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Sugarcane Industry Development Analysis from the Perspective of Agro-Industrial System Quantification

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Abstract

Sugarcane sector has a strong impact as a wealth generator for Brazil. Several authors discuss the importance of quantifying an agro-industrial system. This article aims to analyze the development of the Brazilian sugarcane sector over the past five years and to assess whether the method of mapping and quantification of agribusiness systems (GESis) is a useful tool for analyzing the economic development of an agro-industrial system. The application of the method enabled to see the performance of all the links that make up the agro-industrial system. It also proved to be an important tool to analyze the performance of an agro-industrial system, pointing possible areas for improvement and opportunities. The comparison between both studies contributes to both a better visualization of the sugarcane sector evolution and a better understanding of situational reality of the sector.

Keywords

agribusiness systems, mapping and quantification, sugarcane, GESis, development

1. Introduction

Energy is a key element from the primary and fundamental activity of food production to the functioning of the most varied and technological economic sectors of a nation. The world energy matrix is constituted of renewable and non-renewable fuel, which according to its availability can supply growing fleet of vehicles and machines used to move the economy and enable economic and social development. According to the MAPA (Ministry of Agriculture, Livestock and Supply), the importance of energy security currently focuses on the challenge of supplying the development with clean energy using renewable resources, which has economic and environmental importance.

The Brazilian sugarcane industry shows its strength producing various forms of sustainable and renewable agro-energy (sugar, ethanol and electricity), being able to meet this demand without compromising the environment and the availability for future generations. When addressing this issue, some points deserve close attention such as the importance of economic and social development, entrepreneurship, contractual relationships, independent producers, and respect for workers and the

environment arising from the development of this sector. This article will deal with issues related to the economy and development of the sector in Brazil.

In 2013, Brazil was the largest producer of sugarcane with a 39.4% share. In the production of sugar, the country is also the biggest producer with 21.6% of the total and the largest exporter with a share of 50.1% in total exports. In ethanol production, the country occupied the second position with a total of 26.9% (FAO, 2013; USDA, 2014).

The sector has a strong impact as a wealth generator for the nation, and in 2013/2014 it generated US$ 43.4 billion, which was equivalent to about 2% of Brazil's GDP. The total sum of the sales of the various links that make up the agro-industrial system of sugarcane reached US$ 107.7 billion. The trend is that these values continue to increase while other products, which today are not the main sources of income, gain more importance in wealth generation such as bioelectricity, yeast, bioplastics, sugarcane diesel, biobutanol, cellulosic ethanol and carbon credits (Neves & Trombin, 2014).

The sugarcane business consists of several links: (i) production of sugarcane; (ii) processing of sugar, ethanol and derivatives; (iii) research services, training, and technical and credit assistance; (iv) transport; (v) marketing; (vi) export; and (vii) end user. All these agents involved in the sugarcane industry form the Sugarcane Agro-industrial System.

The financial operation and the wealth generation of one sector are fundamental to the economic development of a city, a region, a state and/or country, and when they are economically developed, they have better conditions to promote their social development. Tax revenues play an important role as well as jobs that are distributors of income, since through the capitalization of workers they move the economy of their cities through sales in supermarkets, clothing stores, food establishments, leisure and others.

Sugarcane plants generate the income that circulates in the city and is widely distributed via wages, taxes and purchases of goods and services, moving sectors such as construction, restaurants, retail and others. It generates a multiplier effect (Neves & Trombin, 2014).

Authors such as Kaplinsky and Morris (2000), Kaplinsky and Fitter (2001), Castro (2000) and Neves (2008), discuss the importance of quantifying an agro-industrial system, claiming that this quantification allows to visualize financial flows throughout the chain, giving greater transparency and identifying the most important and deficient links and the importance of understanding broadly the environment in which an organization operates.

Neves (2008) developed the method of Strategic Planning and Management of Agribusiness Systems (GESis), which addresses the strategic management of an agro-industrial system and which brings in one of its steps the description stage, mapping and quantification of agro-industrial system, showing a sequence of steps to perform it. This method was applied in various agro-industrial systems such as wheat, milk, citrus, beef and sugarcane industry.

