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Revisão/Review

Peeling back the citrus in Brazil: mapping and quantification of the brazilian citrus chain

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SUMMARY

The CHAIN Plan developed by Neves (2007) is a practical process for developing strategic plans for production chains and was applied in several projects in Brazil. One of the initial steps of this method is mapping and quantification of production chains. This step provides knowledge of the size of the production chain analysed, in terms of social and economic magnitude of all the links that comprises. Here this method is presented in detail, 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 citrus chain. In this research, the GDP (Gross Domestic Product) of the citrus chain for the 2008/09 crop year was estimated at US$ 6.5 billion. Here is probably the more updated and profound radiography of the citrus chain in Brazil. This study aims to show an overview of the Brazilian citriculture, including its mapping and quantification, in order to promote a better understanding of the business and the variables that impact its trends while bringing more transparency to the sector. 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.

Index terms: production chain, planning and management, citrus juice.

RESUMO

"Descascando" a citricultura no Brasil: mapeamento e quantificação da cadeia citrícola brasileira

O CHAIN PLAIN, desenvolvido por Neves (2007), é um processo prático para o desenvolvimento de planos estratégicos para cadeias de produção e foi aplicado em diversos projetos no Brasil. Um dos passos iniciais deste método é o mapeamento e quantificação de cadeias produtivas. Esta etapa fornece o conhecimento do tamanho da cadeia de produção analisada, em termos de magnitude econômico e social de todos os elos que compreende. Aqui este método é apresentado em detalhes, a fim de ser útil para pesquisadores interessados em mapeamento e quantificação de uma cadeia. Posteriormente, apresentamos os resultados da aplicação do método em uma das cadeias do agronegócio mais importante do Brasil, a

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cadeia citrícola. Nesta pesquisa, o PIB (Produto Interno Bruto) da cadeia citrícola para a safra 2008/09 foi estimada em US $ 6,5 bilhões. Estes resultados são provavelmente a radiografia mais atualizada e profunda da cadeia citrícola no Brasil. Este estudo tem como objetivo mostrar um panorama da citricultura brasileira, incluindo o seu mapeamento e quantificação, a fim de promover uma melhor compreensão do negócio e as variáveis que impactam suas tendências ao trazer mais transparência para o sector. Este material deve servir de estímulo para a tomada de decisão, pública e privada, além disso, mostra a interligação íntima entre os elos da cadeia e sua capacidade de gerar receitas, impostos e empregos.

Termos de indexação: cadeia de produção, planejamento e gestão, suco de laranja.

INTRODUCTION AND RESEARCH PROBLEM

Since the beginning of Brazil´s colonization process, orange trees have been cultivated and spread throughout the national territory due to the excellent edaphoclimatic conditions. The combination of an established competitive citrus industry and a developed crop production made it possible for Brazil to become the World´s largest orange fruit producer.

Citriculture is currently present in over three thousand Brazilian municipalities, with almost four hundred of them located in the State of São Paulo, and generates more than two hundred thousand direct and indirect jobs.

In Brazil, in 2008/09, subject of this article, according to FAO (2010), the total planted area of citrus, 89.4% is orange, tangerine with 5.8%, 4.7 % with lemon and lime and 0.1% with other citrus. Therefore, a greater focus will be given to Orange due to its importance.

Over one hundred million boxes of orange with 40.8 kg each, 30% of the national production, are consumed each year as fresh fruit among Brazil´s population which have at their disposal a nutritious and healthy fruit at an accessible price.

The other 70% of the national production is processed into orange juice, of which 98% is exported, bringing important revenues to the country of approximately US$ 1.5 billion to US$ 2.5 billion each year.

Mapping and quantification of agribusiness chains in Brazil have been the subject of several studies. The first focused on the wheat chain by Rossi & Neves (2004), then orange juice by Neves & Lopes (2005), next milk by Consoli & Neves (2006), sugarcane by Neves, Trombin & Consoli (2010), and again the citrus chain by Neves & Trombin (2010) whose findings are presented in this paper. In 2011, the cotton sector, and finally the beef industry, were studied.

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 and its GDP?
- 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 collected information 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 objective of this study was to provide further insight and extensive dimensions and economic movements of the Brazilian citrus chain.

THEORETICAL BACKGROUND

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 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).

OBJECTIVES AND METHODOLOGICAL PROCEDURES

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. 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 & Neves (2000) also comment that the definition of the agribusiness systems boundaries shall be dependent on the research purposes, which are generally focused on one 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 citrus chain in Brazil, with major details in São Paulo state, focusing on citrus juices and derived products, and also citrus fruits for fresh consumption and give an overview of the citriculture in order to promote a better understanding of the business and the variables that impact its trends while bringing more transparency to the sector. However, in some cases data presented surpass this scope, in order to analyse the dependence and importance of some agents and sectors in the production chain.

To achieve this, the CHAIN Plan method was applied, which was developed by Neves (2007) 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.

The second step of the method consists of mapping and quantification of chains. This step comprises six stages, as shown in Figure 2. Its application is relatively simple and straight forward, 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.

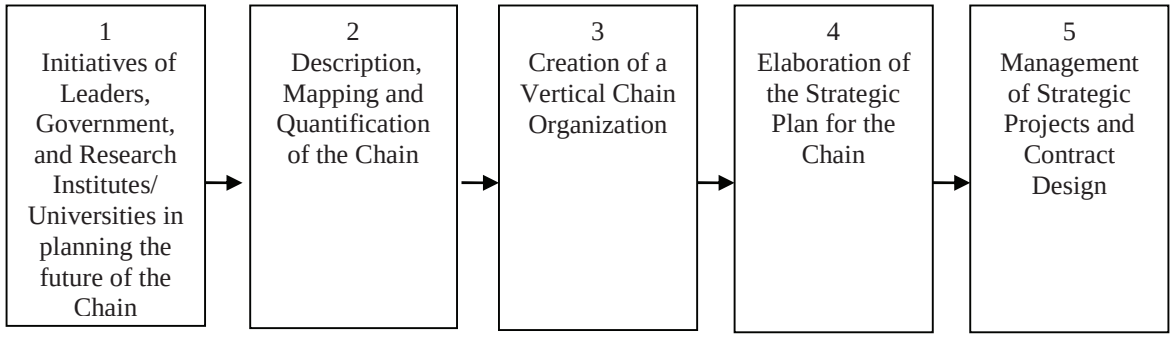


Figure 1. The CHAIN Plan method for strategic planning and management of food and bioenergy chains
Source: Neves (2007).

