Meal & Bone Meal US$ 194.6
- Bladder US$ 75.5
- Blood Meal US$ 31.3

DISTRIBUTION US$ 57.6 billions

Distributors/Wholesalers/Trading US$ 14.740,6
US$ millions
Retailers US$ 42.883,3

Trading US$ 246.8 millions
US$ millions
Meat: 163.2
Byproducts: 83.6

Distributors/Wholesalers US$ 14.493,8 millions
US$ millions
Meat: 13,976.1
Byproducts: 517.8

Tanning industry
Exports US$ 1,729.2 millions
- Cosmetic
- Food
- Animal Feed
- Pharmacy
- Other Industries

Food Industry and Food Service

Retailers US$ 42,883.3 millions
US$ millions
- Major Retail Chain Meat: 25,060.7 Byproducts: 1,601.5
- Small and midsize retailers Meat: 15,119.0 Byproducts: 928.8
- Slaughterhouses own retail stores Meat: 163.8 Byproducts: 9.5

FINAL CONSUMER

Facilitating Agents US$ 23.4 billions

Facilitating Agents – US$ millions

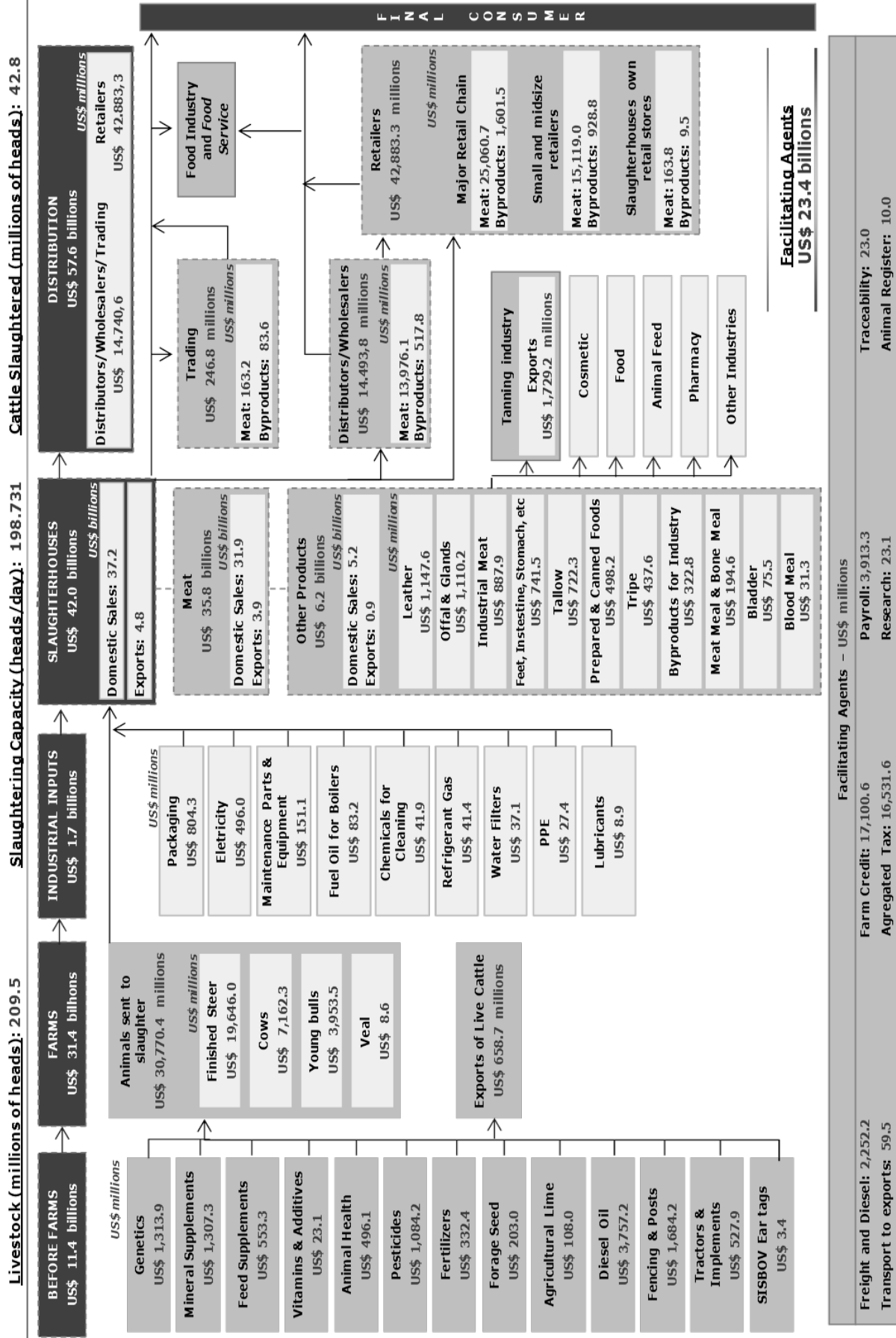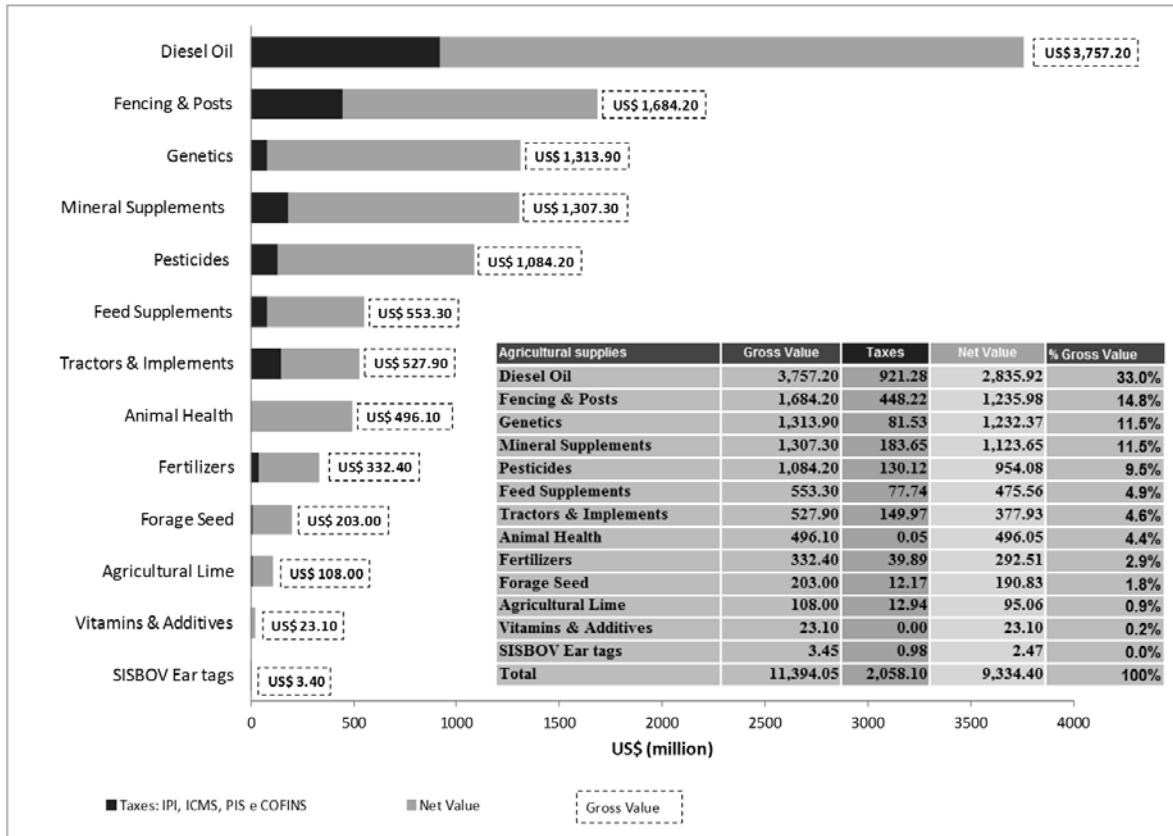|			
Freight and Diesel: 2,252.2	Farm Credit: 17,100.6	Payroll: 3,913.3	Traceability: 23.0
Transport to exports: 59.5	Agregated Tax: 16,531.6	Research: 23.1	Animal Register: 10.0

Figure 3. Brazilian Beef Chain (gross revenue).
Source: Neves et al. prepared with data generated by Markestrat and Scot Consultoria.