Since the importance of the sugarcane industry in Brazil is historic, dating back to the time of colonization (1500), and later walking side by side with the development of the country, being a

mainstay of the Brazilian economy and also for being an important factor for the development of Brazil, this article aims to answer the following research problem: What was the performance of the Brazilian sugarcane industry in the last five years raised from mapping and quantification studies of agro-industrial systems?

In the face of the facts presented, this article aims to (i) analyze the development of the Brazilian sugarcane industry in the last five years, (ii) using mapping and quantification studies of agro-industrial systems as a comparison instrument, and (iii) assess whether the method of mapping and quantification of agro-industrial system (GESis) is a useful tool for analyzing the economic development of an agro-industrial system.

2. Theoretical Framework

In this work the theoretical framework addresses the agro-industrial systems, the evolution of this concept, its characteristics and aspects related to the quantification of agribusiness systems. Besides that, the quantitation method of agro-industrial systems developed by Neves (2008) is seen in detail.

2.1 Approach regarding Agro-Industrial Systems and Quantification of Agro-Industrial Systems

A traditional and pioneering approach regarding agro-industrial system concept that is found in the literature is the one proposed by Goldberg (1968) who developed the theory of Commodity System Approach (CSA) in the USA in studies on the productive systems of citrus, wheat and soybeans. The term CSA indicates that a commodity system addresses all players involved in the production, processing and distribution of a product, emphasizing the sequence of product transformations in the system. The concept analyzes the traditional relationship of buying and selling and evaluates institutional bias, concluding that the final destination of agricultural products was the agricultural industry and not the end user.

Another traditional approach to agribusiness systems was proposed by Morvan (1985), in France, which defines a chain ("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 of companies and collective strategies. Batalha (2001) complements claiming that the chain has complementary interdependence and is influenced by technology.

Zylbersztajn (2000) states that an Agribusiness System (SAG) can be defined as a succession of vertically arranged operations of production activities, from the production to the end user (Figure 1), covering the following key elements: agents, sectors, relations between them, institutional environment and support organizations.

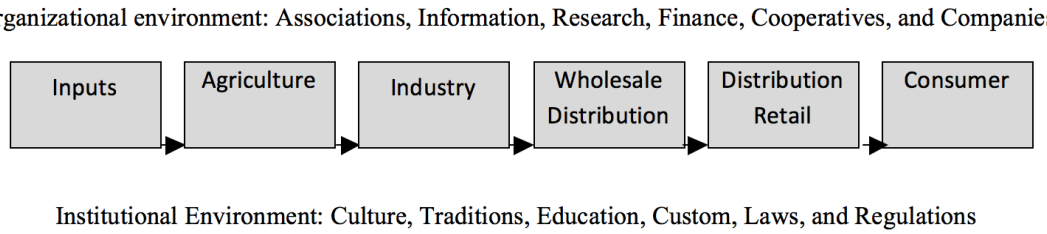

Figure 1. Agribusiness System and Typical Transactions

Source: Zylbersztajn, 2000.

Zylbersztajn (1995) stresses the need for an agribusiness systemic approach, since there is a dependency relationship between the links of the chain and this relationship can not be ignored. This interdependence is present in the food supply chain concept proposed by Folkerts and Koehorst (1997).

Kaplinsky and Fitter (2001) aim to identify the value generated along the production chain. They analyze the global coffee chain by performing a method to map and quantify the sector. Their method is interesting as it incorporates the variable geographical location, clearly showing the essential steps and what is made in consuming countries. According to the authors, in order to achieve a more equitable global income distribution in the coffee chain, consumers should be educated to recognize that the best coffee is directly linked to its place of origin instead of its brand.

Kaplinsky and Morris (2000) point out that supply chain quantification methods tend to result in a tree of input and output streams which carry all information collected. Data can be found in different primary and secondary sources such as annual reports, balance sheet and interviews with key players in each link in the chain involved in the research and other areas.

According to Castro (2000), when analyzing a productive chain, the capital, translated in a particular currency (US Dollars, Brazilian Reais and others), is the most appropriate flow element for its measurement. Castro (2000) also states that the equity in the appropriation of economic benefits generated along the chain can be analyzed by quantifying the capital flow, starting at the end user and verifying the accumulation in other components of the chain.

