
ANALYSIS OF THE LOGISTICS INFRASTRUCTURE OF THE SUGAR BULK PRODUCED TO EXPORT IN THE BRAZILIAN STATE OF SÃO PAULO

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ABSTRACT

Despite being an international benchmark in technology and efficiency in sugar production, Brazil does not have a fully developed logistics infrastructure, which ends up limiting the growth and increasing competitiveness in agricultural products. The present study is an analysis of the evolution of modes of transport and new investments directed towards the port infrastructure. In this way, this work aims to analyze the current infrastructure of logistics export of bulk sugar mills of the state of São Paulo covering from transport to the shipment of the product at the ports of Santos and Paranaguá. For development of this work will be used publications, consultations on scientific works on the subject and reports of professionals of the sector. It will be possible to observe over the work that most of the investments in the area come from private groups seeking partnerships aimed at better competitiveness for sugar producers. It was noted that were and is being made investments, especially private sectors, such as by America Latina Logistica (ALL) and Rumo Logistica, however, still insufficient to keep up with the growing increased exports in a satisfactory way of Brazilian sugar.

Keywords: Logistics, Sugar mill, Bulk sugar, Exportation, São Paulo, Port of Santos, Intermodality.

1. THE PRODUCTION OF SUGAR IN THE STATE OF SÃO PAULO AND BRAZIL

The State of São Paulo has the highest concentration of mills in Brazil, accounting for 60% of sugar production, it stands out due to its higher concentration of production units. According to Zaña (2009), from 343 plants in operation in the country, 115 are located in São Paulo.

By observing the production in São Paulo, compared to other states, you can identify the importance that this state has in the national sugar production. Table 1 shows the production and export numbers of the Brazilian sugar industry.

Table 1 - Production and exportation of Brazilian sugar, 2008-2012

Harvest	Million Tons Produced	Million Tons Exported	Export percentage
2008/09	31.047	20.795	67%
2009/10	32.956	24.088	73%
2010/11	37.989	27.514	72%
2011/12	35.925	24.946	69%

Source: UNICA (2013).

Comparing the export of sugar against the domestic production, it is noted that in the last four seasons (2008/09 - 2011/12), an average of 70% of the Brazilian production was exported, showing the dependence of this sector on the international demand. As for the production, despite the reduction of 4% between the harvests 2009/10 and 2011/12, if we consider the last four years, it comes to an average growth of about 4% per year.

As previously mentioned, there is the relevance of São Paulo plants in sugar production compared to Brazilian production (Table 2).

Table 2 - Sugar production in São Paulo and in Brazil, 2008-2012

Harvest	Millions Tons Produced (Brazil)	Million Tons Produced (SP)	Percentage of Participation
2008/09	31.047	19.662	63%
2009/10	32.956	20.729	63%
2010/11	37.989	23.446	62%
2011/12	35.925	21.068	59%

Source: UNICA (2013).

It can be seen that the production of São Paulo represents on average 62% of the Brazilian production in the last four seasons, and its share has fallen slightly due to the production increase of other states, especially Mato Grosso do Sul and Goiás (UNICA, 2013). According to Pereira (2007), this is due to the limited expansion area in São Paulo and the competition with other types of cultivation, as well as the lower area price in other regions.

As for export, the state of São Paulo is also the one with the greatest importance for the sector (Table 3).

Table 3 - Sugar production for export in São Paulo, 2008-2012

Harvest	Million Tons Produced
2008/09	13.797
2009/10	16.460
2010/11	18.264
2011/12	15.027

Source: UNICA (2013).

The leadership in sugar production takes place in São Paulo due, among other factors, the area used for planting the raw material of this product, sugarcane.

