EFFECTS OF SOYBEAN TRANSPORTATION COSTS IN THE U.S.A. AND BRAZIL: A LOGISTICAL COMPARISON

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Agricultural commodities, and especially soybeans, represent an opportunity for Brazil to position itself as a leader in global markets. Brazil and the United States of America are the world’s largest soybean exporters, and both possess unique agricultural commodity transportation structures. This article examines in detail the infrastructure differences between the two countries and how this influences the means of transportation chosen in soybean transportation. After giving a theoretical overview of logistics and transportation, both the Brazilian and U.S. transportation systems are analyzed and compared. Some cost analyses of the soybean production cycle within the respective countries are performed, and examples are given to enrich the information provided. Finally, some concluding remarks are offered on the effect of transportation on the total landed cost of exported soybeans.

Palavras-chaves: Logistics, Infrastructure, Soybean Transportation, Transport Strategy
1. Introduction

Agricultural commodity trade, and particularly the soybean market, represents an opportunity for Brazil to position itself as a leader in the world market. Among the three most commonly produced grains in the agricultural market – soybeans, wheat and corn – soybeans maintain the highest price on the market, almost two and three times more expensive than the others, respectively (USDA, 2010). Brazil is the second largest soybean exporter in the world after only the United States and one of the most important competitors in the world oilseed market (SALIN, 2009).

As the world’s two principal soybean producers, Brazil and the United States also export the majority of the soybeans in the world and thus, compete for the edge in the world’s largest soybean-consuming markets: China and the European Union. Currently, the world’s three principal soybean exporting nations – the U.S., Brazil and Argentina – contribute to nearly 90% of international trade. These data are represented in Graphic 1 (USDA, 2008).

![Graphic 1 - Leading Soybean Exporting Nations, Source: USDA Agriculture Statistics Annual, 2008](image)

An increase in Brazilian soybean production is expected in the coming years. According to the U.S. Department of Agriculture’s (USDA) projections, by the year 2019, Brazilian soybean exports will increase by 40%. The increased pressure from Brazilian and Argentinean soybeans will result in the reduction of the U.S. market share from nearly 40% to 30% by the end of the projections (U.S.D.A., 2010). This shift in the balance of the soybean market will create opportunities for profit within Brazil.

However, Brazilian soybeans currently suffer from a disadvantage in comparison with its world-market competitors: cost of transport. Among competitors, Brazil maintains the lowest farm-level cost of production (SCHNEPF, DOHLMAN and BOLLING, 2001), but loses out on this advantage between the field and the port on the way to the international market due to the large distances traveled by inefficient means of transportation in comparison with the United States (PLÁ and SALIB, 2003).
In logistical terms, soybeans are a low aggregated-value product, turning its transport policy into an essential element in cost control and, ultimately, competitiveness. According to Dornier et al. (2000), transport policy involves the choice between modes of transportation, decisions about delivery size, routing and scheduling. It is highly related with client service and policy and stock and storage locations.

The cost of transporting soybeans in Brazil is considerably more than that of the U.S. In 2007, the Agricultural Marketing Service and the U.S.D.A. measured the internal transport costs of Brazilian soybeans to be three times more than that of American soybeans (U.S.D.A., 2007). It is generally accepted that as infrastructural systems improve, modes of transportation can reduce in terms of cost, thus reducing the cost of the product in general (COSTA and ROSSON, 2007).

This paper will evaluate the respective modes of transportation of soybeans from Brazil and the U.S. The structure will follow the subsequent order: Part 1 introduces the topic of the paper; Part 2 will address the objective of the study; Part 3 will present a discussion about some theories and definitions from the area of logistics; Part 4 will analyze the different modes of transporting soybeans within the countries in question; finally, Part 5 will conclude the paper with a discussion of the data presented in the paper and a summary of the details and implications.

2. Objective

The logistical situations and challenges that both Brazil and the U.S. face will be discussed taking the previously discussed data and differences in transportation costs into account. The objective of this article is to evaluate the means of internal transportation utilized within Brazil and the U.S. in reaching the international market, leading to a better comprehension of the ways in which soybeans are transported in the world’s two largest soybean exporting nations.

In the following section, some theories relevant to the efficient practice of logistics and transportation will be evaluated.

3. Logistics Theory

Logistics and operations have never performed such an important role in organizations (DORNIER et al. 2000). According to the definition offered by the cited authors, “logistics is the flow management between marketing and business functions. The current definition of logistics encompasses a larger amplitude than in the past.”

In this article, global operations, logistics and transportation within the context of the soybean market will be examined. Dornier et al. (2000) offer a functional definition of global operations upon which will be used in this article. “Global operations involve the process of planning, implantation and control of the flow and storage of,” among other things, “prime materials,” such as soybeans, “from the point of origin to the point of consumption” (DORNIER et al., 2000).