It is important to highlight that this study does not use a network approach since the unit of analysis is not a network but an agro-industrial system (SAG). Beside that, agro-industrial system is considered limited by the borders of a particular country. The players in the agro-industrial system are: input suppliers, farmers, suppliers of industrial inputs, industries, distributors, service providers and consumers, in addition to facilitating agents, who are players that are linked to the agro-industrial system, but not directly (not allocated inside the main links).

Neves (2008), states that the productive system concept focuses the existing vertical relationships between agents, whereas the concept of network includes vertical, horizontal and lateral relationships between independent agents and, therefore, the network concept is more general. Ménard (2002) claims that networks are a hybrid form of governance and that the agro-industrial system is a special case of network.

2.2 Strategic Planning and Management of Agro-Industrial Systems (GESis)

The method of Strategic Planning and Management of Agro-Industrial Systems (GESis) was developed by Neves in 2008 and addresses the strategic management of an agricultural system, that is, its focus is in the direction of agro-industrial system in the long term. This method has already been applied several times in other agro-industrial systems such as wheat by Rossi and Neves (2004), milk by Cônsoli and Neves (2006), sugarcane by Neves, Trombin and Consoli (2010), beef by Neves, Trombin, Gerbasi and Kalaki (2014) and cotton by Neves and Pinto (2012). The method was also applied in agro-industrial systems abroad such as the milk chain in Argentina (2007) and wheat (2007) and milk (2010) in Uruguay.

The method of Strategic Planning and Management of Agro-Industrial Systems (GESis) is a five-step process as shown in Figure 2 below:

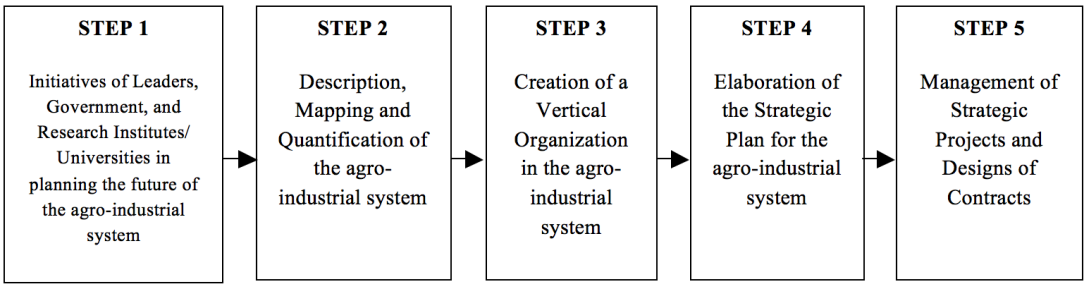

Figure 2. Method of Strategic Planning and Management of Agro-Industrial System (GESis)

Source: Neves, 2008.

Step 1 refers to the initiative of any organization in the industry (usually a trade group), with research institutions and universities and/or government that aim to organize a planning process and a future vision for the system. The government can also take the initiative through sectoral chambers. At this step of the method, information on the production chain is received from research organizations, government and private sector. This step aims to identify the key players participating in the system, how to have representativeness in this system, the existing organizations and associations, that is, information on important topics about the agro-industrial system studied. This step already begins to join forces for the second step of the method (Neves, 2004, 2008).

Step 2, which was the focus of this research, aims to describe, map and quantify the agro-industrial system. It has been a major subject of study for the enrichment of scientific knowledge in administration: the systemic approach. The importance of understanding the environment in which an organization operates is highlighted by many researchers (Neves, 2004). Therefore, searching for a systemic view of the agro-industrial system, Step 2 is divided into six stages (Figure 3).