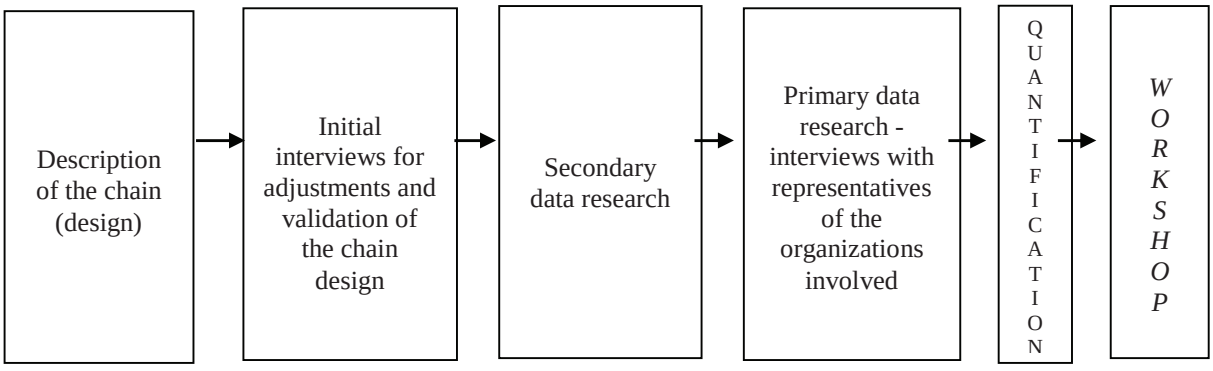


Figure 2. Method for mapping and quantification of the chain
Source: Neves (2007).

We will explain further in details the method CHAIN Plan 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, it 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, deep interviews were done with representatives of several organizations in the citrus chain.

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 with the researchers and promote communication for future contacts, additionally, must be able to indicate possible contact agents who will contribute with unavailable data.

The quantification (fifth stage) determines the turnover of each sector in the chain, through the company revenues and estimates of several sub sectors of the citrus 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, with additional interviews with similar agents when needed.

In the sixth step, a workshop is organized for the presentation of results and discussion of numbers.

RESULTS

This study estimated the Gross Domestic Product (GDP) value of the Brazilian citrus production chain at US$ 6.5 billion (Table 1) for 2008/09, which corresponded to approximately 2% of the country´s agribusiness GDP. Of this total, US$ 4.39 billion were generated in the internal market and US$ 2.15 billion in the external market. Sales of fresh fruit in the internal market represented 34% and 28% from orange juice exports (FCOJ – Frozen Concentrated Orange Juice and NFC – Not From Concentrated). It is important to note that orange juice exports accounted for 94% of the citrus complex exports. The citriculture GDP was estimated by the sum of the sales of final goods within the citrus agroindustry system.

Figure 3 represents the citrus chain and the value in each column indicates the gross sale of that particular item in 2008/09. The gross revenue of the citrus sector in this period was approximately US$ 14.6 billion. This value represents the sum of the estimated sales from several segments of the production chain and the financial transactions of the facilitating agents.

Pre Orchard

The agricultural input industry sold US$ 819 million in agricultural products to the citrus sector in 2008/09. The sales are detailed in Figure 4. It is important to note that 84% of the total value comes from sales of acaricides, fungicides and pesticides due to high standards required for pest and disease control.

Citriculture is the second most intensive in use of agricultural pesticides in Brazil, behind only cotton. In 2009, citrus producers consumed 4.2% of all commercial sales of agricultural pesticides (acaricide, insecticides and fungicides) and applied an average of 17.5 kg/hectare in active ingredients, of which 6.8 kg/hectare are acaricides and 5.1 kg/hectare of insecticides. The increasing incidence of huanglongbing (HLB) and citrus variegated chlorosis (CVC) has drastically increased the consumption of pesticides in citrus crops by over 600% from 2003 to 2009, impacting directly the total consumption of agricultural pesticides in citriculture (Figure 5).

Table 1. Gross Domestic Product (GDP) estimated for Brazilian citrus production chain based on final goods

Product	Internal Market (IM) US$ (millions)	External Market (EM) US$ (millions)	Total (IM + EM) US$ (millions)
Oranges	2,232.9	19.1	2,252.0
Lemons/Limes	673.1	48.2	721.2
Tangerines	945.9	5.8	951.7
FCOJ	-	1,545.9	1,545.9
NFC	-	299.5	299.5
Citrus pulp	85.2	93.5	178.8
Essential oils	-	72.9	72.9
Terpenes	-	55.2	55.2
Frozen cells	-	9.1	9.1
D-Limonene	-	0.9	0.9
Orange juice/nectar	459.1	-	459.1
Total	4,396.21	2,150.10	6,546.31

Source: Elaborated by author.

