Logistics Aspects Of Transport Modalities On The Exports Of Raw Sugar

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doi: 10.19044/esj.2016.v12n16p345 URL:http://dx.doi.org/10.19044/esj.2016.v12n16p345

Abstract

This work aims to present the current scenario of the Brazilian raw sugar export logistics, focusing on transportation, pointing out the benefits of intermodal road-rail in the flow of bulk sugar from mills to the Port of Santos. The study analyzes the evolution of modes of transportation and new investments focused on port infrastructure. It is possible to notice throughout the work that most of the investments in the area comes from private business groups seeking partnerships to improve competitiveness for the sector, such as Rumo Logística and America Latina Logística, which holds the largest concession and rail network in the state. The state of São Paulo currently offers transshipment options warehouses located in its territory and can meet the demand of the sugar mills to flow their product. It could be identified that the existence of a logistical planning well done using these two modes (road and rail) can guarantee competitive prices, load security and a transit time that does not compromise the receipt of the goods at the port, which historically suffer from the accumulation of vehicles, and is a great alternative for reducing air pollutants, with the reduction of vehicles circulating on the roads.

Keywords: Export, Logistics, Port of Santos, Sugar, Transport

Introduction

Sugar production in the Brazilian state of São Paulo, according to the Union of Sugar Cane Sugar Industry - UNICA (2015), represented in the 2014/15 harvest more than 60% of the country's production and export through the Port Santos. UNICA (2015) also comments that, as sugar being an agricultural commodity, its price is fixed by international stock exchanges, so the logistics strategy to be used becomes crucial for

representative gains in their marketing. Despite the progress and advancement of the sugarcane sector, in which Brazil represents 50% of the world's sugar exports, the infrastructure sector has not yet advanced enough to make the product even more competitive.

Logistics at the thought of Novaes (2007, p. 35) appears as the "planning process, implementation and efficient and effective control of goods flow, services and information from point of origin to the point of consumption with order to meet customer demands."

The proper use of logistics varies conforming to geographical location, economic context and infrastructure of each country. As reported by Araújo (2013), road transportation accounts for approximately 60% of total cargo transported in Brazil, more specifically, about 80% of the domestic production of commodities is transported by road. This type of transportation, although it has a higher cost per ton, demonstrates the advantage of being faster and more flexible in the connection between source and destination, having also a lower fixed costs and higher variable costs.

Caixeta-Filho and Gameiro (2001) study point out that the road transportation for the outflow of sugar and for major commodities have the value of freight a very considerable end participation rate, ie, logistics costs have an important percentage to be considered in the planning and investment.

Regarding the railways, the National Transport Confederation - CNT (2011) describes it as the most appropriate mode for transporting large volumes of cargo and long distance stretches. This mode is also safe, economical and low polluting, especially with the use of biodiesel as a fuel. Taking into account geographical and economic characteristics of Brazil, which requires transport over long distances and large volumes of product commodities (low value-added product and considered volume), this type of transportation can be widely exploited, providing an opportunity to perform a significant representation in the national economy.

The CNT (2011) also highlights that the long period of stagnation suffered by the national railroad industry affected in a significant way the transportation matrix. It is estimated that are transported by Brazilian railroads more than 20% of the country's production, however, this rate is considered low when observing the size of the country and the potential use of this modality.

As stated by the National Land Transportation Agency - ANTT (2013), the Brazilian rail network does not exceed the 28,000 km long, maintaining the same size of the last 10 years. The concentration of this system takes place in the Southeast and South parts of the country.

For the flow of sugar from the countryside of São Paulo to the Port of Santos to export, the intermodal practice is used, prevailing the combination

of road and rail modes. For Ballou (2006) and Caixeta-Filho and Gameiro (2001), the use of intermodal transportation has the main objective the reduction of logistics costs since it does not modify the main attributes of the transport operation.

Thus, the overall objective of the study is to point out the characteristics of the means of transportation used to export the raw sugar produced in the mills of the State of São Paulo, trying to show advantages with the use of intermodal road-rail. For this purpose this study has the specific objectives: a) to present the principles of logistics, options and advantages of modes of transportation used to move big loads; b) describe the characteristics of the current São Paulo state structure for the flow of bulk sugar intended for export, including the railway infrastructure in the post-grant period to the present day; c) show new investments and projects to make viable inter-modality, introducing the benefits of this operation in the transport of sugar for export.

