

## Overview of sugarcane chain in Brazil

Marcos Fava Neves, Rafael Bordonal Kalaki, Vinícius Gustavo Trombin

School of Economics and Business (FEARP) University of São Paulo  
Bloco C, sl 64. São Paulo, Ribeirão Preto, 14.040-900, Brazil  
favaneves@gmail.com

School of Economics and Business (FEARP) University of São Paulo  
Bloco C, sl 64. São Paulo, Ribeirão Preto, 14.040-900, Brazil  
rbkalaki@gmail.com

School of Economics and Business (FEARP) University of São Paulo  
Bloco C, sl 64. São Paulo, Ribeirão Preto, 14.040-900, Brazil  
vinicius.trombin@gmail.com

### ABSTRACT

In 2013, Brazil was the world's largest producer of sugar cane with a share of 39.4%. The aim of this paper is to present a method for mapping and quantification of productive chains and discuss the results of this method in the sugar cane chain in Brazil. To achieve this, was applied the method CHAINPlan which was developed by Prof. Marcos Fava Neves in 2004 focusing in strategic planning and management of agribusiness systems. The complete overview of a chain is justified by bringing greater transparency to the sector, clarifying myths and adding value to the image of the chain.

The sugar cane chain's GDP was US\$ 43.4 billion, equivalent to 2% of Brazilian GDP or almost the overall economic output produced in a country like Paraguay, North Korea, Afghanistan, Jamaica and Estonia. Total gross revenue (financial movement of a chain in a year) of the sugar cane chain was about US\$ 107.7 billion. The values presented here do not represent a census, but the attempt to estimate the gross value of production. This data serves as input for public and private decision-making, showing who participates, the interconnecting links among chain participants and the industry's capacity to generate resources, taxes, and jobs.

### Indexing terms/Keywords

Mapping And Quantification, Sugar Cane, Chain.

### Academic Discipline And Sub-Disciplines

Economics and Business.

### SUBJECT CLASSIFICATION

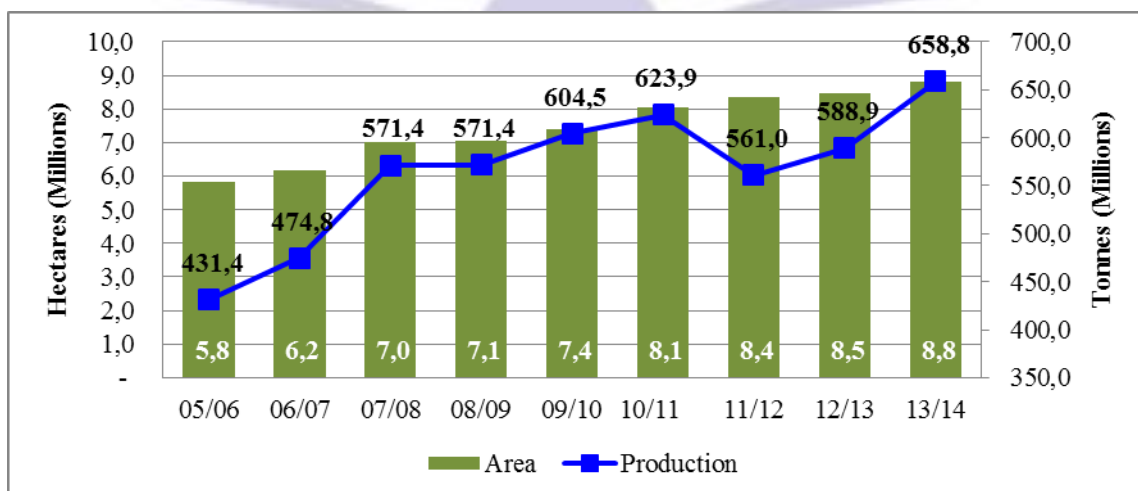
Agribusiness and Strategy.

### TYPE (METHOD/APPROACH)

Exploratory study; CHAINPlan method was applied; forms of data collection were desk; research and in-depth interviews.

### INTRODUCTION

The importance of the sugar-energy sector in Brazil is historic, dating from the time of colonization, and later walking side by side with the development of the country. In addition, the sector is one of the mainstays of the Brazilian economy. In 2013, Brazil was the world's largest producer of sugar cane with a share of 39.4%. As shown in Figure 1, sugar cane currently covers 8.8 million hectares in Brazil, or 3.2% of the country's total arable land (FAO, 2014).