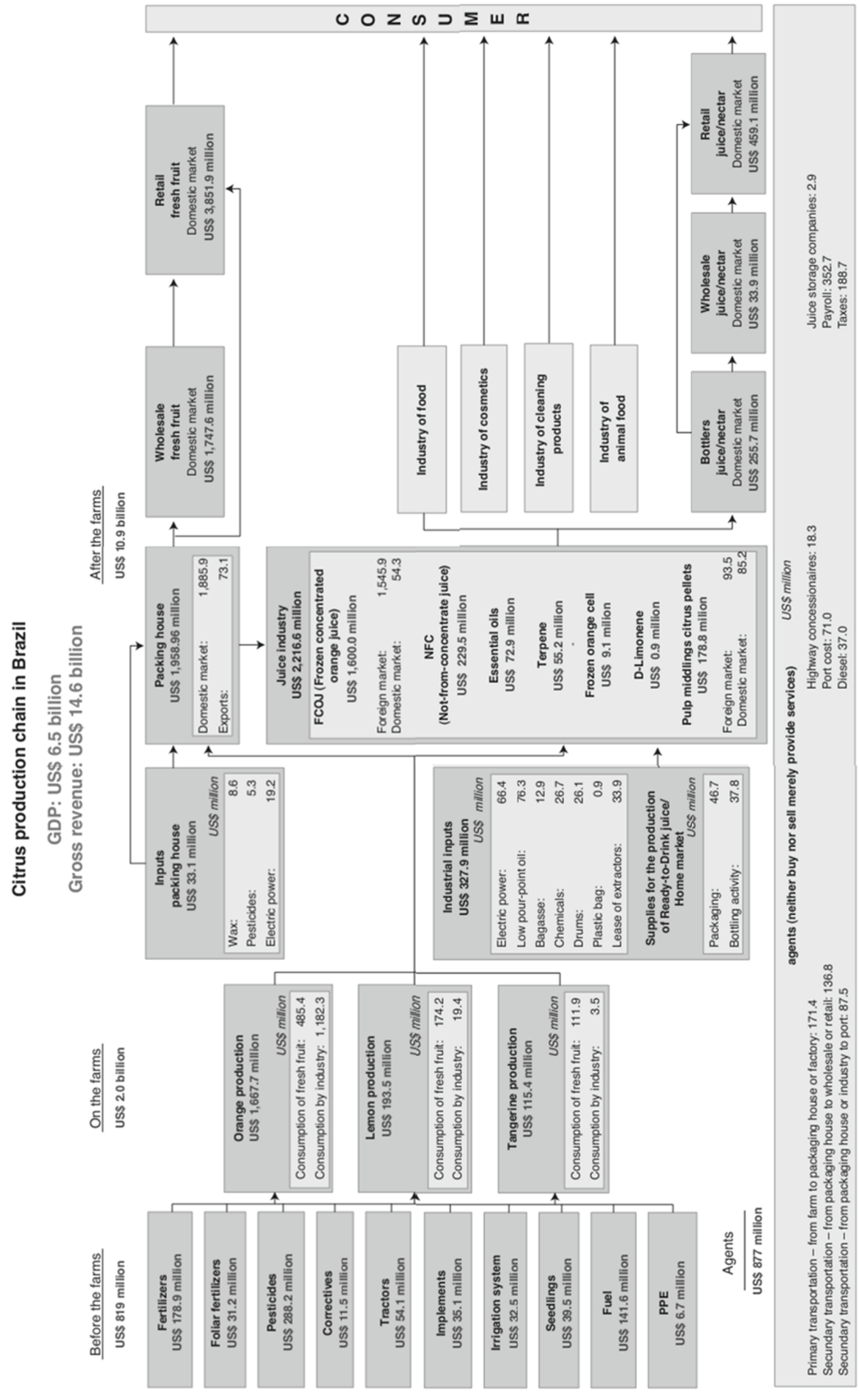


Figure 3. The mapping and quantification of the Brazilian Citrus Chain in 2008/2009
Source: Elaborated by Neves and Trombin with data from Markestrat.

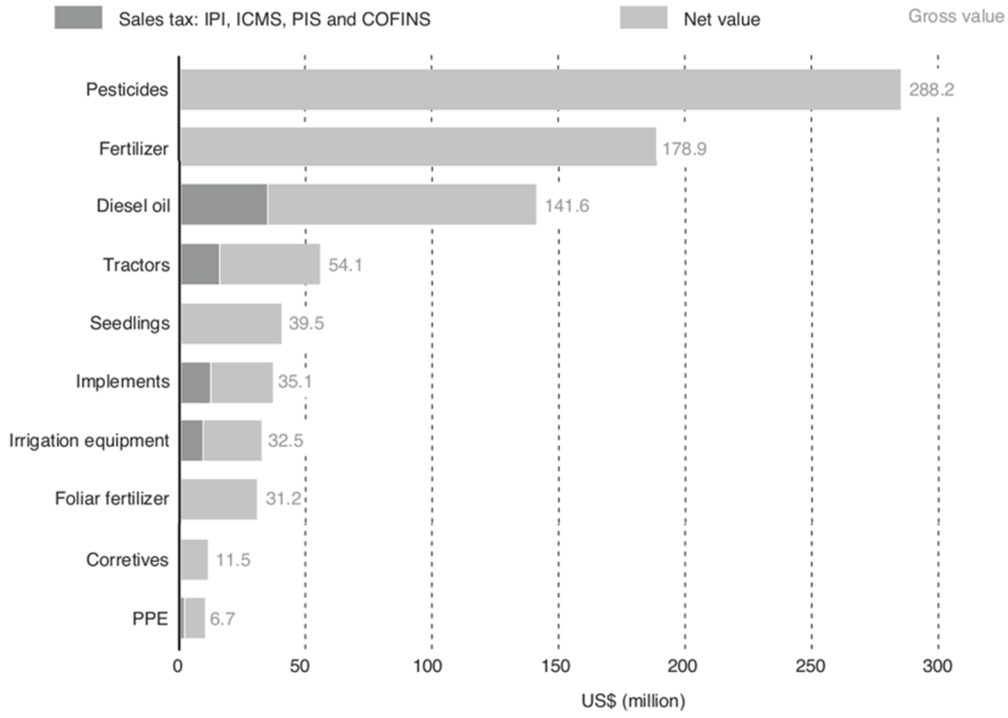


Figure 4. Sales of agricultural supplies link in the citrus cultivation in Brazil, 2008/2009
Source: Elaborated by Neves and Trombin with data from Markestrat.