Material and Methods

Methodologically the study is characterized as exploratory and descriptive, as it holds on a theoretical basis consistent result of bibliographic research made by the analysis of published texts, both in the literature, such as journals (printed and / or published on the Internet).

The data collection was gathered from primary sources close to those involved in the sector of sugar export operations, such as producers, road and rail carriers and export terminals agents. Official websites and external publications that are open to disclosure were also used in order to obtain relevant information about the sugar for export transportation logistics process.

The established methodology for the analysis of the information was the identification of significant factors that characterize the sugar transportation logistics from production plants to the port for export. In this respect, Ballou (2006) notes that the railways has high fixed costs, however, by having potential to operate with higher load capacity units it results in the achievement of economy of scale, and its slow performance is recommended for products in bulk, large quantities, long distances and with higher delivery times.

As for the road transportation, in Novaes vision (2007), when compared with the rail, it reveals less investment, low fixed costs and high variable costs. The main advantages are the ability to reach any point of the country and the flexibility in carrying different types of cargo, and the disadvantage is the lack of scale due to the limitation in the amounts worked.

The criteria for analysis of the information was the identification of modes of transportation in general with their concepts and most important

features and in particular the movement of sugar for export. This gathering of significant data on transport, especially sugar, allowed to know and see how it behaves, trying to observe equipment and processes, as well as indicators that reveal not only the potential of performance, but also the reality.

To this end, took advantage of the search results, in which the information was organized and worked towards providing an insight into the logistics scenario sugar transport from production plants in the state of São Paulo to the Port of Santos, with purpose of export.

Analysis of large volumes transportation

The transportation of large volumes throughout the country, which has continental dimensions, demands analysis of the options available, and its important to consider suitability in order to find the best operationally viability, practicality, agility, safety and cost.

The transport of goods is characterized as a development indicator of a country. Frequent searches for ideal transportation alternative is directly related to cost savings and added value to the product. Traditionally transportation is the most important component in the agenda of the logistics process. Research in Transportation Cargo became a scientific expertise factor, enhancing the understanding and analysis of all the variables involved in improving the performance on meeting the complex needs arising from commercial transactions local, regional and international (Rodrigues, 2008).

The logistics system is fundamental for operational improvement of any productive sector, whether is the transportation of raw materials or the final products. Ballou (2006) reveals that transportation, in general, commits between 30 and 60% of global logistic chain costs and no company can work without moving their raw materials or products. It is, therefore, a challenge to the logistics management choose the appropriate modal for handling each type of product, considering the routes and the use of equipment.

When moving large volumes of goods the management of logistics search for the most effective strategy based on the characteristics of the products in order to find the most efficient and effective strategy in terms of traffic. There is also the option to use a combination of modalities in order to provide agility, safety and costs reduction, in the case of intermodal or multimodal.

However, for better understanding of the aspects of transporting large volumes, it is important to know the concepts, definitions and the main logistics characteristics, as well as modes of transport and their specificities.

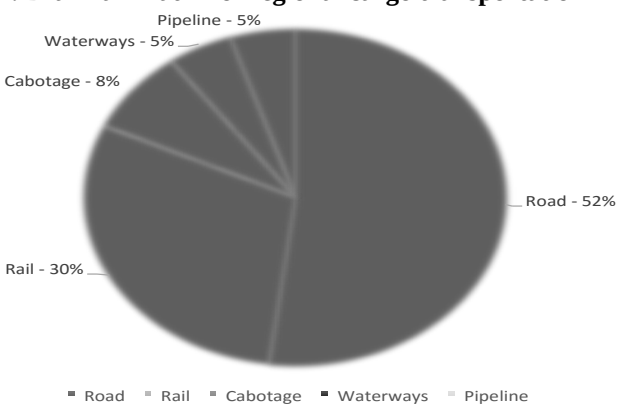
Modes of transportation

By the observation of Alvarenga and Novaes (2000), to provide an efficient transportation system it is important to take a systemic view, covering specially planning, however, for this to happen it is necessary to acknowledge: the flows in the various the network connections; the current level of service; the desired level of service; the characteristics or parameters of the load; the types of equipment available and their characteristics (capacity, manufacturer etc.); and the seven principles or knowledge concerning the implementation of systemic approach. Regarding the load parameters, the main elements are: weight and volume, medium density; load size; dimension of the vehicle; degree of loading of weakness; degree of perishability; physical state; asymmetry; and compatibility between different loads.

