Maritime Transportation and Harvesting of Sea Resources – Guedes Soares & Teixeira (Eds)
© 2018 Taylor & Francis Group, London, ISBN 978-0-8153-7993-5

Challenges for implementation of the green corridor in Brazil

D.A. Moura
Federal University of ABC, Santo André, Brazil

R.C. Botter & J.F. Netto
University of SãoPaulo, São Paulo, Brazil

ABSTRACT: This paper will report on the challenges of establishing a green sea corridor in Brazil. It will deal with the legal aspects, the public policies related to the Brazilian maritime navigation sector, the integration of logistic modalities, the technical and political obstacles for a continental extension country. The focus of this project is to study European green corridors and to analyze the feasibility of adopting something similar for Brazil, as a focus on multimodality, especially in the use of short sea shipping transport, taking advantage of the extensive coastline that Brazil possesses. The specific objectives are to identify sustainable transportation in the green corridor, clean technologies applicable to multimodal corridors with emphasis on short sea shipping.

1 INTRODUCTION

The integration of transportation modals in Brazil cannot be considered a relevant point for the national logistics system. There are several infrastructure problems that interfere with the flow of transportation of goods, which contributes to high logistics costs and loss of competitiveness in the national and international scenario.

The world soybean market is a clear example. We are the second largest exporter of soybeans in the world. The world harvest in 2015/2016 was 312,362 million tons. The United States had a production of 106,934 million tons and Brazil was the second largest producer, with a harvest of 95,631 million tons.

The state of Mato Grosso is the largest soybean producer in Brazil. It is located in the central region and produces 30,514 million tons. However, Mato Grosso is located far from port areas to flow its production abroad, mainly to the Asian market, which is Brazil's largest soybean consumer.

In addition to transporting soybeans for export, short sea shipping on the Brazilian coast is another example of a major challenge for the green corridor.

This paper intends to approach some legal and current aspects of logistics infrastructure in Brazil for the implementation of a sustainable logistics corridor.

2 RELEVANT ASPECTS OF A SUSTAINABLE LOGISTICS SYSTEM

A sustainable logistics system must meet the needs of society, aiming to reduce or eliminate negative environmental impacts such as emission of polluting gasses, congested roads or noise pollution. It should, on the contrary, optimize the use of resources, reduce operating costs and waste, use energy in an intelligent and renewable way, and create economic value for society (Psaraftis, Panagakos, 2012; Lee, et al., 2016; Jafarzadeh et al., 2017).

In order to meet the needs of society, there must be a participation of public and private institutions with the same objective. Suiting infrastructure to promote the best performance of the logistics system in each transport corridor is an essential condition for the success of the project. Committed companies, research centers, universities, municipal, state and federal public agencies and the community are key factors to initiate a sustainable transport engagement.

Promoting sustainable growth is associated with the use of efficient, preferably green, resources that are economically competitive and do not bring disruption to the environment and society. The focus should be on the use of renewable energy in all transport operations between origin and destination, seeking low carbon economy, innovation in transportation, storage and transshipment operations, regardless of the modalities used to transport the products (Psaraftis, Panagakos, 2012; Jafarzadeh et al., 2017; Eng-Larsson and Kohn, 2012; Wang et al., 2015).

The use of information and communication technology is an ally for the application of sustainable transport systems. It can contribute immensely to monitoring transportation processes to eliminate or minimize congestion bottlenecks and eliminating bureaucratic documentation in operations, to simplify the system, and to support staff in transportation operations on highways, urban transport, waterways, railways, ports, maritime and air transport (Psaraftis and Kontovas, 2010; Chapman et al. 2003; Perego et al., 2011; Wang et al., 2015).

Eliminating or reducing paperwork along the transport chain is the essential role of the area of information technology and communication, which should support the transport of goods in a green corridor. Only then, one can think of optimizing the operations and helping in the decision making that contributes to an integrated logistics system (Presbitero et al., 2017; Perego et al., 2011; Wang et al., 2015).

Along with the use of information and communication technology that eliminates or minimizes paper bureaucracy throughout the freight transport chain, the focus is on the use of the best modalities at each stage of the transportation of merchandise. By optimizing modals using clean energy, the benefits will be great for sustainable transportation (Perego et al., 2011; Eng-Larsson and Kohn, 2012; Wang et al., 2015).

Thus, it is important the commitment of all actors in the sustainable transport corridors to invest in innovative technologies, regardless of the mode of transportation used in logistics operations.

The type of fuel used in transportation operations directly influences the sustainability of operations. Using renewable energy is an important differential for green corridors. Using modal which minimizes or eliminates polluting gasses is also essential (Psaraftis, Panagakos, 2012).