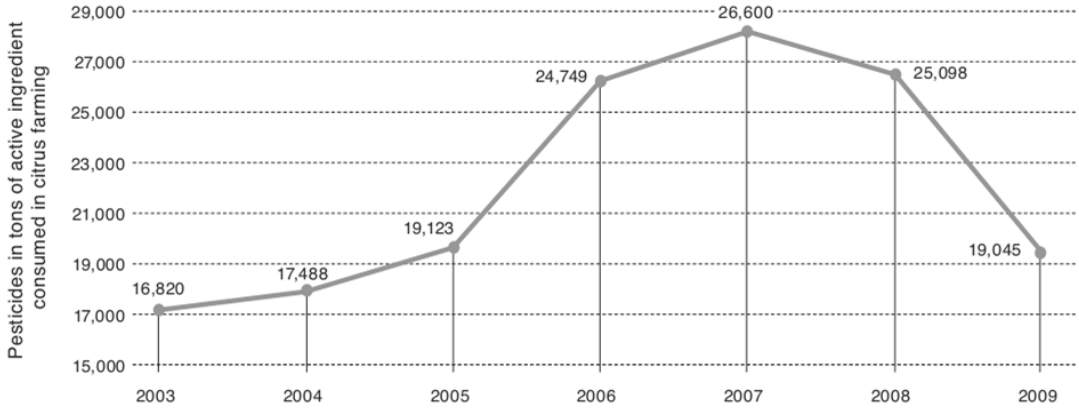


Figure 5. Evolution in pesticide consumption in citrus cultivation, from 2003 to 2009
Source: Elaborated by Markestrat with data from SINDAG (2010).

In regards to fertilizers, citriculture is responsible for only 2% of the total consumption in Brazil, after 11 other cultures. In terms of intensity in use, citriculture ranks sixth, applying 362 kg/hectare in 2009, a reduction of 10.2% in relation to 2008 and of 26.3 % in relation to 2007. This is partly justified by a worsening in the exchange ratio between a ton of fertilizer and a 40.8 kg box of orange. In 2007, it took 60 boxes of 40.8 kg of oranges to buy one ton of fertilizer and in 2009 it took 95 boxes (Figure 6).

Orchard

Citriculture is present in almost every Brazilian state. With over 800 thousand hectares in orchards, oranges are the most cultivated fruit in the country with an area occupying about metadade the planted area of fruit in Brazil, being about two times larger than the area of banana, eleven times greater than the area of grape and twenty times greater than the area of apple,. The State of São Paulo concentrates around 80% of the

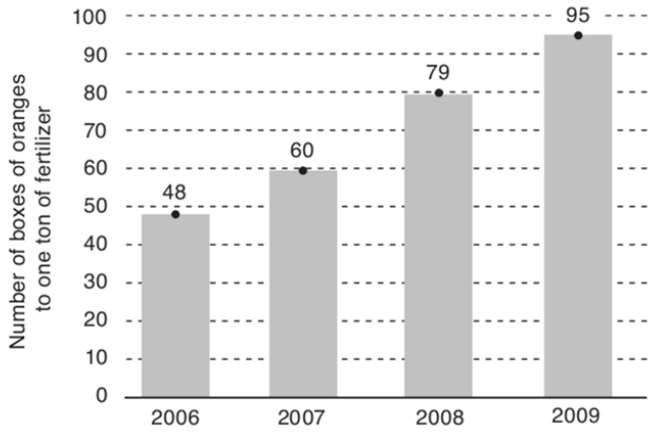


Figure 6. Exchange ratio between a ton of fertilizer and a 40.8 kg box of oranges
Source: Elaborated by Markestrat with data from ANDA (2010).

area with orange orchards but the States of Bahia, Minas Gerais, Paraná and Sergipe are the regions in which the expansion has been occurring more intensively. This is due to a rise in demand for fresh fruits from inhabitants of the north and northeast regions of Brazil and reflects a recent increase in their purchasing power.

Oranges can have three basic destinations: processing industry, internal market and external market. In the States of Bahia and Sergipe, 77% of the production is absorbed by the fresh fruit market. In the Brazilian citrus belt (the Brazilian citrus belt includes the state of São Paulo, Triangulo Mineiro and Northwest Paraná), 86% of the production is destined for the processing industry. This is due to the characteristics of the oranges, which enable the industry to have a high efficiency in its conversion into FCOJ at 66º Brix.

As shown in Figure 7, the citrus fruits (oranges, lemons/limes and tangerines) revenue in 2008/09 totaled US$ 2 billion. From the total production, 67% was destined for the processing industry, 32% to the internal fresh fruit market and 1% was exported as fresh fruit. From the total of oranges processed by the industry, 35% was produced in the industry's farms, 34% was bought from orange producers with pre-established Short and long-term contracts and 31% was bought from orange producers on the spot market.

Despite the fact that areas cultivated with oranges in Brazil have reduced by 8% since the beginning of 1990, production has increased by 22% during the same period due to a dramatic increase in productivity. While in 1990 the national average for productivity was 380 boxes per hectare, in 2010 it increased to 475 boxes per hectare. A significant part of this increase is justified by the changes in the citriculture technological practices, which are more enhanced in the citrus belt. This region currently contains over 80% of the national citrus production. Although it is a continuous area, there are some particularities to each location. Therefore, to simplify the study and for a better understanding, in this research, following recommendations of specialists in the sector, the citrus belt was divided into five different production regions, illustrated in Figure 8 which also pinpoints where the processing industries are located.