In this line of work, it can be seen that in a product the transportation process has several parameters that are important and need to be assessed to achieve a level of service desired by the customer. Depending on the service characteristics, it is important to select a mode of transportation or service available in the modal. Ballou (2006) explains that the definition of a modal transportation may be a strategy to generate competitive advantage of service to the company.

The current Brazilian transportation matrix, as for the Ministry of Transportation (2012) information, can be seen in the Figure 1. The percentage of participation of each modal is estimated depending on the quantities of TKUs (Tons per useful kilometer) of each mode, results from the simulations of the National Plan of Logistics and Transport - PNLT for the year 2011. Obviously, the displayed percentage (especially for the less expressive modes) may differ from values obtained from other sources, considering the adopted parameters and methods used to get shipments on the national road network.

Figure 1. Brazilian matrix of regional cargo transportation in 2011



Source: Ministry of Transportation (2012).

The Brazilian transportation matrix has an over dependence on road transportation, the second most expensive after the air mode. As Rego and Lacerda (2013), even with all the lack of infrastructure of Brazilian highways, the country has one of the largest road networks in the world thanks to its territorial extension. To support all the demand there are thousands of vehicles offered, contributing to naturally be the most widely used modal.

The modes of transportation have advantages and disadvantages in their use, because its peculiarities. Ballou (2011) indicates that to choose the most competitive option becomes important depth analysis of the service features (routes, delivery speed) capacity to be transported and costs. Thus, the the context of the large volume of transportation capacity is marked by aspects of the different modes, which can be observed on the topics listed below.

Road Modal

In agreement with Rego and Lacerda (2013), the road transportation is the most used in Brazil due to the strength of automakers who came to the country in the 50s, when the government, pressed by this industry, initiated an extensive construction of highways, generating jobs and income for the sector.

For Dias (2012), the advantages of this modal are the high degree of adaptation, the vast geographic coverage and low investment, since the roads are made with public money. Its disadvantages are the high variable costs (fuel and maintenance) and the limited space in weight and cubing. Ballou (2011) complements pointing out that compared to other available modes, road transportation offers a more agile delivery in mixed loads, because their individual loading. As for the railway mode, for example, it is necessary to establish a complete train in order for it to run to its destination, making it advantageous for road transportation in the small cargo market.

In contrast, Ballou (2011) points out that road transport has low load capacity and high structural costs, making it the most expensive compared to other modes offered. Surplus spending, uncontrollable economic factors, such as increased fuel and lack of security on cargo are weaknesses of this type and influence the total expenditure of its service prices offered.

The National Department of Transport Infrastructure - DNIT (2014), linked to the MT, provides an overview on the road modal, showing that this transportation system is used for moving goods and people by motor vehicles (buses, trucks, vehicle tour etc.). As it has in most cases freight price above the waterway and rail, it is suitable for high-value goods or perishables, finished or semi-finished products.

The DNIT (2014) presents a set of predominant features in road freight transport in Brazil: it reveals the highest rate of representation among

existing modes; It is suitable for operations over short and medium distances; Has low initial cost of deployment; High maintenance costs; It is very polluting, with significant environmental impacts; It has greater flexibility, with great extension of the network; Transport with moderate speed; The costs become high for long distances; It has low carrying capacity with limited volume and weight; and integrates all Brazilian states. These are aspects that determine the road transportation system, some positive others negative, that must be observed to use. The data on the Brazil's road network is briefly shown on Table 1.

Table 1. Overview of Brazilian highways

Roads	Km	%	Highways	Km	%
Paved	221.820	*13*	Federal	119.936	*7,1*
Unpaved	1.363.740	*79,5*	State	255.040	*14,8*
Planned	128.904	*7,5*	City	1.339.260	*78,1*
Total	1.714.464	*100*	Total	1.714.236	*100*

Source: National Department of Transport Infrastructure - DNIT (2014).

It is therefore a vision of Brazilian road transportation sector regarding the road structure, distribution and the agencies responsible for administration.

Rail Modal

The railways modal, as it is described by Ballou (2011), is basically characterized as a long-haul transport and low speed for raw materials and manufactured goods at low cost. In Brazil, can be cited as an example of products handled by this modal, minerals (iron and manganese), coal and cereal grains transported in bulk (sugar, soy). In European countries, rail has a broader aspect of logistics flows, being used for the transportation of containers and semi-trailers.