A country’s infrastructure has a large influence in the efficiency of its productive sectors in the global market. According to Stülp and Plá (1992 apud Ojima, 2005), the transport segment can interfere in the efficiency of the many sectors of a country’s economy. A company’s logistics policy can be limited to the choices which are made available by a country’s infrastructure.
Schnepf, Dohlman and Bolling (2001) agree that infrastructure, among other factors, is one of the factors that contributes directly to the competitiveness of a commodity, such as soybeans.

The efficient practice of logistics offers a competitive advantage to businesses. Competition between competitors is promoted by the improvement of transports: a business farther away from a client is able to compete with a business closer to the same client if its costs are comparatively cheaper (MARTINS and CAIXETA FILHO, 1998).

Being a product of low aggregated value, it is more advantageous to transport soybeans by waterway or railway, thus taking advantage of the economies of scale of great quantities that can be transported (USDA and USDT, 2010). Plá and Salib (2003) also agree and offer the following evaluation of commodity transportation. “Railways and waterways are more adequate for the transportation of agriculture products due to the characteristics of the cargo and its respective movements in Brazil, or rather, large volumes with concentration in a few, short periods of the year, low quotients of value/freight of the products and long distances” (PLÁ and SALIB, 2003).

In the following part, the role of soybeans in the Brazilian economy and the transport of the crop to the international market will be discussed, taking into account the previously discussed logistics concepts.

4. Brazilian soybeans and soybean logistics

Agriculture plays an important role in the Brazilian economy. According to statistics provided by the Brazilian Agricultural Ministry, Ministério da Agricultura, Brazil was the fifth most productive exporter of agricultural products in the world in 2004 (MINISTÉRIO DA AGRICULTURA, 2005). In terms of national impact, the agricultural sector in Brazil contributed 28%, or USD $55 million, to the total Gross Domestic Product (GDP) in 2008 (CEPEA, 2010).

Brazil is the second largest exporter of soybeans in the world, producing 27% of the soybeans in the world in 2008 and 2009 and making up 38% of the crop’s world export figures in the same time period (SALIN, 2009). Soybeans make up a large part of this GDP percentage, being Brazil’s most exported agriculture product. In 2007, the crop itself represented 29% of the total number of exported agriculture products. Soybeans and all of its derivatives, including soybean cakes and oil, contributed to 48% of the total number of exported agriculture products in the same year. These data can be seen in Graphic 2 (UNITED NATIONS, 2007).

In general terms, the chosen transport modalities and the channels of distribution affect the final consumer in the formation of the final price of the product (DIAS, 1987).

Historically in Brazil, the most utilized modality of cargo and goods transport is the highway. According to Dias (1987), at the end of the 1980s, 76.4% of the cargo transported within the country was transported on the road, in comparison with 14.2% by railway and 9.3% by waterway. Both railway and waterway transportation have seen gains in the frequency of their use in the past two decades. The privatization and deregulation of the railways and ports and elimination of export controls in the 1990s helped diminish the costs of these means of transportation (SCHNEPF, DOHLMAN and BOLLING, 2001).
These assertions are supported by the information offered by the Brazilian Confederação Nacional de Transporte 2009 statistics bulletin. In 2006, the percentage of roadway cargo transportation dropped to 61.1%, and percentage of both railway and waterway cargo transportation increased, to 20.7% and 13.6%, respectively (BOLETÍM ESTATÍSTICO, 2009 apud ASSOCIAÇÃO NACIONAL DE TRANSPORTE TERRESTRE, 2006). These data can be seen in Graphic 3.

Moreover, the tendency to transport by truck is extremely relevant in the question of soybeans. Brazilian soybean farmers frequently opt for truck transportation instead of cheaper manners, such as railways and waterways. According to Schnepf, Dohlman and Bolling (2001), these elevated costs incurred in truck transportation are caused by the inefficient and underdeveloped waterway and railway systems.

Brazil possesses almost 30,000 km of functional railways (DIAS, 1987; SCHNEPF, DOHLMAN and BOLLING, 2001). However, Dias contributes the lack of a uniform gauge, among other factors, to the low utilization of the Brazilian railway system in transport. There
are three types of gauges: The “metric” 99 cm gauge used in 65% of the country; the “wide” 160 cm gauge, utilized in 17% of the country, and the mixed gauge, which accommodates both gauge types (SALIN, 2009).