Table 4 - Planted area with sugarcane, 2008-2011 (in hectares)

STATE/HARVEST	2008	2009	2010	2011
Acre	2.886	2.541	2.769	2.654
Alagoas	434.000	434.005	434.370	434.684
Amapá	110	70	130	130
Amazonas	6.050	6.050	5.407	5.211
Bahia	109.606	82.045	96.743	116.171
Ceará	42.159	42.706	43.024	41.370
Distrito Federal	757	783	923	883
Espírito Santo	78.249	80.162	81.393	76.488
Goiás	416.137	524.194	578.666	697.541
Maranhão	48.623	46.112	50.477	48.565
Mato Grosso	218.873	241.668	212.498	226.993
Mato Grosso do Sul	252.544	285.993	399.408	495.821
Minas Gerais	610.456	715.628	746.527	831.329
Pará	8.889	9.973	10.897	12.592
Paraíba	122.587	122.888	123.691	118.097
Paraná	594.585	595.371	625.885	641.765
Pernambuco	403.072	352.276	361.937	345.416
Piauí	12.629	12.866	12.841	15.194
Rio de Janeiro	137.407	135.130	133.286	105.091
Rio Grande do Norte	65.910	67.597	65.326	59.463
Rio Grande do Sul	36.779	36.688	35.970	32.694
Rondônia	3.204	4.220	3.824	3.767
Roraima	559	559	563	564
São Paulo	4.541.509	4.977.077	5.071.205	5.216.491
Santa Catarina	18.084	17.646	9.528	11.129
Sergipe	38.895	41.931	46.665	50.988
Tocantins	6.318	9.654	10.803	25.524
Brasil	8.210.877	8.845.833	9.164.756	9.616.615

Source: UNICA, 2013.

It can be seen that the greatest increase in the area planted during the period between the years 2008 and 2011 occurred in the states of Mato Grosso do Sul, Goiás and Minas Gerais, with a growth rate in the same period of 96%, 67% and 36 %, respectively. The State of São Paulo, the largest in acreage, had a moderate growth of around 15% over the same period.

1.1 TYPES OF SUGAR FOR EXPORT

Sugar, from an economic point of view, according to the Union of Sugar Cane Industry Association (UNICA), is the most important product of the sugarcane agribusiness chain (UNICA, 2013). Several types of sugar are produced in the mills of São Paulo, each type follows a pattern established by the market classification according to their application. The parameters controlled for classification are mostly color, polarization and moisture. This diversity of types occurs due to market demand and adjustments in the process that are needed for the production of different types of sugar (GENEROSO and BORGES, 2009).

Having China, Russia and Middle East countries as majors importers, there are different types of sugar that are exported from Brazil to the world (UNICA, 2013). According to Table 5, it is identified names and packaging standards, based on Raízen's portfolio, the largest producer and exporter of bulk sugar from Brazil (NUNES, 2010).

Table 5 - Types of sugar for export

SUGAR TYPE	STANDARD PACKAGING
VHP	Bulk
VHP PLUS	Bulk
VVHP	Bulk
Cristal	Bag 50 kg; Big bag 1200 kg
Refinado Granulado	Bag 50 kg
Orgânico	Bag 25 kg

Source: Raízen, 2013.

According to PECEGE (2011) and Neto (2012), these types of sugar are defined as follows:

- VHP (Very High Pol) - Gross crystal sugar styling with high polarization compared with demerara sugar, not normally sold direct to the consumer, being raw material for refined sugar;
- VHP PLUS - Special type of VHP sugar;
- VVHP - special type of raw sugar crystal with polarization greater and less color than the VHP;
- Crystal - white crystal sugar, produced for direct consumption or for shipment to the refinery, depending on its specification;
- Refined Granulated - white granulated sugar, produced in the refinery as raw material having usually a sugar type VHP or any sort of crystallized sugar with high color;
- Organic Sugar - Sugar crystal produced from raw materials and processes certified, guaranteed to use only organic products throughout the supply chain.

The bulk sugar, being the most used for export, was chosen as the object of this study. Importantly, regardless of the destination market, the bulk sugar must be transported from the plant and stored in an embarkation point. This type of sugar, reach its end user by the importer, and it still has to go through a refining process, ensuring product purification.

As Carvalho and Caixeta-Filho (2007), the type of sugar and models of packaging used in the transport process are essential factors that make up the formation of the value of the product shipping.