The rail transportation runs on two forms of service, regular carrier and private, and in consonance with Ballou (2011), the regular carrier sells its services to any user, being regulated in economic and security terms by the government, while the carrier private belong to any particular user who handles it exclusively.

Ballou (2011) concludes that despite having high fixed costs in equipment, terminals and railways, its variable cost is low, making costs lower than road transportation. Due to a lack of infrastructure and investment in the sector throughout history, one of the reasons that points Benatto (2009), rail hasn´t been widely used in Brazil yet.

However, the DNIT (2014) points out that currently the railway system ranks second in Brazil as the most widely used modal, but due to lack of

infrastructure and incentive from the government in the past, the railway network in Brazil was privatized.

Waterway Modal

The waterway mode, according to Ballou (2011), has an average fixed cost and low variable costs compared to other modes. It has the lowest cost, and it is used to transport low value and high volume products, as in the case of liquid bulk chemicals, sand, coal, high-value goods in international operations, in containers. Can be cited as examples of this means of transportation container ships and bidirectional ships for vehicles.

There are three ways that this mode of transportation can be divided: the inland, held in national or international route in internal waterways; long distance navigation, conducted between domestic and foreign ports; and cabotage, navigation performed between ports or places in Brazil, using the inland waterways.

The share of waterways in the Brazilian cargo transport matrix is very modest, about 4% in 2012, when confronted with the percentage of 58% of road transportation. Those numbers are from the records of the National Agency of Waterway Transportation - ANTAQ (MT, 2014).

As reported by the MT (2014), Brazil has a waterway network economically sailed of approximately 22,037 kilometers which also has the following characteristics: large carrying capacity; low operating costs; low maintenance costs; low flexibility; relatively slow transport; and is influenced by weather conditions. There is to be registered the low cost of implementation when considering a path of natural bed, but can become high if the construction of special infrastructure is needed as: locks, dams, channels etc.

Ballou (2011) comments that the advantages of this mode is the ability to carry large volumes and weights of goods and cost of damages are considered low compared to other modes. However, the disadvantages that can be displayed are the existence of problems in the port transportation and slowness, because it faces major climate influence for its effectiveness in the goods transit time. For reasons of continental geological formation, much of the possible structure of waterway usage is located in less commercially relevant regions, which has low industrialization rates and population density. Due to this aspect, the commercial viability of this modal do not provide a great application compared to the other modes.

Pipeline Modal

The pipeline transportation is a specific form, by its peculiar characteristics to the transportation of certain products, for example, oil and natural gas. This type of products are transported through pipelines, which

are also used to transport manufactured chemical products and raw materials, in addition the sewage and water in cities and municipalities (Bowersox, Closs, 2001).

Ribeiro and Ferreira (2002) make an overview of the pipeline modal describing the use of this system as very limited. It is intended especially for liquids and gases in large volumes, and materials that can be suspended (crude oil and derivatives, ores). The movement by pipeline is very slow, being offset by the operation being 24/7. The access rights, construction, requirements for control of the stations and pumping capacity to promote pipeline transportation puts it on the top of the list with the highest fixed cost. By contrast, its variable cost is the lowest among the modal, no work force cost of great importance. It is therefore the second modal with lower cost, second only to water transport mode.

As advantages for pipeline transportation, Ribeiro and Ferreira (2002) reported it to be the most reliable of all, as it presents few breakpoints to cause variability in the time and weather factors are not significant. Furthermore, the damage and product losses are relatively low.

Air Modal

The air transportation, in line with Ribeiro and Ferreira (2002), has had a growing demand from users, although their freight is significantly higher than the corresponding road mode. The air transportation mode is used mainly in the handling of loads of high unit value (electronics, high fashion, etc.) and perishables (flowers, noble fruits, medicines, etc).

Conforming to Ballou (2011), for air transportation there is regular, contractual and own services. The air service is available at any of the seven types: regular domestic trunk lines, freighter (only loads), local (main routes and less populated regions, passengers and cargo), supplementary (charters, has no regular schedule), regional (fill routes abandoned by domestic, smaller aircraft), air taxi (cargo and passengers between city centers and airports) and international (cargo and passenger).