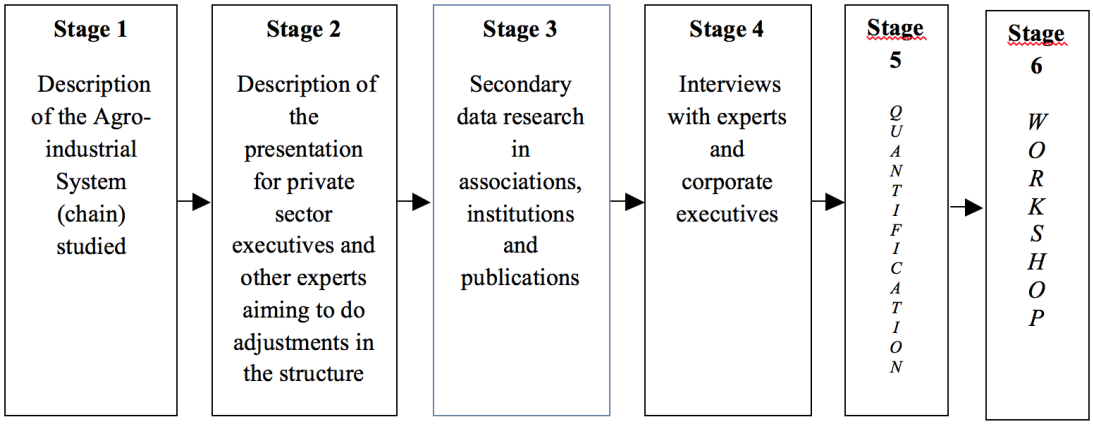

Figure 3. Method to Map and Quantify Agro-Industrial Systems

Source: Neves, 2008.

The six stages that comprise the Step 2 can be summarized according to Table 1:

Table 1. Brief Description of the Stages of the Methodology for Description, Mapping and Quantification of an Agro-Industrial System

Stages of Step 2	Procedures
1. Description of the agro-industrial system (chain)	Design of the agro-industrial system through boxes (flowchart), respecting the flow of products, starting from the inputs to the end consumer
2. Presentation of the description for private sector executives and other experts, aiming adjustments in the structure	From the first version of the description (design) of the agro-industrial system, some in-depth interviews should be carried out with industry experts whether being corporate executives operating in the system or other experts (researchers, sectoral leaders, etc.) in order to adjust the design
3. Secondary data research in associations, institutions and publications	Search for sales data and other numbers of the industry. Private associations can provide their members information on sales, even on the internet. A careful literature review in the search of recent dissertations/theses, and academic papers or magazines and major newspapers can also be performed
4. Interviews with experts and corporate executives	Interviews with managers should be held in the search for raising the total financial amount sold by companies in the sector. Interviews with purchasing managers can also be conducted in order to estimate the market from the opposite side of the system. This is the central point of the methodology

5. Quantification	At this stage, all data received must be processed and inserted into the system description just below the industry name or link. The data should be sent to companies that collaborated with the research in order to have the values analyzed. Companies must then send the data back with their contributions and comments. At this stage, there is a large number of materials to elaborate strategy suggestions to be presented at the end of workshop
6. Workshop	In this final stage, a workshop is conducted to present the results and discuss the numbers

Source: Neves, 2008.

Throughout the applications, since its creation, the quantification process of agro-industrial systems enabled to display some advantages such as: (i) the application of the methodology is relatively simple and direct, not depending on information of public sources to gather information; (ii) from the design obtained, the visualization of the positioning and relevance of the different sectors of the value chain is facilitated; (iii) the credibility of the research increases due to data validation through workshop; (iv) the process generates a commitment environment among the participants in the workshop, since the formation of heterogeneous focal groups elaborate a list of problems and collective actions that exist in the whole system; (v) the environment formed can be used as an integration tool for the system. This step allows greater transparency so that the coordination can be made in the best way (Neves, 2004, 2008).

Step 3 refers to the creation of a vertical organization in the agro-industrial system that could contribute to the achievement of certain objectives: (i) organization and exchange of existing information; (ii) organization with flexibility to capture and use resources; (iii) having a voice and representation of the agro-industrial system with institutions; (iv) discussion of strategies in a forum; (v) working on a positive agenda for the sector; and (vi) building and implementing GESis (Neves, 2008).

The step 4 of the GESis method aims the assembling of the Strategic Plan for the System. Neves (2008) proposes twelve steps that can be used for the preparation of the Strategic Plan, as shown in Figure 4.