Amongst the changes observed in the technological practices, it is important to note the increase in tree density within the orchards. In 1980, the

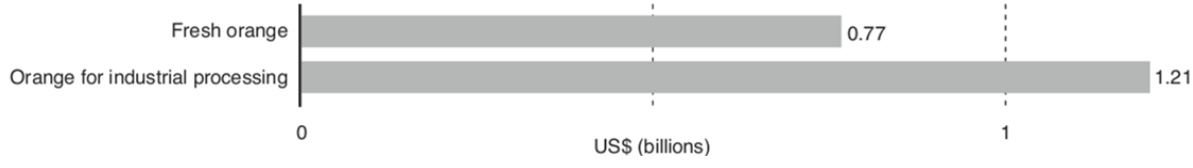


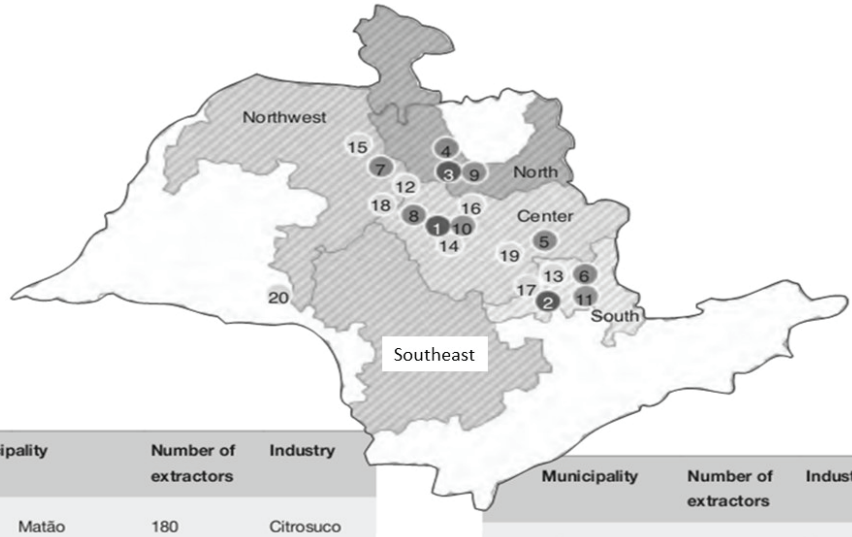
Figure 7. Revenue from sale of orange produces
Source: Elaborated by Neves and Trombin with data from Markestrat.

average planting density was of 250 trees per hectare, in 1990 it was of 357 and in the early years of 2000 it was of 476. Currently, some of the modern orchards are planted with 833 trees per hectare. Other significant changes that positively impacted productivity include: the use of nursery trees with better quality produced in screened nurseries following strict legislation and guidelines; the diversification of root mainly using Citrumello Shingle, etc; advancements and application of expertise aiming at more efficient orchard management and gains in phytosanitary control quality; increase in use of irrigation systems in areas where water deficit problems are more severe; and new considerations in order to determine the optimum moment to renovate an orchard.

Within the citrus belt there was also a migration of the orchards from the regions North, Northwest and Central to the South and Southwest regions. This movement began in the year 2000 and was initially motivated by a more favorable climate condition, lower land values and an absence of threat to the orchards represented by diseases such as citrus sudden death (MSC) CVC. Currently the main motivations for this movement include risk mitigation of HBL, which has already affected 239 municipalities in the State of São Paulo, and the expansion of the sugarcane crop throughout the State of São Paulo, which has occupied citrus areas presenting lower productivity and inadequate profitability.

This reconfiguring of production location is evident in the Southwest region. Between 2005 and 2009 its number of trees has increased by 89%, propelling the Southwest region from last to second place in quantity of trees within the citrus belt. Also, 42% of the new trees (from zero to two years of age) are concentrated in this region, meaning that its participation and importance in production will increase in the years to come.

The Brazilian citrus belt can also be characterized according to the growers profile. The data for such characterization was provided by CitrusBR and was based on the producers who delivered oranges to the industry within 2009/10. It enabled the construction of



	Municipality	Number of extractors	Industry
1	Matão	180	Citrosuco
2	Limeira	60	
3	Bebedouro	72	
4	Colina	96	Cutrale
5	Araraquara	84	
6	Conchal	44	
7	Uchoa	42	
8	Itápolis	24	
9	Bebedouro	84	Dreyfus
10	Matão	70	
11	Eng. Coelho	60	

	Municipality	Number of extractors	Industry
12	Catanduva	66	Citrovita
13	Araras	66	
14	Matão	56	
15	Mirassol	24	Bascitros
16	Dobrada	12	KB
17	Rio Claro	7	Selial Citros
18	Itajobi	6	Agromex
19	São Carlos	6	Hildebrand
20	Santa Cruz do Rio Pardo	5	Guacho

Figure 8. Division of the regions in the citrus belt
Source: Elaborated by Markestrat with data from CitrusBR (2010).

Table 2. Citriculture production details within the Brazilian citrus belt

Harvest	Productive adult trees over 2 years of age (millions)	Yield (boxes* per tree)	Production (millions of boxes)	Oranges to fresh fruit market (millions of boxes)	Oranges to industry (millions of boxes)	Industrial efficiency (boxes / ton of juice**)	Orange juice production (1,000 of tons)
2005/06	159.3	1.9	303.4	38.1	265.3	228	1,164.5
2006/07	158.4	2.22	351.0	34.4	316.6	231	1,369.2
2007/08	159.6	2.23	356.0	38.3	317.7	233	1,362.7
2008/09	160.7	2.01	323.3	35.5	287.8	254	1,132.9
2009/10	164.2	1.93	317.4	43.3	274.1	257	1,064.7

* 40.8 kg boxes.

** orange juice at 66 oBrix.

Source: Elaborated by Markestrat with data from CitrusBR and USDA (2010).

the producer´s profile for the first time, according to the industry´s records regarding area, number of trees and volume produced.

The results show that 87% of producers belonging to the citrus belt can be categorized as small (a total of 11,011 producers), with properties that have up to 20 thousand trees, and are responsible for 21% of all trees. A total of 11% of producers (a total of 1,496) are categorized as medium sized, with properties having 20 to 199 thousand trees, and contain 32% of all trees. And only 2% are categorized as large producers (total of 120), with properties that have over 200 thousand trees, and contain 47% of all trees (Table 3).