In agreement with the observation of Ribeiro and Ferreira (2002), the air transportation is the one with higher cost in relation to other modes. Its fixed cost is high (aircraft handling and loading systems) as well as its variable cost (high cost of fuel, labor, maintenance, etc). The advantages of this mode of transportation is the high-speed, achieved distance, security (theft, damage and misplacement), and reduced stock costs. Its main disadvantages are the cost of freight, collection and delivery times, ground handling and physical dimensions of the aircraft transport basements.

Flow of raw sugar to export in São Paulo

Responsible for over 60% of the sugar produced in Brazil, the state of São Paulo stands out because of higher concentration of mills. Domestic production of the crop 2014/2015 was 35.55 million tons of sugar, while production in the state was 21.94 million tons, result of the work of 98 production units (UNICA, 2015).

As informed by UNICA (2015), about 75% of the sugar produced in the state of São Paulo is destined for export through the ports of Santos and Paranaguá, with the participation of transport using road transportation, rail and road-rail combination.

There are different types of sugars, with the definitions depending on the color and analysis of grains, which are intended for export from Brazil to meet the most varied spread markets around the world, especially Russia and Middle Eastern countries, the largest importers (UNICA , 2015). Table 2 shows the types of sugars and related packaging standards used in the export process.

Table 2. Types of sugar and export packaging standards

SUGAR TYPE	STANDARD PACKAGING
VHP	In bulk
VHP PLUS	In bulk
VVHP	In bulk
Crystal	Bag 50 kg; big bags up to 1200 kg
Refined Granulated	Bag 50 kg
Organic	25 kg bag

Source: Raízen (2013)

This market is characterized by the relationship between sugar mills and trading companies with carriers. According to Carvalho and Caixeta-Filho (2007), different packaging models used for transporting sugar intended for export are fundamental factors at the time of formation of the product value of the freight, as described below:

•Bag 50 kg: concerns the loose sacks, which is packaged in line with the capacity of the vehicle, requiring good number of laborers during handling and has a pattern of packaging associated with cheaper freight;

•Big Bag: packaging that holds 1,200 kilograms of sugar. It is used only in cases of very specific demands, mainly industrial;

•Bulk: due to their higher efficiency at the time of loading and unloading the product is the standard most commonly used in the market. Due to the higher level of requirements that this model need, it is characterized as a slightly more expensive freight, compared to other packaging standards.

Carvalho and Caixeta-Filho (2007) point out that in the case of sugar, the biggest export volume has its carriage in bulk (VHP and VVHP

specifications), but it is important to consider the cost of package in the case of loads that need packaging to be transported.

For sugar movement, Silva (2005) comments that there are three situations that represent the main alternatives to transport: road door to door, road and rail-restricted sugar shipment capacity and in a scenario where long-term rail transport without restriction of sugar shipment capacity.

Advocated by many authors as Benatto (2009) and Caixeta-Filho and Gameiro (2001), the road-rail intermodality in sugar transportation from the mills of São Paulo to the Port of Santos, can provide significant advantages in relation to cost reduction, transit time and safety goods.

To this end, this modality of transportation requires a combination of road transportation, responsible for handling the sugar from the mill to the transshipment terminal and railways, responsible for the longest path, from the terminal to the Port of Santos (Silva, 2005).

A practical example of multimodal transportation carried out between a production mill and the Port of Santos, takes place in the operations coordinated by the company Rumo Logística, which is a company incorporated by the Cosan Group, which provides a multimodal logistics system for the sugar export and others solid bulk as shown in Figure 2 (Cosan, 2015).

Figure 2. Rumo Logística´s transshipment terminals

Source: Cosan (2015)

The company transfers the load from the production centers to its port facilities installed in the area of the Port of Santos. The company Rumo

Logística offers integrated multimodal transportation, storage and shipment of products acting as Multimodal Transport Operator - OTM. (Cosan, 2015).

Brazilian railway network structure

Even with the investments made by the National Economic and Social Development Bank – BNDES, and the process of privatization have contributed significantly to the Brazilian railroads to retake the path seeking to achieve better results, the rail system still needs many improvements. Besides being notorious the lack of rail network in Brazil, the diversity of gauges among the companies constitutes a major problem that complicates an increased flow of trains over longer distances. However, despite all difficulties, rail has become quite competitive compared to other modes, for its handling potential for large volumes at competitive prices and transportation safety. The railways concentrate capacity and speed that being exploited properly provide optimization for logistics, directly benefiting businesses who use this transportation.