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Before the farm

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


Agricultural supplies	Gross Value	Taxes	Net Value	% Gross Value
Diesel Oil	3,757.20	921.28	2,835.92	33.0%
Fencing & Posts	1,684.20	448.22	1,235.98	14.8%
Genetics	1,313.90	81.53	1,232.37	11.5%
Mineral Supplements	1,307.30	183.65	1,123.65	11.5%
Pesticides	1,084.20	130.12	954.08	9.5%
Feed Supplements	553.30	77.74	475.56	4.9%
Tractors & Implements	527.90	149.97	377.93	4.6%
Animal Health	496.10	0.05	496.05	4.4%
Fertilizers	332.40	39.89	292.51	2.9%
Forage Seed	203.00	12.17	190.83	1.8%
Agricultural Lime	108.00	12.94	95.06	0.9%
Vitamins & Additives	23.10	0.00	23.10	0.2%
SISBOV Ear tags	3.45	0.98	2.47	0.0%
Total	11,394.05	2,058.10	9,334.40	100%

Figura 4. Estimated revenue and relative share of the links of agricultural/livestock supplies in the "before-the-farm" segment in 2010.

Source: Prepared by Neves et al. prepared with data generated by Markestrat and Scot Consultoria.

On the farm

A total of 655,000 head of live cattle was exported in 2010, generating an estimated revenue of US$658.7 million. The animals sent to slaughter amounted to 681 million *arrobas* (unit of measure equal to 15 kilos or 33 lbs) generating estimated revenues of US$30.8 billion. Of that total, finished steer (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 US$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.

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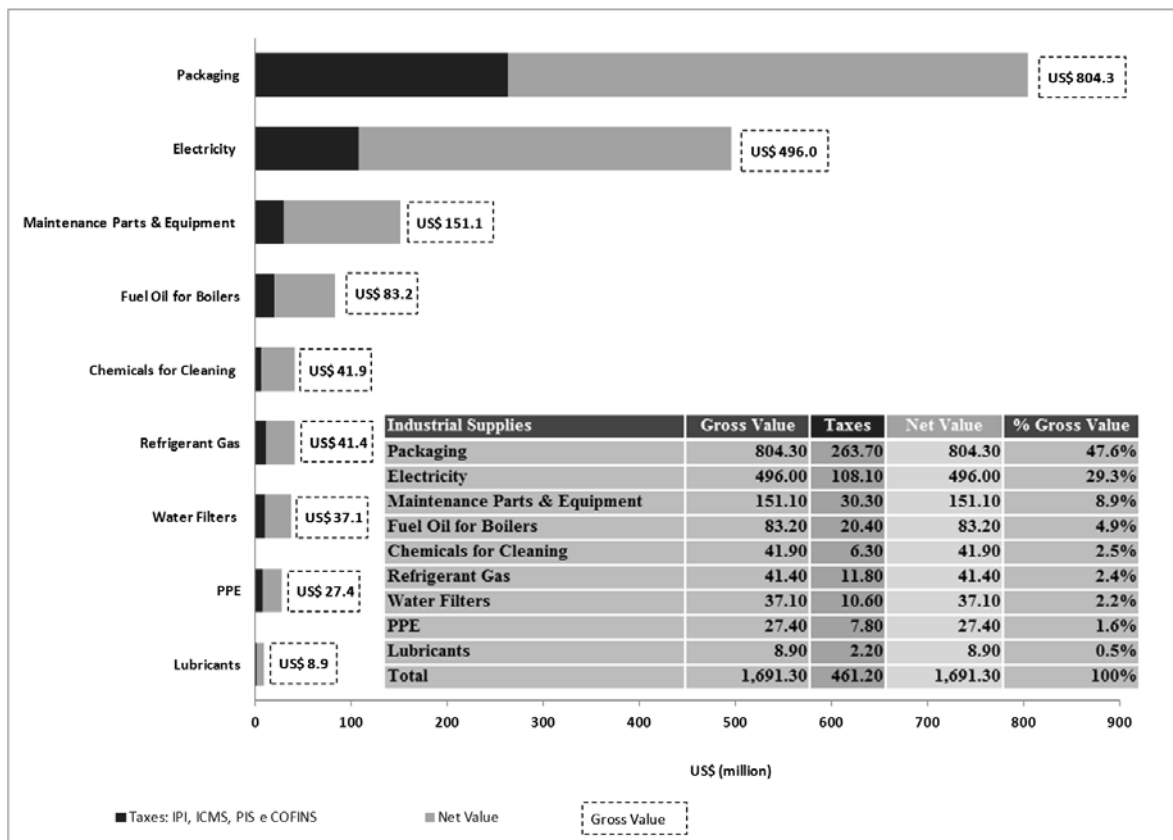
Figure 5. Estimated revenue and relative share of the links of industrial supplies in the "after farm" segment in 2010.