The type of sugar chosen for export can have different logistics strategies, both in economic terms and in operational matters. The type of sugar with its packaging and adequate logistics can minimize possible transport and storage costs (CARVALHO and CAIXETA-FILHO, 2007). According to the authors, there is the specificity of each product:

1. Big Bag: used only in specific cases, it has been losing space in the market. Supporting up to 1200 kg, now it is more used to meet domestic industries, refineries and internal market in general supply.
2. Bag 50 kg: consists of sacks (50 kg) which are loaded on the trucks according to the vehicle capacity, requiring a large number of laborers, known as "saqueiros" and are hired through union. As the whole process is manual, theres no efficiency in loading and unloading. There are two forms to export it: in containers or directly into the hold of the ship, called break-bulk.
3. Bulk: is currently the standard and most used by world traders, among other reasons, for their high efficiency in loading and unloading.

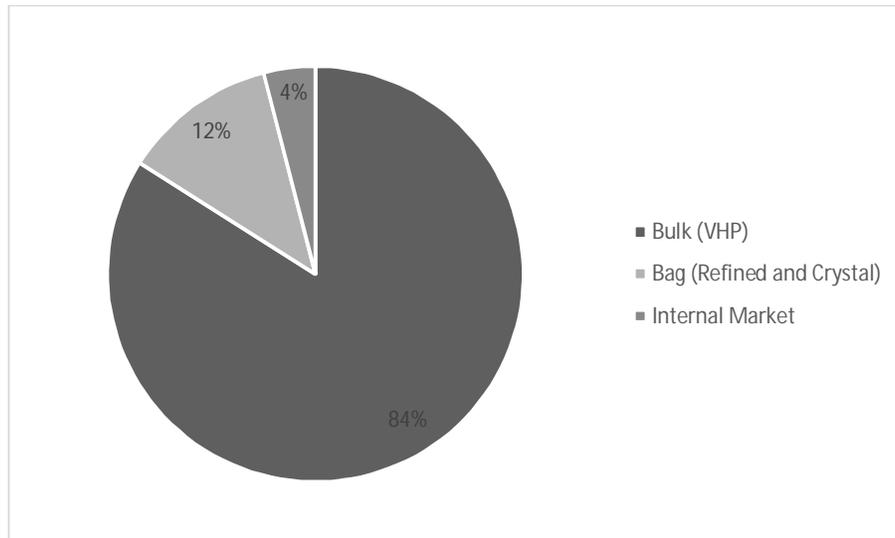
2. LOGISTICS CHARACTERISTICS FOR SUGAR EXPORT IN SAO PAULO

According to Nunes (2010), stability in the logistics flow of sugar intended for export occurs due to the product having ports exclusively as a final destination, resulting in a sequential port demand because most of the sugar companies have warehouses reserved at the ports for receiving the product. There is also another group of companies that determines the volume to be carried by the plants based on the dates of arrival and availability of ships, which can be programmed with certain advance. These logistical factors, combined with the lower cost in production, makes the bulk sugar is the main type of sugar traded and exported.

According to Carvalho and Caixeta-Filho (2007), the type of product and packaging in export for sugars are crucial for the composition of freight values to be practiced in the flow to the ports. And in that sense, the bulk sugar also takes advantage over other sugars, as is characterized by greater efficiency in loading and unloading the product.

The Raizen's sugar matrix distribution, which is one of the largest companies in the sugar/ethanol sector in Brazil, is shown in Figure 1. In the harvest between the years 2013 and 2014, among about 3.5 million tons of sugar sold by them, 84% of this volume was the VHP sugar in bulk.