The state of São Paulo has the largest rail network in the country, investment reflections made mainly of great partnerships and private sector participation, which is the case of Cosan Group, that owns Rumo Logística, and America Latina Logistica SA - ALL, which owns the largest rail network in São Paulo.

By the observation of Benatto (2009), the lack of infrastructure in rail, as for the low public´s sector investments are aspects that influence the timid growth and demand for the modal in the state of Sao Paulo, reflecting directly on the low logistics competitiveness in the flow of the sugar from mills to the Port of Santos. However, this situation arouses the view not only of the government, but also the concessionaires, which strive to build partnerships with private companies in order to improve the sector. Is worth mentioning that the State's participation is very important to boost the actions of private entities.

Oliveira and Caixeta-Filho (2007) also comment that since it is agricultural commodity, which has the price set by the international market, improvements in export logistics becomes an extremely important factor regarding the reduction of costs and increasing the quality level of service offered. In this scenario, increasing the usage of rail for sugar export becomes an interesting alternative considering the product’s characteristics.

Benatto (2009) points out that, although the rail network is small, the state of São Paulo has the highest density of railway lines in the country, with a rail length of more than five thousand kilometers. This extension is divided into three concessionaires operating the system: Ferrovia Centro Atlântica SA - FCA, MRS Logística SA - MRS and ALL. Figure 3 shows the division of São Paulo rail network:

Figure 3. Map of railroads in the state of São Paulo

Source: Esalq-Log (2013)

The São Paulo rail network has experienced investments targeted by concessionaries, both ALL and Rumo Logística, as they have sought to apply action by the significant demands and ways to meet the flow of sugar mills to the Port of Santos to meet export quotas.

Scenario and expectations for intermodality in São Paulo

The transport logistics in its scope, the means and existing roads reflects on economic and social consequences, varying according to their characteristics and qualities. They are linked to a complex and imbricate network of activities that mark the everyday, and establish the dynamics and internal and external integration (Silveira, 2007). Given these conditions, in order to be able to increase efficiency in the management and modernization of infrastructure, those are essential factors for the articulation to be intense and facilitated, in spite of decreasing transportation costs, increasing security and mobility assurance, reducing losses and damage to goods, to ensure the shortest delivery time of goods to customers, quality in storage and transhipment of cargo, cooperation between modes of transport, among others.

The use of intermodality in Brazil, in the opinion of Araújo (2013), is an operation characterized by the combination of different modes of transportation to move the same product from the place of origin to it´s destination, and it still not traditional and usual face an environment that prevails the usability of road transportation. The major intermodal routes used in agribusiness are the ones that make use of the rivers Tiete and

Paraná, Araguaia / Tocantins and Madeira, and the railways of ALL in the Midwest and South parts of the country.

Given the investment and development of the railway sector in the state of Sao Paulo, Oliveira and Caixeta-Filho (2007) claim that to achieve efficiency in this transport system the load concentration is necessary in a certain place, since flexibility is not a regular feature of rail transportation. Nowadays the state of São Paulo has several intermodal terminals strategically located in regions with high rates of concentration of mills but there is stillroom for the viability of building new terminals.