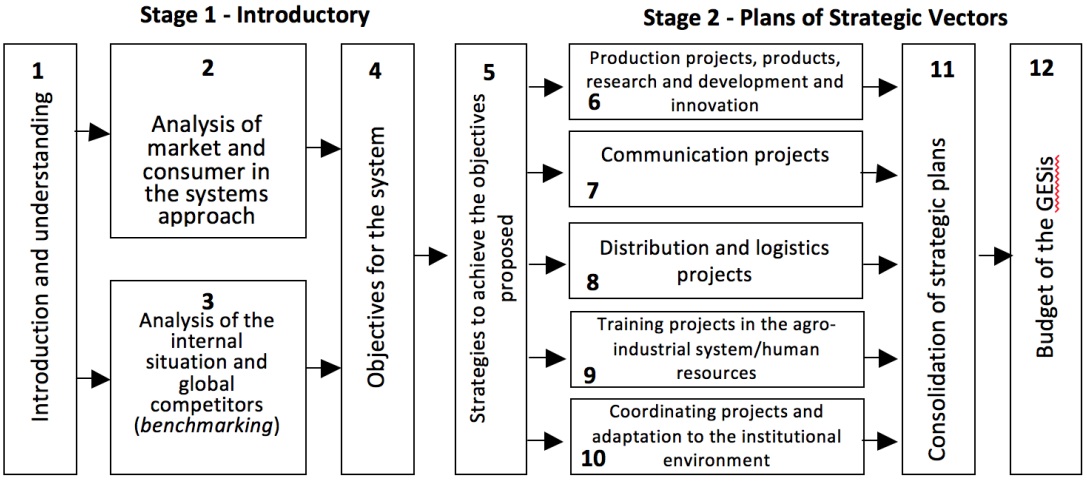

Figure 4. Summary of the Step 4 of the GESis Method

Source: Neves, 2008.

Step 5 of the method aims the administration of prioritized projects and the preparation of contracts. Several projects will emerge from the Step 4. Neves (2008) states that these projects should be worked out based on the traditional steps of a project, with description and analysis of objectives, actions, indicators of performance, suggestions of implementation, projects and plans related, teams, interpellations, deadlines, budgets and management forms. In this step, contracts between agents of the agro-industrial system should also be designed.

Due to the fact it is a method that addresses the strategic management of agro-industrial systems, the overall focus is in the long-term management, the definition of objectives and collective strategies that will be analyzed in an overall perspective, the development of a sustainable and viable structure in the long term.

The method is an effective implementation attempt to: (i) build a vertical organization that is able to implement the strategies with the creation of support of an organizational structure, distinctive skills, abilities and selected people for key positions; (ii) install an administrative support system with policies, procedures and skills needed for the strategy of the organization created; (iii) establish a supporting budgetary strategy, with a collection system that is fair and consistent between the links and members of the system; (iv) model a cooperative culture, establishing shared values, ethical standards and an institutional environment that supports collective strategy of the system; (v) establish a system of incentives related to the objectives and strategies, motivating the agents and links of the agro-industrial system to perform the actions planned, inducing the desired performance and guiding actions to the result of the system; (vi) establish the practice of a strategic leadership for the organization of the system (Neves, 2008).

3. Methodological Procedures

The objective of this research is to make a comparative analysis of the Brazilian sugarcane industry performance in the 2008/2009 and 2013/2014 crops using GESis method for the mapping and quantification of agro-industrial systems. In order to do so, this study was characterized for being an exploratory and qualitative research.

The study was performed in 3 phases: (i) the search and analysis of mapping and quantitation studies of 2008/2009 and 2013/2014 crops; (ii) transformation of values into a common comparative base; (iii) analysis of the results of the 2008/2009 and 2013/2014 crops. It is important to highlight that data from mapping and quantification studies relating to 2008/2009 and 2013/2014 crops were obtained using the GESis method, allowing the comparison between them since they were obtained by the same calculation formula.

3.1 Phase 1. Search and Analysis of Mapping and Quantification Studies of 2008/2009 and 2013/2014 Crops

In this phase of the research, the quantification results of the sugarcane industry in the 2008/2009 and 2013/2014 crops were searched and analyzed. Two studies were consulted: mapping and quantification of sugarcane sector of the 2008/2009 crop and the mapping and quantification of the 2013/2014 crop.

Quantification study of the 2008/2009 crop: this study was conducted by Markestrat (Marketing & Strategy Projects and Research Center) in 2009 involving about 10 researchers for 5 months. The study showed for the first time to Brazil, the economic grandeur of sugarcane production chain, describing its links, identifying the financial flows between them, highlighting the enormous importance in generating jobs and taxes. The study results were published in several papers and book chapters. The study used in this research as a quantification data source of the 2008/2009 crop was the "Measurement of Sugar Cane Chain in Brazil", written by Neves, Trombin and Consoli, published in the International Food and Agribusiness Management Review, Volume 13, Issue 3, in 2010. The search system used for obtaining the mapping and quantification of the sugarcane industry was the website "Science Direct".