As aforementioned in the theory section, Doriner et al. (2000) assert that the storage of a product is directly related to its transportation policy. Thus, the lack of storage centers along the soybean transportation chains stands out as a weak spot in the soybean transportation scheme, principally in the waterway ports and railway stations (SCHLEPF, DOHLMAN and BOLLING, 2001). According to the cited authors, due to the perishable nature of soybeans, the lack of satisfactory storage centers, such as silos, causes Brazilian exporters to push soybeans onto the international market in undesirable seasons when the prices are relatively low. The lack of sufficient storage contributes to the crop’s exposure to negative factors such as the elements and rodents, resulting in the diminishing of the product’s quality. The resulting rush to transport soybeans has reportedly contributed to enormous lines of trucks waiting for multiple days to load and then transport soybeans to the ports.

The majority of Brazilian soybeans are produced in the states Mato Grosso (MT) and Mato Grosso do Sul (MS) in the interior of the country. Once harvested, soybeans face an arduous journey on the way to the international market: From the fields of MT and MS along the roads, many times unpaved (COSTA and ROSSON, 2007) to the most utilized Brazilian ports of Santos, Paranaguá and Rio Grande, representing journeys of 1,500 km in some cases.

The production of Brazilian soybeans has expanded to the Central-West, North and North-East regions of the country in the last three decades. Even though this rapid growth has occurred, these regions are still in the process of developing their transportation infrastructure (COSTA and ROSSON, 2007).

Ojima and Rocha (2005) assert that the railway and waterway systems in Brazil are not sufficient to realize the transport of grain in many cases, making the utilization of roadway transportation necessary, even when dealing with long distances. As previously mentioned, soybeans are a low aggregated-value commodity and trucks are not the most efficient means of transportation in this case, due to the high volume that must be carried to achieve sufficient economies of scale.

The previously mentioned authors confirm that “a truck loads around 150 times less soybeans than a railway composition and around 600 times less than a barge, such as the ones on the Madeira River” (OJIMA and ROCHA, 2005).

The influence of the cost accumulated in roadway transportation in the final landed cost of an international product can be seen in the following examples.

The distances from Sorriso, MT, to the most utilized ports in Brazilian soybean transportation of Santos and Paranaguá are 1904 km and 2019 km, respectively. The transport cost from Sorriso, MT, to the ports of Shanghai, China or Hamburg, Germany through said ports represents 31-34% of the total landed cost (SALIN, 2009).

A difference can be seen in the total landed cost to the final consumer when the aforementioned logistical situation is compared with that of Cruz Alta in the state Rio Grande do Sul (RS). The distance from Cruz Alta to the port of Rio Grande is 463 km, and the corresponding transportation costs to the same ports almost reduce by half, falling to 16-19% of the landed cost (SALIN, 2009). “From a logistical perspective, soybean production located within a small radius of these ports remains highly competitive with U.S. soybeans in
European markets. However, as Brazilian production moves into the interior, the high cost of getting soybeans to market erodes competitiveness” (SCHLEPF, DOHLMAN and BOLLING, 2001). Implications of the previous assertion can be seen in Graphic 4, which compares transportation costs from Sorriso, MT, located 1,914 km from the Santos port, and Cruz Alta, Rio Grande do Sul (RS), located 463 km from the Rio Grande port, with costs from Davenport, Iowa (IA) located 2,160 km from the U.S. Gulf port via the Mississippi River (SALIN, 2008).

![Transportation Cost Comparison between Sorriso, MT, Brazil, Cruz Alta, RS, Brazil, and Davenport, IA, USA to Shanghai, China, Source: SALIN, 2008](image)

<table>
<thead>
<tr>
<th>Year</th>
<th>Sorriso, MT (1914 km to port)</th>
<th>Davenport, IA (2160 km to port)</th>
<th>Cruz Alta, RS (463 km to port)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$USD/mt</td>
<td>$USD/km</td>
<td>$USD/mt</td>
</tr>
<tr>
<td>2007</td>
<td>$180.51</td>
<td>$0.09/km</td>
<td>$155.35</td>
</tr>
<tr>
<td>2008</td>
<td>$186.12</td>
<td>$0.10/km</td>
<td>$133.09</td>
</tr>
</tbody>
</table>

Source: SALIN, 2008

Table 1 – Transportation Cost Comparison in $USD/Metric Ton and $USD/kilometer from Sorriso, MT, Brazil, Cruz Alta, RS, Brazil, and Davenport, IA, USA to Shanghai, China, Source: SALIN, 2008

Now the logistical measures and infrastructure in the transport of U.S. soybeans will be considered.