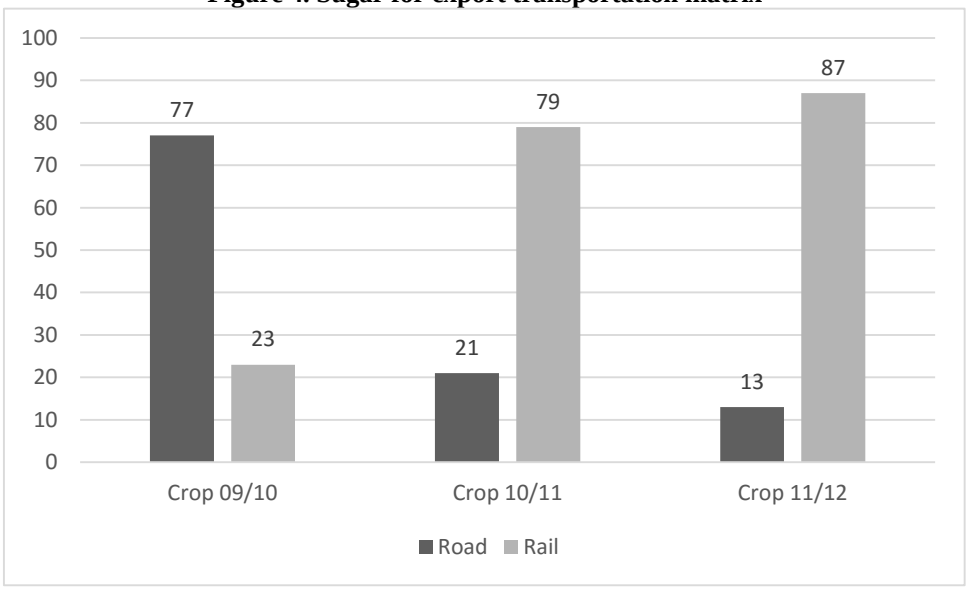
In the state of São Paulo there is the option of integration between road transport and rail, but there is the need of transfer points. This alternative is enhanced in some regions by terminals managed by Cosan, such as: Multimodal Terminal Logispot, located in Sumaré; Jau Terminal, located in the town of Jau; Pradópolis Terminal, located in the municipality of Pradópolis; Fernandópolis Terminal, located in the city of Ferandópolis; Barretos Terminal, located in Barretos; and the Itirapina Terminal, located in Itirapina (Cosan, 2015).

This structure is the result of Cosan investments, which has been promoting an interesting migration of the road mode to rail. This process, in keeping with UNICA (2015), estimates that has caused a reduction in the flow of trucks on state roads of São Paulo in about 30 thousand vehicles / month, contributing to the decrease of 60% in CO2 emissions in the atmosphere and a better conservation of the roads. This change has generated a containment logistics costs, increasing competitiveness of Brazilian sugar in the international market, since the cost of transporting the product represent on average about 10% of the total value of the product.

Starting its operations in the 2010/2011 harvest, Rumo Logística was responsible for a significant change in the logistics concept about the logistics of sugar in the state of São Paulo. Its performance in two harvests reflected in the change of the employed logistic modal, road by rail transportation, to the Port of Santos of the Cosan Group production, and has increasingly established itself as the best alternative for the transportation of this commodity, which in addition to environmental benefits, ensures greater cost competitiveness and product safety for the sector (Raizen, 2013).

The reduction of the numbers of unloading vehicles in the Port of Santos also reflected in contribution to the flow of vehicles, since, as stated by Lacerda (2005), is one of the largest logistical bottlenecks in export is the concentration of trucks in the unloads terminal. They disposes of little space, which generates queues, delays in unloading and extra costs. Figure 4 below shows the result of this change in sugar transport matrix transported by the Rumo Logística to the Port of Santos.

Figure 4. Sugar for export transportation matrix



Source: Raízen (2013)

It is, therefore, a new vision that is consolidated, in directing attention to the railways, without totally despise the road transportation, but to establish the combination that determines the intermodality, which through its conscious use promotes benefits and advantages for the mills.

Conclusion

The production of domestic sugar scenery reveals the participation of Brazil in the international market as a leading exporter. Considering the continental dimensions of the country and the geographical characteristics, the sugar transportation logistics from the production unit to the port for exportation constitutes a factor of high importance, especially with regard to the cost of freight and other factors.

The handling of large volumes involves analysis for the use of the most appropriate transportation system. For this, the options are road, rail, waterway, pipeline and air. Each mode has its own characteristics and depending on the demand of the product to be moved and the operation to be held down the level of operability and degree of viability.

In the specific case of sugar, a commodity, the transport factor has a strong representation, not only in terms of operation, as to determine the cost of freight. In this situation, the most appropriate modal for sugar transportation is road and rail, and for certain situations a combination of both consolidating the road-rail intermodality.

It is worth noting that São Paulo is presented as the largest state producer of sugar by the high concentration of mills, and a large part of their

production is exported using the Port of Santos. However, for sugar to be taken from the point of production to point of shipment for exportation a long stretch is covered and for that, it is necessary to use the road and rail modal and intermodal in the best composition of the two.

The research reveals the importance and need for investments for the sugar transport occurs efficiently. With the privatization of the sector, companies have made investments in the rail network so that has raised the use of railways for sugar transport to the Port of Santos which serves most of the production in the state of São Paulo, since the use of modal alternatives has gained importance when it comes to minimizing the agribusiness transportation costs and consequently maximizing the sector's competitiveness facing the international market.

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