### Figure 1. Area and production of Brazilian sugar cane

Source: CONAB (2015).

The mapping and quantification of the agribusiness chains is the subject of several previous studies under the supervision of Professor Marcos Fava Neves. The first was made for the wheat chain by Rossi and Neves (2004), followed by the orange juice chain by Neves and Lopes (2005), then for the milk chain by Consoli and Neves (2006), sugar cane by Neves, Trombin and Consoli (2010), in 2010, and again for the citrus chain by Neves and Trombin (2010). These studies are technical research projects that aim to generate detailed knowledge about the magnitude of economic and social development of the productive chain in Brazil.

The analysis goes from the farms' inputs to the products that are offered to the consumer. The study presented in 2010 by Neves, Trombin and Consoli shows the results of the 2008/09 crop in which the scenario changed over the years. Thus, the ethanol stimulus policy at the time of the first quantification encouraged farmers to increase sugar cane plantations and industrial process owners to build new processing units. Production increased in the field and the industry, which led to increased business along the chain and hence to the increase in the sectorial GDP.

Objectively, the research problems, which are intended to respond to the sugar cane chain in this paper, focusing on the year 2014, are:

- How significant is the sum of sales of the various links in the supply chain and its Gross Domestic Product (GDP)?
- How much tax is generated by the production chain?
- How many direct and indirect jobs are generated in Brazil?
- How significant is the sum of the wages paid to workers during a harvest?

For each link of the chain, the sales were estimated by adding the sales of all final goods and services offered in the economy of the 2013/14 crop. Initially, interviews with professionals of the various links of the chain were held through the collection of secondary data. The transactions of the product and byproducts were calculated during their transformation from raw materials to finished product. The study also measures government investment through agricultural credit policies, which quantifies the manpower and taxes generated.

The complete overview of a chain is justified as it provides greater transparency to the sector, clarifies myths, and adds value to the image of the chain. The information collected allows a market intelligence gain that can support the structuring of a strategic plan in order to identify innovations in business, explore new opportunities and raise the competitiveness of the sector. The information may also be used to support decision-making in the public sector and in those operated by individual or collective companies.

## THEORETICAL FRAMEWORK

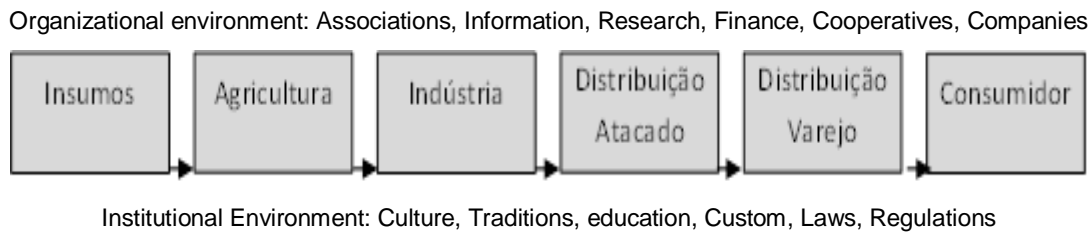
### Approaches to agribusiness systems, supply chains and networks

Two traditional and pioneering approaches to the concept of agribusiness systems are found in the literature and have been developed in different times and places, namely the approach developed by Goldberg (1968) and the proposal by Morvan (1985).

Goldberg (1968) developed the theory of Commodity System Approach (CSA) in the USA while studying the productive systems of citrus, wheat and soybeans. The term CSA indicates that a commodity system addresses all actors involved in the production, processing and distribution of a product, emphasizing the following product transformations in the system. The concept analyzed the traditional relationship of buying and selling and evaluated institutional bias, concluding that the final destination of agricultural products was the agricultural industry and not the consumer. The author's merit lies in the modification of the focus of analysis, which was previously limited only to production within the farm, to looking at the system as a whole, analyzing the agricultural sector from the global economy and not only considering it in the isolation sector.

Another traditional approach to agribusiness systems was proposed by Morvan (1985), in France, which defines a string ("filière") as a set of related operations to transform a product. The author also states that the filière analysis is an important tool for describing systems, organizing the integration of studies, and analyzing industrial policies, companies and collective strategies. Battle (2001) complements this by saying that the chain has complementary interdependence and is influenced by technology.

Zylbersztajn (2000) states that a SAG can be defined as a succession of operations that are vertically organized production activities, from production to the final consumer (Figure 1), covering the following key elements: actors, sectors, relationship between them, institutional environment and support organizations.