5. American soybeans and U.S. logistics

The U.S. produces 38% of the world’s soybeans and makes up 45% of the soybean export trade. In spite of having a higher accumulated farm-level production cost among its competitors, the U.S. maintains a position of leadership in the world market. In 2001, in the principal areas of production in the U.S., soybean cultivation and harvest cost $5.11/bushel, in
comparison with that of MT, Brazil, where the cost was just $3.89/bushel. The manner in which the U.S. recovers this competitive edge is in its relatively low transportation costs (SCHNEPF, DOHLMAN and BOLLING, 2001). Graphic 5 shows these data from Schnepf, Dohlman and Bolling’s comparison of soybean’s accumulated landed cost from the principal U.S. and Brazilian soybean producing regions.

![Graphic 5 – Brazilian and U.S. Soybean Cost Comparison in USD $/bushel, Source: SCHNEPF, DOHLMAN and BOLLING, 2001](image)

Overall, according to the Agricultural Marketing Service’s report *Transportation of U.S. Grain from 1987-2006* report featured in the U.S.D.A. and U.S. Department of Transportation’s 2010 report, railways and waterways constituted 46% and 49% of U.S. soybean export transportation, while roadway transportation by truck accounted for just 5% (AGRICULTURAL MARKETING SERVICE, 2006 *apud* U.S.D.A. and U.S.D.T., 2010). The same report concludes that “rail and barges lend themselves to bulk and lower-value products such as wheat and soybeans…The higher ratio of ton-miles for rail and barge indicates their efficiency at moving commodities long distances, such as moving grains and oilseeds to ports for export.”

As has been discussed, the logistical situation of soybeans in the U.S. has a transport structure which differs from Brazil’s, depending more on railway and waterway systems for the commodities’ mass transport. According to Schnepf, Dohlman and Bolling (2001), the U.S. has a wide-spread network, centered around the Mississippi River and its tributaries, which makes for economic and efficient commodity transport, such as soybeans, to the international markets via barge. The cited authors assert that the American barge system is “unrivaled as the most economic and efficient manner of transport of commodities from the field to the international market.”

The U.S. also possesses 240,000 km of usable railway, eight times that of than Brazil, favoring American soybeans in logistical terms. (SALIN, 2009) The previously cited authors also state that the existence of a uniform gauge system offers a competitive advantage to the U.S., as transporting along a multiple-gauge system requires expensive stops, and the uniform system facilitates the movement of equipment. Moreover, due to the heavier rails of the
American trains, the locomotives and train cars are able to transport larger densities of the crop, thus gaining an advantage in economies of scale.

A difference in the transportation tendencies between the two respective countries can be seen when considering the following example. In the case of American soybean exports to Mexico, which can be accessed by roadway, railway and waterway, the most utilized method is railway, representing 61% of the soybean exports from the U.S. to Mexico. Maritime transports and trucks represent 31% and 8%, respectively (SALIN, 2010). Basically inverting the Brazilian model of soybean transportation, the example given demonstrates a large break from the Brazilian tendency to transport soybeans via roadways, which is considered more costly in commodity transportation.

Considering the example given in the examination of the landed cost of Brazilian soybeans to Germany and China, the average cost of transport from the Mid-West U.S. to Shanghai and Hamburg composes, on average, 20% of the landed cost, compared to 31-34% from Mato Grosso to the same ports (SALIN, 2009). These reductions in transport costs are reflected in the cost to the final consumer, thus aiding the competitiveness of American soybeans in the international market.

In the following section, some considerations and conclusions to this paper will be discussed.

6. Conclusions

In this paper, the roles of transport and logistics in the international soybean market have been discussed. Specifically, the Brazilian and U.S. transport systems were compared, drawing upon statistics and logistics theory in the discussion.

Until Brazil improves its means of transportation, Brazilian soybeans will be more subject to the fluctuations in the world petroleum market than American soybeans. A jump in gas prices would affect Brazil more profoundly than the U.S., since the transport costs from the production regions to the ports are disproportionally larger in Brazil, due to its dependence on truck transportation.

Soybean transportation via navigable rivers has been developing in recent decades, aiding in the decrease of transportation costs. Waterway projects, such as the Tiete-Parana river waterway, have aided and improved in a more economic transportation of the crop. Such waterway transport systems are similar to those of the U.S., which can contribute to the increased competitiveness of Brazilian soybeans.

In the literature, many authors agree that Brazilian soybeans suffer increases in price along the way to the international market due to its comparatively high costs in the transportation sector. The same authors agree that improvement in the area of transports and their utilization would bring about a lowering of the cost of soybeans to the final customer (SALIN, 2009; COSTA e ROSSON, 2007; OJIMA e ROCHA, 2005; PLÁ e SALIB, 2003; SCHNEPF, DOHLMAN e BOLLING, 2001). These elevated transport costs are transferred to the final clients, thus raising the landed cost of the product and influencing the performance and competitiveness of soybeans, Brazil’s leading agricultural export.

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8. Bibliography