Quantification study of the 2013/2014 crop: the quantification study of the 2013/2014 crop was also performed by Markestrat in 2014, also involving nearly 10 researchers. This study was published in a book titled "A dimensão do setor sucroenergético: mapeamento e quantificação da safra 2013/2014", coordinated by Neves and Trombin (2014), which served as data source for this study.

After searching the data in the studies cited, the variables were selected and collected, which were considered the most representative by the authors regarding the sector's development. The selected variables were: GDP of the sector, total financial transaction, financial transactions of the link of agricultural inputs (before the farm), financial activities on the farms, financial activities of industrial inputs (after the farm), financial transactions of the link of mills/distilleries (after the farm), wages in the sector, taxes aggregated, total sugar sales, total ethanol sales, sales of bioelectricity, price of hydrous ethanol, price of sugar, price of sugarcane ton, price of bioelectricity, cost of agricultural production, cost of industrial production, industrial yield, agricultural productivity and industrial

profitability.

3.2 Phase 2. Transformation of Values in a Comparative Basis

Before starting the comparison of the two studies, it was necessary to turn them into the same standard unit of currency and value. The transformation of the studies in the same scale of value is fundamental due to the fact that, in a period of five years, the sector is affected by inflation and currency fluctuations. Therefore, it was decided to carry out a comparison of the studies bringing the values for the present value basis in March 2014. It was chosen March 2014 because it was when the quantification study of the 2013/2014 crop ended up.

Since the study conducted in 2014 was already with the basis in March 2014, it was necessary to transform the study in 2009 to the basis of March 2014. This transformation was carried out in three steps: (i) the conversion of the values presented in the study in 2009 of dollar (US$) to real (R$), (ii) the transformation of nominal values into current values based on March 2014, and (iii) the conversion of the values of the two studies in dollars.

The conversion of dollar to real, from the values regarding the quantification of 2008/2009, was made using the formula:

$$VR\$ = VUS\$ \times Cd \quad (1)$$

In which, VR$ = values in real (R$); VUS$ = values in dollar (US$); Cd = dollar exchange rate used in the 2009 study.

Then the transformation of the values in the 2009 study was made to current values with basis on March 2014. This transformation was carried out by inflating the values in 2009. It was used as a deflator index one of the indexes which measures inflation in Brazil, which is the General Price Index-Internal Availability (IGP-DI). The formula used in the transformation in the present values of March 2014 was:

$$Vr_{14} = Vn_9 \times \sum (In_{13} + In_{12} + In_{11} + In_{10}) \quad (2)$$

In which, Vr_{14} = Current value in March 2014; Vn_9 = Nominal value in 2009; In_{13} = IGP-DI collected in 2013; In_{12}= IGP-DI collected in 2012; In_{11}= IGP-DI collected in 2011; In_{10}= IGP-DI collected in 2010.

After bringing the values in 2009 and 2014 to current values in the same comparative basis, the values were converted to US trade dollar using the average sale price in the 2013/2014 crop, equivalent to US$ 1 = R$ 2.25, in order to give a comprehensive understanding of the scale of values. The conversion was carried out as follows:

$$VUS\$ = VR\$ \div Cd \quad (3)$$

In which, VR$ = values in real (R$); VUS$ = values in dollar (US$); Cd = dollar exchange rate used in the study in 2014.

Thus, this stage of the research results in the current values in the same comparative basis (March, 2014) of the quantifications of 2008/2009 and 2013/2014 crops.

3.3 Phase 3. Comparative Analysis of the Results of the 2008/2009 and 2013/2014 Crops

After the standardization of the numbers for the same comparison basis, the variation of the results for the period was calculated. The formula used to calculate the variation was:

$$\Delta = \frac{V14 - V09}{V09} \quad (4)$$

And = Variation from 2009 to 2014; V14 = current values of the 2013/2014 crop; V09 = current values of the 2009/2008 crop.

The results were organized in a table for later analysis.

4. Results

The variables selected for comparison of the studies were organized in Table 2. When analyzing the result found in 2008/2009 crop and comparing it with 2013/2014, it is concluded that the GDP of the sugarcane industry increased 44%, with the inflation already corrected from the IGP-DI. Although GDP has increased, it can not be stated that the industry has shown better performance as a whole.