**Figure 1 - Agribusiness system and typical transactions**

*Source: Zylbersztajn (2000)*

A production chain is, first of all, a segmentation with economic, offering agents that compose better conditions for observation and analysis. A chain of production is organized around agricultural products, which broadly include the notion of industry and field; thus causing the observer not to be deprived of macroeconomic data. Therefore, it is around these products is organized commercial game targeting a more competitive product can be made available to the consumer (LEUSIE, 2005).

Complementing the notion of the agribusiness system, the concepts of networks arise. Omta, Trienekens and Beers (2001) define networks as total agents within an industry and / or between industries that are related and that can potentially work jointly seeking to add value to consumers.

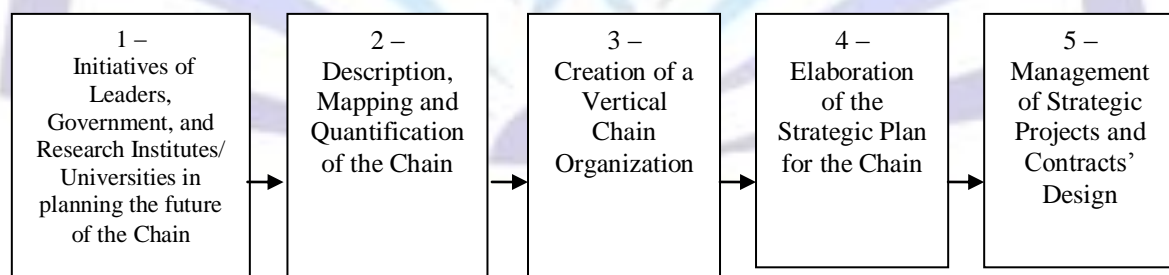
Lazzarini et al. (2001) integrate the approaches of the concepts of systems and networks in a new approach, referred to as netchains by them, which make it possible to consider existing organizational interdependencies in a network, and the various coordination mechanisms (management plans, standardization of processes and adjustments) and sources of value (production and optimization of operations, cost reduction operations, diversity and coespecialização of knowledge).

Barbosa et al. (2007) argue that the benefit of a network is the design of the individual achievements of each agent in the network and the movement towards the collective benefits for the entire network. For Neves (2008), the concept of the production system brings focus on the vertical relationships between the agents, whereas the concept of network includes vertical, horizontal and lateral relationships between independent agents and, therefore, the concept of network is a more general concept. Ménard (2002) state that networks are a hybrid form of governance and the agro-industrial system is a special network case.

The changes in the macro-environment also affected the relationships in agribusiness systems, whereas in the past it was production pushing the demand and today production is driven by demand. In this context, Saab, and Claudio Neves (2009) argue that to satisfy the consumer, it is necessary to increase the management of all actors in the chain.

## METHOD

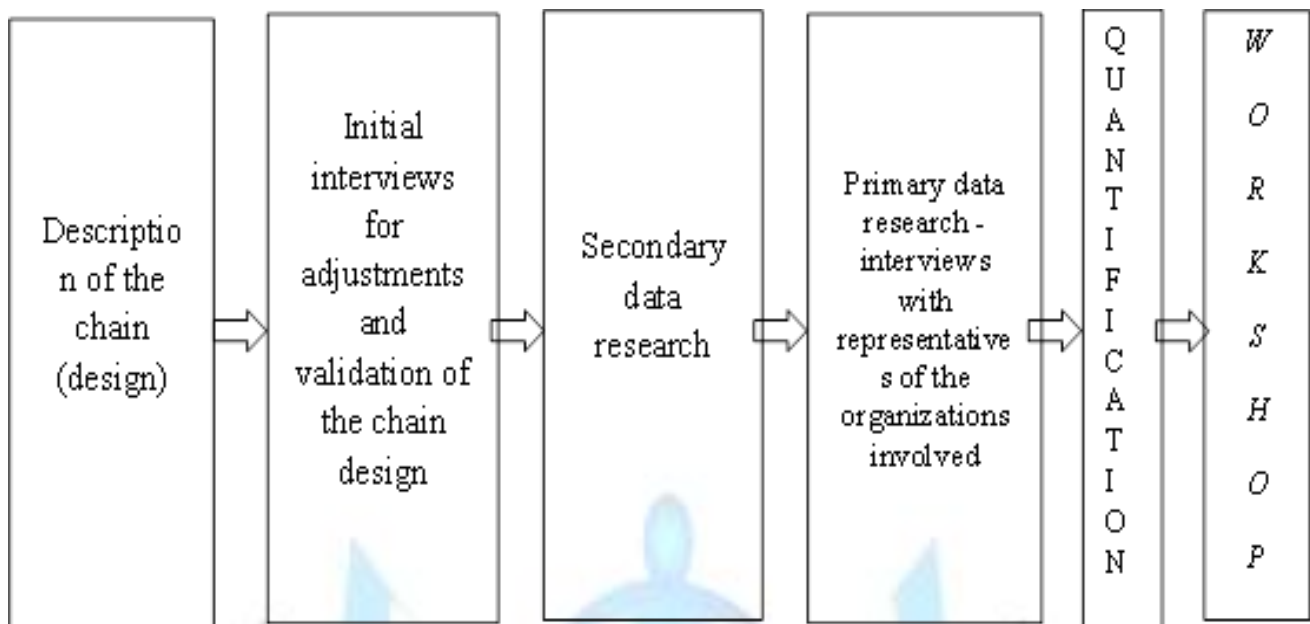
The aim of this paper is to present a method for the mapping and quantification of productive chains and to discuss the results of this method in the sugar cane chain in Brazil. To achieve this, the method CHAINPlan was applied, which was developed by Prof. Marcos Fava Neves in 2004 and focuses on the 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 productive chain.