Figure 1 – Raízen’s sugar matrix distribution 2012-2013

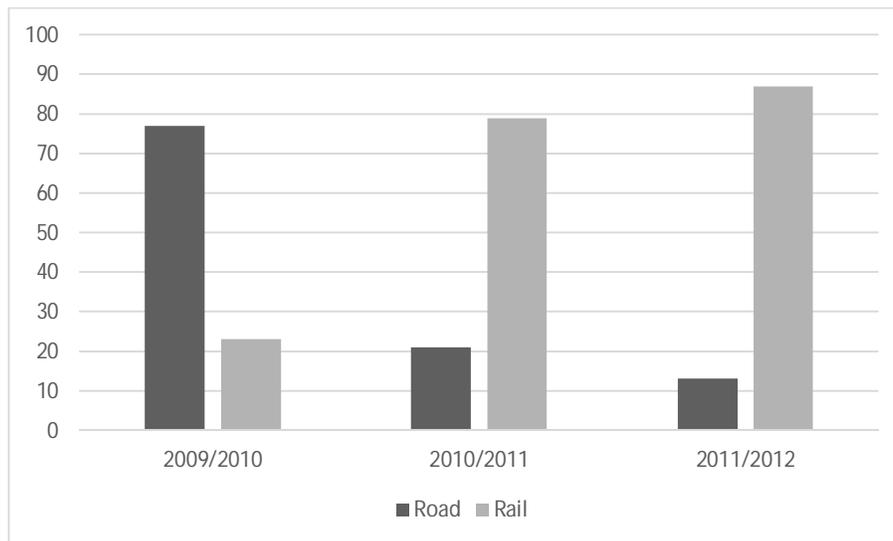


Source: Raízen, 2013.

The transport of the product of São Paulo plants to the ports is done in two modes, road, mills to the port of destination, or using the combination of road and rail (intermodal), where the product leaves the plant to a transshipment warehouse and from there is transported via railway to Santos.

As Silva (2006), in the 2005/2006 harvest, 13.3 million tons of sugar were exported from Brazilian plants through the Port of Santos, of which 18% was carried by rail and 82% via highway. This scenario has only changed with the creation of the company Rumo Logística, established by Cosan in partnership with ALL (America Latina Logistica), which owns the largest rail network in the state. The company was born with the goal of creating rail solutions and change the current matrix distribution back then (NUNES, 2010). As visualized in Figure 2, this change occurred from the 2010/2011 season and remained in the recent period.

Figure 2 - Sugar bulk transportation matrix export at the Port of Santos, 2009-2012



Source: Raízen, 2013.

In general, you can consider three ways that represent the main alternatives for transportation in this sector: Road (door-to-door), Road + Rail: with restricted sugar shipment capacity and a long-term scenario of rail transport, without restriction sugar shipment capacity (SILVA, 2006).

3. SUGAR MODE OF TRANSPORTATION

3.1. Sugar road transportation

The road transportation is used most often, because even if the final destination of the goods is exported by rail, the first stage of the transportation will be via the highway. Thus, given the different locations of the plants in São Paulo, road transport is the production flow of bulk sugar mills directly to the port of export (NUNES, 2010).

Although the types of equipment used in the sugar operation and the operational attributes are similar, the major difference between road transportation for export in relation to the internal market are the different demands that have different characteristics (CAIXETA-FILHO and GAMEIRO, 2001).

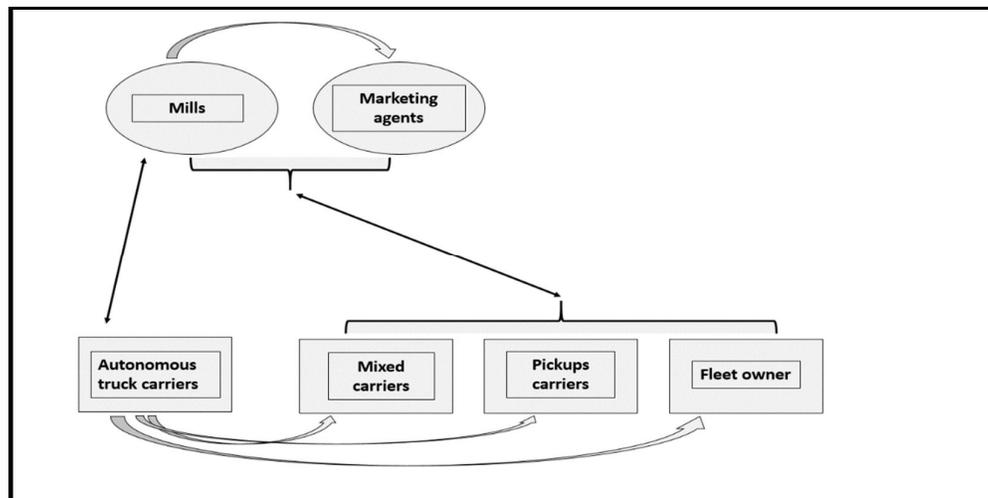
These differences, as well as product and packaging specifications, according Caixeta-Filho and Gameiro (2001), are factors contributing to the composition of the cost of shipping. The authors state that the most important factor is the type of vehicle used in the process. They point out that for road transport sugar to the foreign market can be defined in two types of trucks:

- Tipper: trucks have hydraulic system for moving the bucket, eliminating another technology for unloading. It is possible to find vehicles capable, 26 to 60 tons.
- Grain: on average for up to 28 tons. They have no bucket, requiring the use of unloading platforms, called tombadores, to effect the discharge service in ports or other final destinations.