Source: Prepared by Neves et al. prepared with data generated by Markestrat.

In 2010, the slaughtering capacity at the establishments registered with the Federal Inspection Service (SIF) 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. Of this total, meat sales totaled US$35.8 billion, and sales of other products, US$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 US$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, skiner, tendinous meat, tongue, flank, as well as tendon and

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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 US$1.9 billion, of which US$322.8 million refers only to edible byproducts for industrialization and US$1.6 billion to beef cuts.

Sales of beef to distributors/wholesalers generated an estimated revenue of US$10.5 billion for slaughterhouses. The estimated revenue of slaughterhouses from direct sales to retailers was US$19.9 billion, representing 60% of the volume of beef sold by slaughterhouses on the domestic market. Beef exports generated revenues of US$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.

Other Products	Gross Value	Taxes	Net Value	% Gross Value
Leather	1,147.58	142.83	1,004.75	18.6%
Offal & Glands	1,110.18	189.91	920.27	18.0%
Industrial Meat	887.90	136.37	751.53	14.4%
Feet, Instestine, Stomach, etc.	741.5	88.98	652.52	12.0%
Tallow	722.3	90.16	632.14	11.7%
Prepared Foods & Canned Foods	498.22	59.79	438.43	8.1%
Tripe	437.58	24.77	412.81	7.1%
Byproducts for Industry	322.8	38.736	284.064	5.2%
Meat Meal & Bone Meal	194.59	70.01	124.58	3.2%
Bladder	75.46	9.06	66.4	1.2%
Blood Meal	31.31	9.71	21.6	0.5%
Total	6,169.42	860.33	5,309.09	100%

Figure 6. Estimated revenue of slaughterhouses from sales "Other bovine products".
Source: Prepared by Neves et al. prepared with data generated by Markestrat.

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 US$1.1 billion on the domestic market. In 2010, leather exports generated revenues of US$1.7 billion for tanning industry. Brazilian exports of this product represent 6% of worldwide leather exports, ranking Brazil fourth among leather exporting countries.

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Estimated revenues of distributors/wholesalers from the sale of meat and edible byproducts were US$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 slaughterhouses on the domestic market passed through a distributor/wholesaler before reaching the final consumer.

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 US$42.9 billion. Major retail chains accounted for 62.2% of total revenues from sales of beef and beef byproducts, i.e., US$26.7 billion, while small and midsize retailers earned US$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 US$40.3 billion.

Imports of products of the beef cattle production chain totaled US$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

Most prominent among the facilitating agents are the jobs created. 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 US$3.9 billion in 2010.

Conclusions

This paper was intended to present the method CHAINPlan and the adaptation performed in order to broaden understanding about a theoretical basis for operationalization academic research aimed to quantify and map production chains. The modification consist in replacing the workshop stage for a second round of interviews in which the first round results are presented, giving the opportunity to the respondents to change their answers and to comment on the emerging and collective perspective of the research participants. Individual interviews in this stage have brought important gain by making participation more convenient to the respondent and provide greater freedom for the display of data and opinions, without constraining the respondent publicly. Also, it was concluded that the interviews become the most effective method for providing greater convenience for the respondent to participate and by allowing 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.

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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 performed to the method of Neves (2008) proved to be a suitable alternative to the research, and can be understood as a possible approach for convergence of data and opinions. The study limitation is 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 able to bring more transparency to the sectors and support for strategic decision making.

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