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

*Source: Neves (2007).*

The second step of the method consists of the mapping and quantification of the chains. This step is made up of six 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 makes the method advantageous. In addition, the figure obtained makes it easy to visualize the positioning and the relevance of different sectors in an existing value chain.



**Figure 2: Method for mapping and quantification of the chain**

*Source: Neves (2007).*

Being one of the purposes of this article, the explanation of this stage of the CHAINPlan method will be explained in detail. 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 axle of the system, due to the objective of the research. In this paper, the sugar cane chain was chosen as the central object of the system, while taking into account the Goldenberg (1968) notion of commodity system approach (CSA), as well as emphasizing a product as the starting point for the system analysis.

After the productive chain has been designed, the second step is to submit it to sector specialists and interview them, these individuals will have to propose possible adjustments in order to obtain a current reality of the system.

The third stage consists of secondary data research, which according to Malhotra (2001) is collected for purposes that are different from the research problem. For this step, data was sought from sources that have academic and statistical credibility, reputation, and integrity.

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

To select and define the interviews, data that was not found through the secondary research was firstly identified, and thus was selected for interviews with agents in the chain. To be selected, the agent had to match some characteristics; i.e., to have access to the information and data of the sector in study, to have knowledge and experience regarding the system, to be willing to collaborate with the research and promote a communication channel for futures contact, and in addition, to indicate possible contact agents to contribute with data that was not available.

The quantification (fifth stage) determines the turnover of each sector in the chain, through the companies' revenues and estimative to several sub sectors of the sugar cane productive chain. Therefore, it is important to delineate the period of the research's evaluation. In order to guarantee the data's confiability, some secondary and primary data were contrasted in an attempt to find incongruous possibilities. In this process at least two different data sources were used to try and check the results, with additional interviews with similar agents used when required.

In the sixth step, a workshop is organized to present the results and discuss the numbers.

As mentioned at the beginning, the method was applied many times by Neves, its application in the cane sugar chain was first performed in 2009 and now, in 2014, the study is carried out again.