As Oliveira and Caixeta-Filho (2007), logistics negotiations more practiced in São Paulo sugarcane sector involve the hiring of specialized and autonomous truck carriers by the companies, establishing an informal relationship based on trust. Few transactions are supported through formal contracts, leaving them subject to supply and demand conditions of trucks in the region.

Nunes (2010) adds that the fact that carriers does not necessarily depend on a fleet for loading, the supply and demand of autonomous drivers can impact on the freight market. Thus, in some situations there is no guarantee that a the contract will be completed on time and within the agreed values. In this regard, the cited author has developed a framework based on research as shown in Figure 3, indicating the relationship between sugarcane companies, shipping agents, carriers and truck drivers, since there is no clear rule in the segment.

Figure 3 - Relations of road transport transactions on the sugar export operation



Source: Nunes, 2010.

Given the scenario described in Figure 3, it is possible to see that the freight contracting strategy varies according to the company, which can negotiate with marketing agents, who will be responsible for making the exchange between carriers and independent truckers to carry the load, or have a domestic sector responsible for making hiring, negotiating directly with those involved. Generally negotiating with carriers is based on contracts where a minimum volume is offered in exchange for a more competitive freight value over the crop. As for the autonomous truckers, negotiation occurs in the spot market, which is considered a volume that is not part of the contract, or which was not planned for that period (NUNES, 2010).

3.2. Sugar rail transportation

As Nunes (2010), rail for export of sugar in the State of São Paulo is used mainly by mills and marketing agents that have large production capacities. Since the mills have their own transshipment points, they try to use the modal as an outlet. Inside their warehouse they transport the sugar via rail or provide the service to third parties, using its structure to receive the product via highway and operationalize the rail operation.

Other authors such as Benatto (2009) and Caixeta-Filho and Gameiro (2001) advocate the use of road-rail intermodal transportation of sugar for export, indicating that this method has major advantages in terms of cost, security of goods and transit times clocked.

In order to make the intermodal combination work, road-rail, an association of road transport will be necessary, as it will be responsible to transport the sugar from the plant to the intermodal terminal. The railway will be responsible for the longer path, which will be from the terminal to the port of export (SILVA, 2006).

Silva (2006) points out that intermodal terminals are located at different locations within the state, and are served by railways, and may contain broad gauge (1.60 m) and narrow gauge (1.00 m). Among intermodal terminals, presents the Terminal Airosa Galvão (TAG), located in Jaú (São Paulo), with 99 wagons a day loading capacity, the Multimodal Terminal Logisport, located in Sumaré (São Paulo), with capacity of load 120 cars per day and the Multimodal terminal Itirapina, located in Itirapina - SP, which is the largest and most modern shipping terminal of Rumo, with 120 cars per day loading capacity, static capacity of 400,000 tons and possibility to 12 million tons per year (RUMO LOGISTICA, 2013).