In this study, GDP was calculated from the sum of final sales of the production chain, that is, the total turnover generated by exports and sales of final products in the domestic market, thus it is directly influenced by the price and the quantity sold of final products. Another way to calculate GDP is by the sum of value added at each transaction. Due to the lack of this information, the calculation of GDP was carried out through the sales of its final products.

When performing a comparative analysis of prices between 2008/2009 and 2013/2014 crops, it was noted that, in the case of sugar, the real increase was 36%. In ethanol, the increase was 37% and bioelectricity fell by 32%. Regarding the quantity sold, sugar increased by 22%, ethanol 49% and bioelectricity 242%. Therefore, the analysis of sales of the major products of the sector clearly shows the reasons that led to the increase in GDP. However, in order to have a better understanding of the comparative performance, it is necessary to assess other variables.

Table 2. Performance of the Items Analyzed in 2008/2009 and 2013/2014

	Items	Unit	Crop 2008/2009	Crop 2013/14	Variation between 20013/14 and 2008/09	
Quantification	GDP Sugarcane	US$ (billion)	30.1	43.4	44.2%	⬆
	Total Financial Transaction	US$ (billion)	92.7	107.7	16.2%	⬆
	Financial Transaction of the Segment Before the farm—Agricultural Inputs	US$ (billion)	9.9	9.3	-6.1%	⬇
	Financial Transaction of the Segment	US$ (billion)	12.3	18.0	46.3%	⬆

	On the Farm					
	Financial Transaction of the Link Industrial Inputs—Segment After the Farm	US$ (billion)	6.8	1.7	-75.0%	⬇
	Financial Transaction of the Link Industries—Segment After the Farm	US$ (billion)	24.2	38.4	58.7%	⬆
	Wages	US$ (billion)	9.5	4.1	-56.8%	⬇
	Taxes Aggregated	US$ (billion)	7.3	8.5	16.4%	⬆
	Total Sugar Sales	Tons (millions)	31.1	37.8	21.5%	⬆
	Total Ethanol Sales	Liters (billion)	20.3	30.2	48.8%	⬆
	Sales of Bioelectricity	MW	503	1720	242%	⬆
Market and Production indicators	Price of Hydrous Ethanol (R$/l)	US$/liter	0.48	0.66	37.5%	⬆
	Price of Sugar	US$/bag 50 kg	15.0	20.4	35.9%	⬆
	Price of Sugarcane (Ton)	US$/ton	23.1	27.3	18.2%	⬆
	Price of Bioelectricity	US$/hour	87.3	59.3	-32.1%	⬇
	Cost of Agricultural Production	US$/ton	25.7	34.3	33.5%	⬆
	Cost of Industrial Production	US$/ton	33.9	43.4	28.0%	⬆
	Industrial Yield	Kg ATR/t of sugarcane	143.3	134.4	-6.2%	⬇
	Agricultural Productivity	Tons/ha	81.0	74.8	-7.7%	⬇
	Industrial Profitability	US$/ton	3.64	1.4	-6.5%	⬇

In this comparative analysis, the operating production cost industry increased 28%, and its two main components—raw materials and manpower—had significant increases of 18% and 25%, respectively. Another factor that impacted negatively was the deterioration in the yield of raw material, which fell by 6%, which corresponds to about 10 kg of ATR per ton of cane.

This reduction is due to climate issues, expansion of cultivation to less productive areas, aging of sugar cane plantations, and pests and diseases. Therefore, in the 2013/2014 crop a greater amount of sugarcane processed per ton of final product was required, and prices were higher for the industry rather than in the previous crops, which encumbered the final result of the sector. These factors led to the decrease of 62% in the profitability of agribusiness by ton of processed sugarcane.