## RESULTS AND DISCUSSIONS

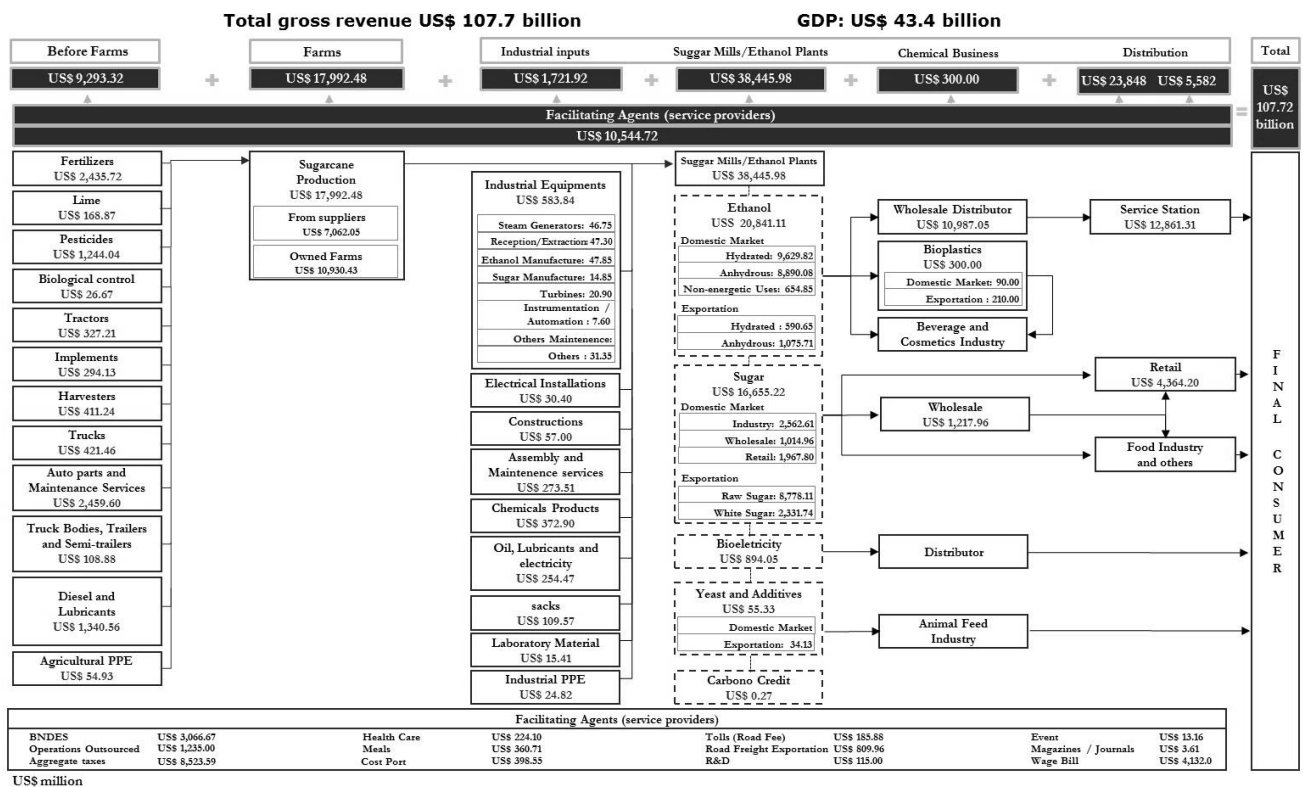
The sugar cane chain's GDP was US\$ 43.4 billion, which is equivalent to 2% of Brazilian GDP or almost the entire economic output produced in a countries such as Paraguay, North Korea, Afghanistan, Jamaica and Estonia. The GDP chain calculation was estimated by adding the sales of all final goods and services offered in the economy (Table 1).

Produto	Mercado Interno (MI)	Mercado Externo (ME)	Total (MI + ME)
	US\$ (milhões)	US\$ (milhões)	US\$ (milhões)
Ethanol Hydrated	12,861.31	590.65	13,451.96
Ethanol Anhydrous	8,890.08	1,075.71	9,965.79
Non-energetic Uses	654.85	-	654.85
Sugar	6,926.80	11,109.85	18,036.65
Bioelectricity	894.05	-	894.05
Bioplastic	90.00	210.00	300.00
Yeast and Additives	21.20	34.13	55.33
Carbon Credits	-	0.27	0.27
<b>Total</b>	<b>30,338.29</b>	<b>13,020.61</b>	<b>43,358.90</b>

**Table 1: Estimates of the Sector's Gross Domestic Product Based on the End Products**

Source: developed by the authors.

Total gross revenue (financial movement of a chain in a year) of the sugar cane chain was about US\$ 107.7 billion. This value represents the sum of all estimated sales made by every link of the chain and the financial transactions of the described facilitating agents. Figure 3 is the major output of this method, representing the sugar cane chain, and the values below each link indicate its gross sales in this productive chain in 2008.



**Figure 3: Sugar Cane Chain (gross revenue).**

Source: developed by the authors.

## Before Farms

Composed of the set of machine suppliers, equipment and inputs for agricultural production, the link "before the farms" totaled an estimated turnover of US\$ 9.29 billion in sales for sugarcane cultivation. In this segment, inputs sold in 2012 were recorded that were used in the sugarcane harvest during the 2013/14 season.