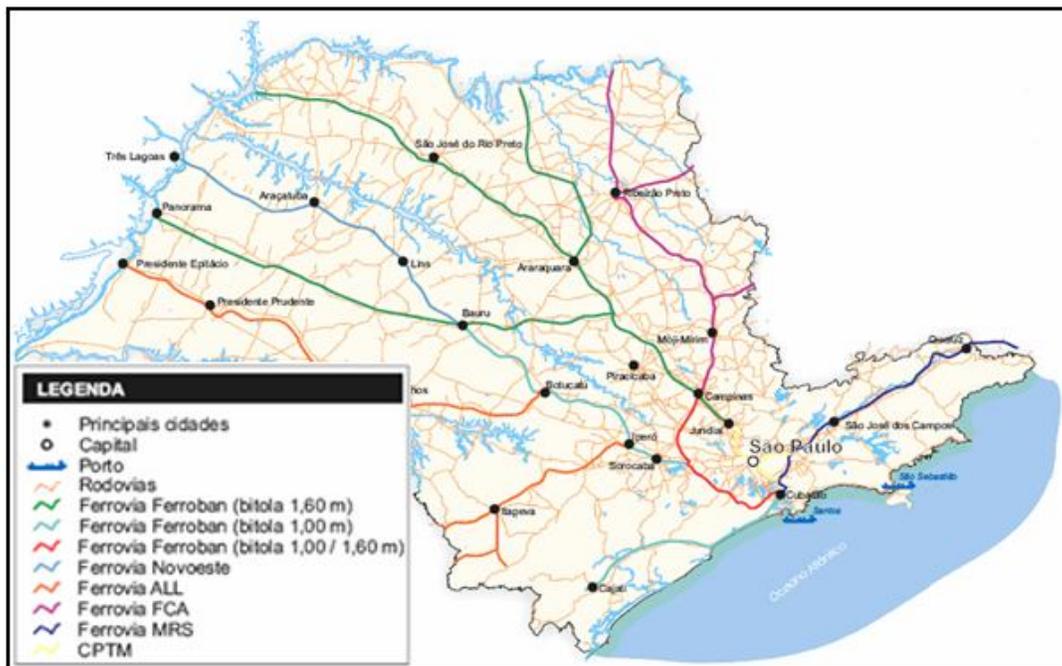
3.3. Intermodal sugar transportation

As Benatto (2009), between 1997 and 2005 were injected over R\$ 9.5 billion in railway operational improvements, from rail network to equipments, such as wagons and locomotives. The author points out that even with private investment, the government's help is critical. Nunes (2010) reports that all the sugar that shall be sold by rail for export has as their final destination either the ports of Santos or Paranagua.

According to Oliveira and Caixeta-Filho (2007), the use of rail modal logistics of sugar for export can be an important alternative for cost reduction and improved quality of service.

Nunes (2010) indicates that in South-Central Brazil, only three concessionaires offer rail service: America Latina Logistica - ALL (Ferrobán and Novoeste), Ferrovia Centro Atlântica (FCA) and MRS Logística SA, characterizing an oligopoly. As shown in Figure 4, you can see a greater participation of ALL compared to other utilities, thanks to the acquisition of Ferrobán and Novoeste concessionaires in 2006.

Figure 4 - Distribution of railway concessionaires in the State of São Paulo



Source: ESALQ-LOG, 2013.

As Nunes (2010), when viewing a railway route, such as Araraquara (São Paulo) to Santos (São Paulo), the region of large number of unit producing sugar, you can see that only a concessionaires has rail network, changing the setting for a natural monopoly, since on certain routes only a railroad agent offers the service.

4. SUGAR PORT SYSTEM

Currently sugar producers in the State of São Paulo have two ports to meet the sugar export demand, the Port of Santos and Paranaguá. According to Nunes (2010), port costs and the problems faced in this area are fundamental to the pricing of previous supply chains.

In 2012, sea transport accounted for 96% of Brazilian exports, representing in value 80% of the national trade flow that reached USD\$ 466 billion (SECEX, 2013).

According to data released CODESP's annual report (2013), the Port of Santos and Paranaguá are those with greater representation in the Brazilian trade balance, together, in 2012, a third of the value of exports and imports by Brazil went through these ports, as can be seen in Table 6.

Table 6 - Volume of exports and imports through ports in Brazil, 2010-2012

Ports	2010		2011		2012	
	US\$ bi	Part.	US\$ bi	Part.	US\$ bi	Part.
Santos	95,9	25,0%	118,2	24,5%	120,0	25,8%
Paranaguá	24,4	6,4%	32,4	6,7%	33,9	7,3%

Source: CODESP, 2013.

4.1. Port of Santos

It was the Port of Santos the port that represented greater importance in Brazilian exports of sugar and ethanol in 2009, followed by the port of Paranaguá and Maceió, with 70%, 19% and 8%, respectively (NUNES, 2010).

The Port of Santos is located in the city of Santos (SP), 70 km from the state capital, São Paulo. It's administration is made by the Company of São Paulo State Dock (CODESP). The port was established in 1892 to cater mainly coffee exports, and he went expanding to the current period (CODESP, 2013).