The data also makes it possible to observe the increase in number of trees, and the increasing participation of large growers. This is explained by the economy of scale obtained in larger properties which allows for gains in competitiveness due to a more efficient use of technology and orchard management. In other words, inefficient producers will be forced out of the activity due to their inability to compete with other players in the market. The growers producers that remain in citriculture must find the most appropriate path for their profile and determine a strategy to be followed, be it low cost, differentiation or diversification.

Citrus varieties

The diversification of citrus varieties in an orchard is important because it allows growers to sell part of their crop during months with higher prices and also enables the industry to increase the period for fruit processing. It is also a way for improving pest and disease management as well as reducing the impacts of adverse climate conditions.

Currently, the orchards located in the state of São Paulo grow 55% of late season sweet orange varieties (Natal and Valencia), 23% of early season varieties (Hamlin, Westin, Rubi and Pineapple) and 22% of mid season varieties (Pera) (Figure 9). The preference for the late season varieties is due to their higher yield and soluble solids in the juice. But this situation created a gap for mid season varieties, which have excellent characteristics for the fresh fruit market, increasing competition for oranges between the industry and the fresh fruit market during September.

It has been observed that in new orchards (from ages 0 to 2 years), the percentage of early season varieties has increased to 29%, indicating that growers are changing their orchard profiles in order to reduce the supply deficit from May to August. But the gap in mid season varieties still remains.

Financial impacts of diseases in the brazilian citrus belt

Undoubtedly, citrus diseases are one of the most important threats to the Brazilian citriculture. During the last decade, four diseases (citrus canker, CVC, MSC and HLB) alone were responsible for eradicating

Table 3. Brazilian citrus belt growers stratification according to their number of trees, for 2001, 2006 and 2009

Thousands of trees	2001			2006			2009		
	Trees (%)	Producers (%)	Number of producers	Trees (%)	Producers (%)	Number of producers	Trees (%)	Producers (%)	Number of producers
> 400	16.15	0.15	23	33.65	0.35	46	39.25	0.40	51
> 200 and < 399	7.65	0.25	38	8.05	0.55	73	7.35	0.55	69
> 100 and < 199	10.60	0.70	105	8.10	1.05	139	8.95	1.30	164
> 50 and < 99	12.40	1.75	263	11.45	2.70	356	10.75	2.95	372
> 30 and < 49	12.30	3.15	473	7.70	3.35	442	7.00	3.50	442
> 20 and < 29	8.95	3.90	585	5.50	3.80	502	5.30	4.10	518
> 10 and < 19	16.45	14.50	2,175	9.45	11.35	1,498	8.00	11.15	1,408
< 10	15.45	75.55	11,333	16.15	76.90	10,151	13.40	76.05	9,603
Total	100	100	14,995	100	100	13,207	100	100	12,627

Source: Elaborated by Markestrat with data from CitrusBR (2010).

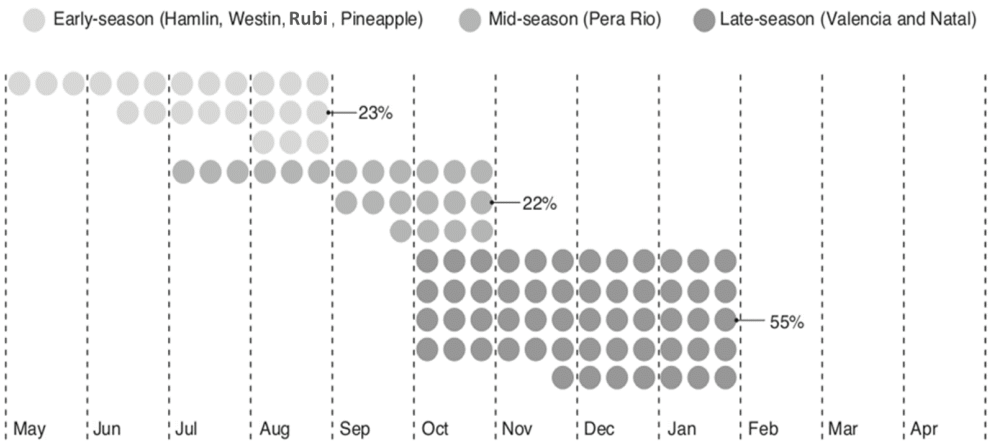


Figure 9. Harvesting season by citrus orange variety and participation in the total production.
Source: Elaborated by Markestrat with data from CitrusBR (2010).

39 million trees within the citrus belt. This increased the mortality rate from 4.5% to 7.3%, reducing annual production in aproximatly 78 million boxes of 40.8 kg, when considering an average productivity of two boxes per tree. This figure represents 25% of the 2009/10 harvest of 317 million boxes of 40.8 kg (Table 4).

Post Orchards

The inputs acquired by packing houses and juice factories for citrus processing totaled US$ 360.9 million, as detailed in Figure 10. Electricity represented 24% of the total value and BPF oil/bagasse 25% (BPF oil is a fuel oil used by industry).

In 2008/09 packing house revenue with fresh fruit was of US$ 1.8 billion, 96% of which was obtained in the internal market. Fresh fruit whole sales revenue was of US$ 1.7 billion and the retailers obtained US$ 3.8 billion, of which 58% came from orange sales, 17% from lemons/limes and 25% from tangerines.

Juice and sub product sales totaled US$ 2.2 billion, of which 95% was obtained in the external market and 5% in the internal market. From the revenue gained from exports, US$ 2.07 billion, 86% came from orange juice (Figure 11), with this value representing around 3% of the country´s agribusiness exports. Bottling companies, wholesalers and retailers presented the following revenue with orange juice

Table 4. Number of thousand of trees eradicated within the citrus belt due to four diseases from 2000 to 2009

Disease	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	TOTAL
Citrus canker	795	191	71	164	177	153	186	151	115	240	2,243
CVC	678	2,406	2,380	1,023	2,887	4,043	3,320	3,299	3,276	3,070	26,382
HLB	-	-	-	-	-			5,330			5,330
Sudden death	-	-			5,158			-	-	-	5,158

Source: Elaborated by Markestrat with data from Fundecitrus and CitrusBR (2010).