The increase in production costs and the decrease in profitability led to a growing indebtedness of the sector in recent years. Currently, there is an indebtedness that exceeds the annual revenue and 20% of this turnover is committed to the payment of interests. The indebtedness of the sector reached in the

2013/2014 crop around US$ 30 billion, 38% higher than in 2008/2009, which is equivalent to about US$ 50.00 per ton of processed sugarcane in 2013/2014. This debt is mainly due to high investments made in crops previous to the international financial crisis of 2008, driven by favorable scenarios for ethanol and sugar. The main driver in the case of ethanol was due to the increased flex car fleet, and in the case of sugar, consumption growth in emerging countries. However, in the years that followed, ethanol became less competitive with gasoline as a result of national policy, which triggered a decrease in the share of ethanol in Otto cycle, going from 44.7% in 2008 to 33.7% in 2013. For sugar, there were consecutive production surplus rising global stocks and resulting in stock/consumption levels around 41%, which pushed the price of the commodity down. This situation resulted in a decrease of investments for construction of new industrial units and maintenance of those that are in operation. In the 2008/2009 crop, 29 units started to operate, compared to only 2 in 2013/2014. Due to this situation, the revenue of raw materials companies was reduced by 75% when comparing the two crops.

The area planted with sugarcane for the period increased. Thus it was normal to expect that the agricultural inputs also would have higher revenues. However, in the period analyzed, agricultural inputs fell by 6% in sales of 6%. In 2008/2009, approximately US$ 1,400 was invested in inputs by hectares of sugarcane harvested, and in the 2013/2014 crop, this investment was US$ 1050, which was a reduction of 25%.

There was also a reduction in the number of formal workers in the comparison between the 2008/09 and the 2013/2014 crops. In the sugar mills, there were more than 64,000 of jobs lost and in the ethanol distilleries more than 20 thousand jobs. The wages generated in 2008 was about US$ 9.5 billion discounted to present values and although there was improvement in the average income of workers in the last four years, it was found a decrease in payrolls in the last crop due the reduction of jobs. In 2013, the wage mass of the sector was US$ 4.13 billion, which corresponded to a decrease of 57%.

The variables selected allow us to analyze that, despite the sectoral GDP in 2013/2014 crop being higher than the 2008/2009 crop, not all links of the agro-industrial system presented growth. According to Neves and Trombin (2014), since 2009, about 50 industrial units in the south central region closed their operations in the last seven crops, and in the 2014/2015 crop, 10 units may suspend the activities.

5. Conclusions

The application of the method of Planning and Strategic Management of Agro-industrial Systems (GESis) was positive for both years. The fact that the method is flexible enabled a more coherent application in the sugarcane sector. Necessary adjustments to the reality of the sector were made in its first application in 2009. In 2014, the GESis was replicated with the adaptations already made in 2009. The method enabled to clearly see the performance of all the links that make up the agro-industrial system, analyzing which weakened and which improved for possible action proposals. It was possible to carry out a comparison between the two applications and measure the performance of the sector in the period since the values used were calculated by the same method, allowing a comparison basis.

It was concluded that the method Strategic Planning and Management of Agribusiness Systems (GESis) proved to be an important tool to analyze the performance of an agro-industrial system, pointing possible areas for improvement and opportunities in the system.

In this research only the values obtained in studies conducted in 2009 and 2014 were analyzed, which represented a limitation. An in-depth and qualitative research, aiming to understand the reasons that led to the performance of all variables analyzed would be important to have a deeper understanding of the sector's development.

In the case of the sugarcane industry, which is the target of this research, it was concluded that the comparison between both studies contributes to both better visualization of the evolution of the sugarcane industry and a better understanding of situational reality of the sector. In the interval between one study and another, the ethanol stimulus policy that was in force at the time of the first quantification, encouraged farmers to increase sugarcane plantations and industries to install new processing units. Thus producers and industries that were excited about the direction the government was addressing ethanol have made the sugarcane industry grow in size and the production increased in the field and industry, leading to an increase in business along the chain and hence the increase in sectoral GDP.

However, when analyzing the economic reality, it was realized that the situation is no longer of growth as it was in that year because the sector's competitiveness worsened mainly as a consequence of the artificially low price of gasoline held by the current government. The sugarcane industry that was considered one of the most successful for the national economy is now undergoing a crisis. In less than four years, there was a complete discontinuation of ethanol stimulus policy, resulting in widespread disbelief and low expectations about what can be offered, since there is no consistent long-term policy for fuels in Brazil.

By not encouraging the sugarcane industry, the government fails not only to stimulate the production of a fuel that pollutes 90% less than gasoline, but also reduces the possibility of several municipalities to experience impressive growth and hence improvement in the life quality of the population. A sector that has always been important for the economic development of Brazil now deserves greater attention, with clear policies and incentives to be effective as in the past.

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