Currently, the port has 62 private terminals for the performance of various goods, operating 24 hours a day in four shifts of six hours. Its facilities have an area of 7.7 million square meters and also has a plant for own supply, which however, can not always meet the entire energy needs. The port access can be done either by highways, railroads and pipelines (CODESP, 2013). Table 7 below shows the main cargo handled in 2012.

Table 7 - Major cargos handled at the Port of Santos in 2012

Cargo	Quantity (million t)	Participation
Sugar	16.782	16,05%
Soy	13.657	13,06%
Corn	10.027	9,59%
Fertilizer	3.447	3,30%
Coal	2.875	2,75%
Fuel oil	2.413	2,31%
Ethanol	2.376	2,27%
Others	52.967	50,66%
Total	104.544	100,00%

Source: CODESP (2013).

Of 16.782 million tons of sugar exported from the Port of Santos, 14.278 million tons were of bulk sugar, the object of this study, and the estimate for 2013 was an increase in home 3.7%, totaling approximately 14.8 million tons (CODESP, 2013).

The main trade partners of Brazil in 2012, the United States were China and Argentina, respectively, in the item import. As for exports, China, the Netherlands and the United States were respectively the main destinations for Brazilian products that had the Port of Santos (CODESP, 2013).

According to CODESP (2013), many investments are being made to improve the Port of Santos. The compatibility of the depth of berths to 15 meters deepening and widening access the navigation channel to 220 meters meant that there is an expectation in 2013 to increase cargo handling and decrease the number of vessels, improving maritime logistics, enabling the simultaneous drive in both senses of direction, and giving conditions for receiving ships carrying up to 9,000 containers.

With the attention of the Ministry of Planning, investments directed to the Port of Santos, in the Growth Acceleration Program (PAC 2), totaling R \$ 1.2 billion for the period 2011-2014. In the works predicted by the program is the construction of the Perimeter Avenue of the Left Bank, in Guarujá (São Paulo). Another project that is part of PAC 2, is the realignment and construction of Outeirinhos pier with the intention of increasing the structure to meet passenger ships for the World Cup Football 2014. This improvement will bring the possibility of berthing up to 6 ships in Outeirinhos region (PAC, 2013).

According to CODESP (2013), besides public investment, the port also has many private investors, such as the COPERSUCAR, which is Brazil's largest cooperative of sugar and alcohol (CAMPOS, 2013), and which has in its planning the investment of \$ 2 billion in logistics by 2015. Another private investment that is ongoing is Rumo Logística's, which developed an unprecedented at their terminal, a roof project which comes as an important logistics solution for the lack of operation on rainy days. This problem, which causes the terminal to stop operating approximately 120 days a year (RUMO LOGISTICA, 2013).

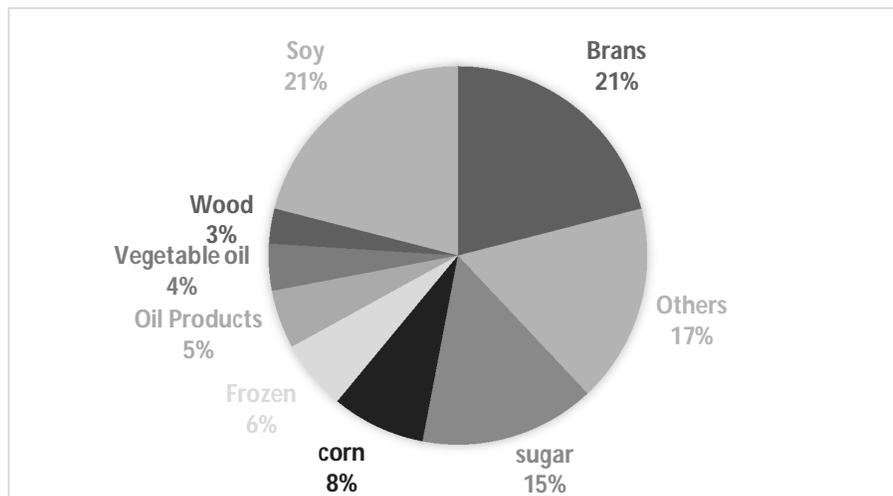
4.2. Porto de Paranaguá

Located on the coast of Paraná, in the city of Paranaguá, the Port of Paranaguá was founded in 1872 and is currently managed by the Administration of Paranaguá and Antonina Ports - APPA. Besides attending the state of Paraná, also attends part of the states of São Paulo, Santa Catarina, Rio Grande do Sul, Mato Grosso and Mato Grosso do Sul and Rondônia, including even another country, Paraguay (APPA, 2013).