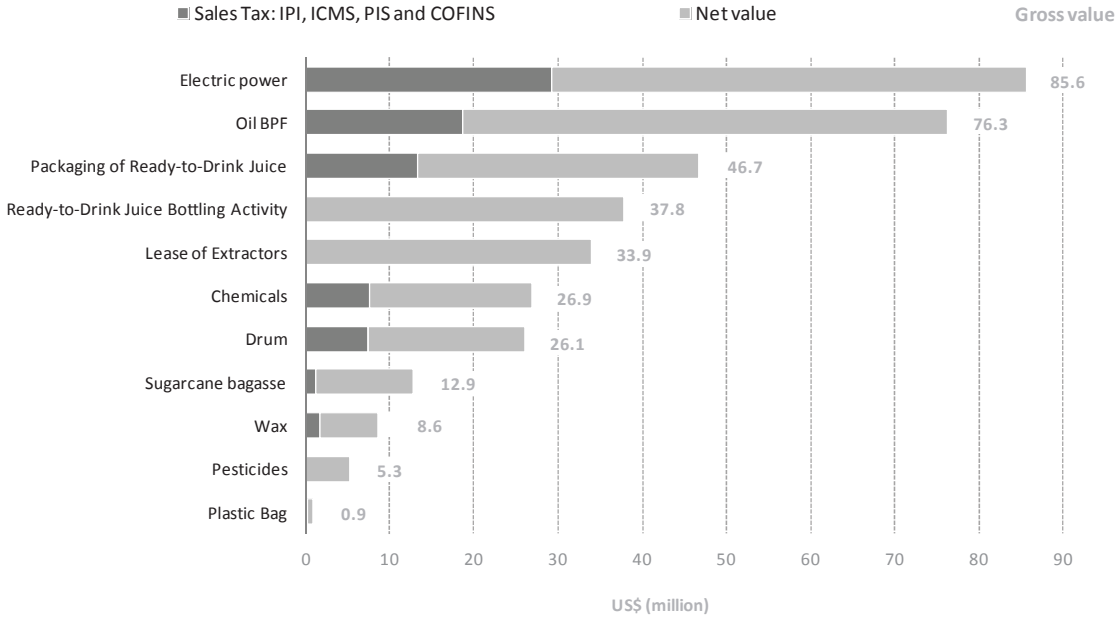


Figure 10. Sales of the industrial inputs link of the supply chain in the Brazilian citrus industry, 2008/2009
Source: Elaborated by Neves and Trombin with data from Markestrat.

or nectar, respectively: US$ 255.7 million, US$ 33.9 million and US$ 459.1 million.

The numbers obtained for the Brazilian citrus industry are impressive. Brazil comprises 53% of the World´s orange juice production and exports 98% of its production of this commodity. Between the years of 1962 and 2009, citriculture accumulated almost US$ 60 billions in export revenues, bringing an average of US$ 1.3 billion per year in foreign exchange.

In 2002, the Brazilian citrus industry took an important step with the beginning of the NFC exports. This showed the industry´s capacity to innovate before a change in consumer habits, switching to less processed products with a more natural image. NFC has a more pleasant taste because its flavor is more similar to fresh orange juice and its image is associated with a healthier product.

This same innovation capacity was again demonstrated during the past decade with the diversification of the exports destination as a response to the citrus industry´s search for new and non saturated markets. Traditionally, Europe and USA imported together over 90% of Brazil´s orange juice exports. Currently, the most promising markets in growth potential are Asia, due to its population, and the Middle East, mainly because of the population´s habit of not consuming alcohol. In 2009, Brazil exported orange juice to 70 different countries, of which 20 imported NFC (Figure 12).

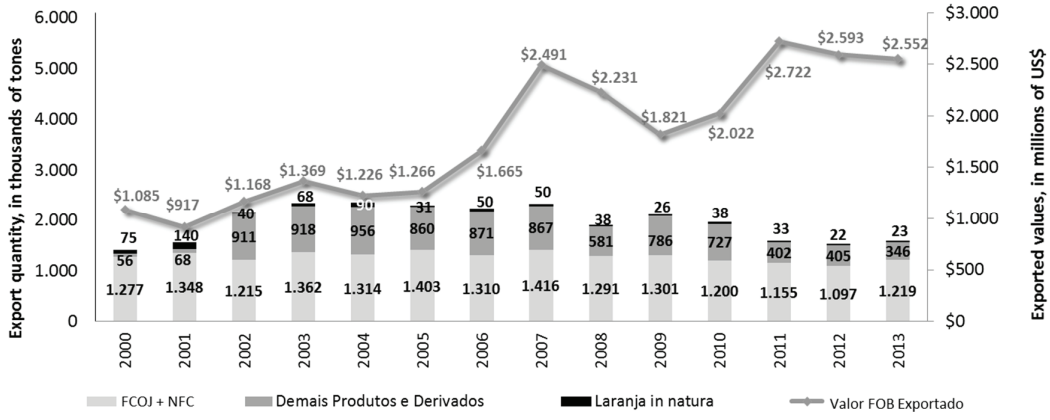


Figure 11. Brazilian citrus complex exports, from years 2000 to 2009.
Source: Elaborated by Marketstrat with data from SECEX/MIDC (2014).