The largest financial volume in this segment was from fertilization that reached a turnover of about US\$ 2.5 billion. The turnover achieved by the service providers that perform machinery and equipment maintenance and provide auto parts was similar, reaching US\$ 2.459 billion. Expenses with diesel and lubricants reached US\$1.3 billion while the pesticides added to a US\$ 1.25 billion revenue.

Thus, the link "before the farms" accounted for 9% of the revenue from the entire chain of Brazilian sugar cane during the 2013/14 season.

## On Farms

The estimated revenue generated from the sale of sugar cane to the mills was US\$ 17.99 billion during the 2013/14 season. Sales from own sugarcane industrial units accounted for 61% of the value while 39% was derived from independent sugarcane producers.

The total harvested area was 8.8 million hectares and the mean yield was about 75 tonnes/ha, and 134.4 kg of ATR per ton of cane. The sugar cane crop during the 2013/14 season reached a production of 658,800,000 tons with a mean ATR value of about US\$ 0.20 and a mean value per ton of cane being about US\$ 27.31.

Thus, the link farms, which includes the production and sale of sugarcane accounted for about 17% of the total chain's sales in Brazil during the analyzed season.

## After Farms

The link set to "after the farm" aggregates the equipment industry, service and industrial inputs, plants producing products derived from sugar cane and distribution channels. Together these links obtained an estimated revenue of US\$ 69.90 billion during the 2013/14 harvest.

To quantify the sales of industrial equipment suppliers and companies providing installation and industrial maintenance services, investments in two plants that started operations in 2013 were considered. It was estimated that the equipment industries, services and industrial inputs together earned US\$ 1.72 billion during the 2013/2014 harvest.

As regards the billing of plants and distributors, the amount was US\$ 68 billion. Included in this category are the transactions from the sale of ethanol for energy and non-energy (US\$ 19.17 billion); ethanol sales by gas stations (US\$ 12.86 billion); sugar and ethanol exports (US\$ 12.68 billion); revenue from ethanol for energy purposes distributors (US\$ 10.99 billion); sales of plants in the internal market (US\$ 5.55 billion); sugar sales by wholesalers and retailers (US\$ 5.58 billion); bioelectricity (US\$ 894 million); yeast and additives sales (US\$ 55.33 million); carbon credit (US\$ 266 thousand); and bioplastic (US\$ 300 million).

## Facilitating Agents

The facilitating agents of an agroindustrial system are formed by a group of companies that are essential for its operation but do not own industrial products. The financial transactions in this segment were estimated at US\$ 10.54 billion during the 2013/14 season.

To quantify this category the financial transactions carried out by the following agents were considered: BNDES (US\$ 3.2 billion); export logistics costs (US\$ 1.39 billion); research and development (US\$ 115.0 million); meals and health care (US\$ 585 million); outsourced cut, loading and transportation (US\$ 1.24 billion); events and magazines (US\$ 16.77 million); wages (US\$ 4.13 billion).

In the cultivation of sugar cane and the production of sugar and ethanol, it is estimated that the chain directly employed about 613,000 people, and could reach 988,000 if the seasonal jobs created at the peak of harvest are considered. If informal, direct and indirect jobs are considered, employment levels would reach 3.56 million workers.

Due to all the financial transactions generated by the sugar cane agribusiness system, it is estimated that the tax collection during the 2013/14 harvest was US\$ 8.52 billion.

## CONCLUSIONS

This study aimed to map and quantify the sugar cane chain. The industry's role is impressive with a turnover of over US\$ 107.7 billion per year. This data serves as an input for public and private decision-making, which reveals who participates, the interconnecting links among chain participants and the industry's capacity to generate resources, taxes, and jobs.

The main objective of the study was achieved and the results show that CHAINPlan method introduced by Neves (2008) is a viable alternative for the mapping and quantification of the sugar cane chain. These results are consistent with those obtained by Neves, Trombim and Consoli (2010), which allows comparisons to be made between the studies. This ability enhances the convergence of data and opinions obtained by this approach.

The study has limitations due to 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 (Neves et al. 2014).

The values presented here do not represent a census, but an attempt to estimate the gross value of production. Some hitherto unpublished information will serve as a basis for deeper analysis by researchers, farmers, businessmen, and others parties interested in information concerning the production chain and its insertion in the current world scenario. It is noteworthy that both the material contained in this study, and new data that will be collected in future research projects will



provide improvements in research and knowledge regarding the difficulties encountered in mapping and quantifying the sugar cane chain.

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