Currently, the port has an area of 2.4 million square meters, and its access, as occurs at the Port of Santos, also can be done either by highways, by railroads and pipelines. The Port of Paranaqua has ten private and leased terminals, and a public for the handling of bulk solids (APPA, 2013).

According to APPA (2013), sugar in 2009, was the third most exported product by the Port of Paranaguá, representing 3.263 million tons, accounting for 15% of the total 22.758 million tons, as shown in Figure 5.

Figure 5 - Relative participation of the main products exported through the Port of Paranaguá, 2009



Source: APPA, 2013.

There are two sugar export terminals in the Port of Paranaguá, the Bunge / Socepar, which has an estimated loading capacity of 800,000 tons per year, and the Pasa, which has loading capacity of 3.2 million tons per year. Yet also has the CBL terminail, which is eventually used to export sugar, with a capacity of one million ton per year (SETTEN, 2010). Also according to the author, the receiving of sugar can be done either by road, which in 2008 was about 26.4%, and by railroad, which was 73.6% in the same period.

As for new projects, according to APPA (2013), between 2011 and 2014, there are nine major projects being implemented. Featured appears the restructuring of export corridor, which consists of a conglomeration of horizontal and vertical silos within the port that connects terminals improving the logistics process for export. These investments will result in increased loading capacity of the port.

5. FINAL

This study aims at the analysis and characterization of the logistics infrastructure of the State of São Paulo for export of bulk sugar.

As can be observed, the importance of logistics in the industrial sector has been a differentiating factor to achieve market share gains, especially the study of the use of the most profitable way of transportation modes.

In the sugar industry it is no different, since this plays an important role in the national economy, generating large production and hence employment and income, especially in São Paulo, this production that will be highlighted during this study. Remembering that the importance of this product also is due to the positive impulse in the Brazilian trade balance.

Given the above, in the present scenario of exporting sugar mills of the State of São Paulo through the ports of Santos and Paranaguá, there is concern of mills to reduce their operating costs, which in this study is specified in flow the production of sugar to the destination port. It is therefore crucial the choice of a logistics plan that favors in terms of price and level of service.

The work aims to identify the current infrastructure in sugar export logistics of the plants of São Paulo to the Port of Santos and Paranaguá, in addition to observing growth opportunities and shortcomings that hinder the process.

It might be noted in the study, five years to the present time, much has been done on the railway issue. Due to private investments of ALL, driven by Rumo Logística, the railway has been very taken advantage of, and by consequence, the logistics cost has been decreasing. However, it should be noted that the oligopoly of three companies holding this service delivery, ALL, Ferrovias Centro Atlântica (FCA) and MRS Logística SA, just making the rail market does not work optimally.

Analysis of the State of São Paulo's infrastructure reveals that it has a satisfactory transport infrastructure, including railroads and intermodal strategically located warehouses with effective participation of private investments, able to meet a substantial demand and increase the railway's participation in transportation to the Port of Santos.

As for the port system that serves the mills of São Paulo, it was observed that there is a concern to modernize these ports, especially the port of Santos, so there is the possibility of increasing exports. This has been done mainly through private investment, for example, Rumo Logística, which is developing a logistics solution, covering structure, for the lack of operation on rainy days, which makes the terminal stop operating approximately 120 days a year.

Currently, the Brazilian government has also boosted investments aimed at improving conditions in ports. This is due to the works of the Growth Acceleration Program, which was encouraged by international events that must occur in this and the coming years as the World Cup Soccer and the Olympics to be held in 2016. These factors eventually instigate the government to apply public resources for the development of the country's logistics infrastructure.

It has been thus confirming the relevance of logistics infrastructure of the export sector of sugar that interferes with the competitiveness of Brazilian production of raw sugar in the world market.

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