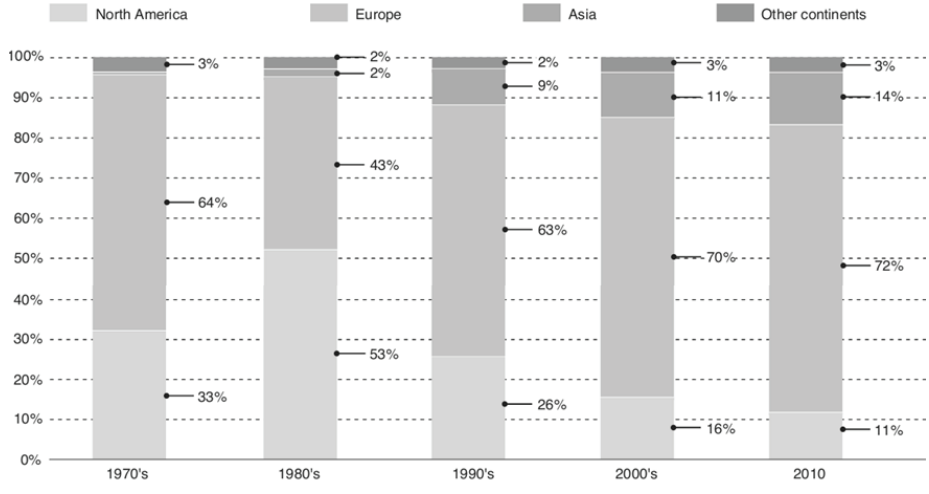


Figure 12. Brazilian FOCJ export destinations, by decade and in the year 2010.
Source: Elaborated by Marketstrat with data from SECEX/MIDC (2014).

In addition to the demand for less processed products and the need to search for new and non saturated markets, the citrus industry export is also challenged with tax policies, phytosanitary and technical barriers which reduce its competitiveness in the international market.

With the exception of the USA, where Brazilian orange juice is taxed with a fixed value per ton, in other continents and countries, such as in Europe, Japan, South Korea, China and Australia, the tax value is calculated as a percentage of the financial volume imported. This tends to amplify the effect of a rise in orange juice prices in the international market to the final consumer because once orange juice prices rise, more taxes will be paid for the same quantity of the commodity. In 2009, orange juice exports from Brazil were taxed with US$ 260.4 millions.

Phytosanitary and technical barriers are related to package characteristics, consistency in product quality and punctuality in delivery. In Europe, for example, the main demands are food security (consumer health, contaminant levels, and pesticide residues), quality (sensational appeal and compliance with technical specifications), authenticity (adulteration and compliance with the legislation), traceability (product identification and readiness in identifying the source of any potential problem) and consumer perception (product image and origin).

Facilitating agents

The revenue for facilitating agents in the citrus production chain in 2008/09 was US$ 877.5 million. Regarding transportation, on average, over six trucks per hour passed through a tollbooth on their way to the Port of Santos in São Paulo State. This made it possible for highway concessionaires to garner revenues of US$ 18.5 million, corresponding to 5% of all freight expenses paid by the citrus sector, which totaled US$ 396 million. Diesel represented 9% of this total. Freight can be divided into primary, transportation from orchards to packing houses or the processing industry, which showed a total revenue of US$ 171.4 million; and secondary, which refer to transportation from packing houses to wholesalers or retailers, with total revenue of US$ 137 million, or to the port, with total revenue of US$ 2.7 million. Secondary freight can also refer to transportation between processing industry and port, with total revenue of US$ 85 million.

Regarding port costs, it is estimated that in 2008, the Port of Santos earned US$ 71 million when storing oranges in warehouses and loading them on ships. It is important to state that 97% of Brazil´s orange juice exports were shipped through the Port of Santos.

Regarding payroll, the agricultural year 2008/09 ended with 132,776 employees in the citrus sector, of which 121,332 were registered in fruit production activities and 11,444 in the juice industry. During this period, over 69,000 workers were hired, contributing to the US$ 352.7 million paid in salaries and benefits.

Aggregated taxes

Total tax expenses were calculated by adding the taxes generated in each segment of the production chain, from the sales of agricultural and industrial inputs to the sales of final goods. From this total, taxes generated at the beginning of the production chain (agricultural and industrial inputs) were subtracted to eliminate double counting and to consider the aggregated taxes in the production chain. It was presumed that companies opted for the actual profit tax contribution system.

The results of this estimate indicate that taxes charged to the citrus production chain totaled US$ 339.4 million, of which US$ 150.6 were generated by agricultural and industrial inputs sales. This means that aggregated taxes were estimated at US$ 188.7 million.

CONCLUSION

This work was able to present a method for both quantification and mapping of productive chains as well as to discuss some relevant findings for its applications in the citrus chain in Brazil. It was noted in this research that the CHAINPlan method proved an effective tool to demonstrate the importance of the financial activities of a production chain. This paper shows also an overview of the current situation of the Brazilian citriculture with discussions about the most relevant subjects that impact the sector. Brazil has achieved high efficiency in the citrus production chain. This efficiency includes everything from certified nurser, to the planting and cultivation of oranges, to the production and international distribution of orange juice through integrated bulk

cargo systems that include tanker-trucks, port terminals, and dedicated ocean vessels that ship citrus products to consumers in Europe, North America and Asia, with dozens of different specifications and blends for the most diversified applications and unmatched excellence. All with Brazilian competence and know-how. Brazil produces half of the orange juice on the planet, the exports of which bring in US$ 1.5 - 2.5 billions to Brazil yearly. In roughly 50 years, the supply chain has brought to Brazil nearly US$ 60 billion (at today's prices) directly from the World's orange juice consumers.

This wealth is distributed to hundreds of enterprises directly involved in the sector, on thousands of orchards, generating over 200,000 direct and indirect jobs, paying taxes, and serving as a driving force for establishments and many other companies located in nearly 400 municipalities in the state of São Paulo dedicated to growing oranges, accounting for 80% of Brazil's overall production. In fact, oranges are grown in more than 3,000 municipalities across Brazil.

This papers also highlights the citrus industry´s strengths, and its social and economic importance and points to some of the major challenges for the future. The changes that occur throughout the Brazilian citrus production chain have the same origin: the understanding that the final consumer doesn´t want to and will no longer pay for the inefficiencies of the supply chain. These new demands have brought new challenges that will not be solved under the assumption of an isolated and static system. It will take the coordination of the production chain as whole and its never-ceasing search for efficiency and low costs to stimulate the performance of all the links that compose the chain.

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