In the waterway modal, it is essential to limit or reduce the emission of gaseous pollutants using a parameter that is defined by the International Maritime Organization (IMO). The same is true on roads to reduce or eliminate CO2, with the use of electric motors in vehicles, or with the use of renewable energies such as solar, for example (Psaraftis, Panagakos, 2012; Lee, et al., 2016; Sys et al. 2016; Jafarzadeh et al., 2017; Eng-Larsson and Kohn, 2012). It is also applicable for the case of NOx nitrogen oxide gas and for particulate matter (PM). The concept also applies to locomotive engines in the use of the rail modal and the whole transshipment system. Avoiding or eliminating the use of fossil fuel is a relevant condition in the sustainable transport process (Psaraftis, Panagakos, 2012; Sys et al. 2016; Liljestrand, 2016; Zis and Psaraftis, 2017; Pålsson, and Kovács, 2014; Amaya et al., 2016).

Conventional transportation must be rethought and innovated. New alternatives should be used, such as hybrid system, use of renewable energy, liquefied petroleum gas, biomethane, compressed natural gas etc. For urban areas, electric motors or compressed natural gas could be used in transport vehicles. The compressed natural gas in vehicles could be used on highways. However, it would be essential to have several points of supply for the trucks along the way. The power grid in port operations could be used in river and maritime transport, for example, the use of wind to feed ports in sustainable logistics operations. Hydrogen gas for vehicles engines and LNG gas for ships are two other possibilities (Zis and Psaraftis, 2017; Jafarzadeh et al., 2017).

Attention should be given to the emission of organic compounds, oils used in transport operations, tires, batteries, etc.

The ballast water treatment of ships corroborates for sustainable transport. All attention is essential to avoid the transfer of pathogenic aquatic organisms.

Another essential factor for the right development of sustainable logistics system is to avoid or minimize congestion in transportation operations. Monitoring all operations to avoid any kind of congestion will contribute to the sustainable logistics system and for this, information technology and communications systems are important for success in implementing green sustainable corridors. Thus, it is possible to optimize the logistics operations by optimizing the routes and the operations of transport, transshipment, movement and storage. Limiting the speed of vehicles used in transport modes is also an interesting and important measure for the entire logistics system (Liljestrand, 2016; Chapman et al. 2003; Presbitero et al., 2017; Perego et al., 2011; Wang et al., 2015).

3 METHODOLOGY

The methodology consisted of the qualitative type research. It was carried through by means of personal interviews, with entrepreneurs, directors and managers of the transportation industry. The criterion used for selection of the companies in the qualitative research was based on the importance of the company inside its segment. However, other data had been collected personally in the other actors of the national transportation industry.

The methodological procedures adopted were based on the opinion of experts. This type of research design can be used to answer questions about relationships, including those of cause. Thus, the questioning of the participants happened through questionnaires.

Regarding the questionnaire, the survey method involves structured questions that the respondents answered and which was carried out to describe the current stage of the national transportation industry.

It was accomplished through personal interviews, in loco, with entrepreneurs, presidents, directors and managers in the Brazilian maritime industry (short sea shipping), road transportation and railway transportation industry. It was included 30 companies of the three segments of transportation. The total of the companies working in transportation systems, almost 90% of the total has been interviewed.

4 CHALLENGES FOR IMPLEMENTATION OF GREEN CORRIDORS FOR BRAZIL

The main types of cargo in the Short Sea Shipping are the liquid bulk of Transpetro, subsidiary of Petrobras, which transports oils through Brazil. Second are solid bulks, for example, bauxite and, subsequently, the general cargo. The general cargo transport has been increasing in percentage in the Short Sea Shipping. Short Sea Shipping with containers has grown by an average of 8% in recent years.

The maritime short-sea transportation can be analyzed according to the type of cargo. They can be: dry bulk, wet bulk, general cargo, containerized cargo.

The transport of dry bulk is basically: wheat, salt, alumina, corn, manganese, iron ore, limestone and bauxite.

The transport of wet bulk and gas involves light and dark oil derivatives, soya oil, solvent and aromatics, alcohol, acetate monomer, acids, gasoline, styrene and Liquefied petroleum gas (LPG).

The general cargo transport and containerized Cargo is usually: rice, paper, construction material, electronics, PET resin and dry chemicals.

4.1 *Logistic corridor for soybean exportation*

In general, the lack of integration between modes is a negative point in the transportation of goods throughout Brazil. Transportation of soybeans for export can be used as an example. The largest production is located in the Center-West region of Brazil, in the state of Mato Grosso (MT). The second largest exporter is the state of Rio Grande do Sul (RS), located in the southern region of the country and the third largest producer is the state of Paraná (PR), also located in that region, according to Figure 1.

The state of Mato Grosso is the largest exporter of soybeans in Brazil, responsible for 29.18% of all Brazilian production, approximately 30,514 million tons, followed by the state of Paraná with 18.68%, approximately 19,534 million tons and the state of Rio Grande do Sul with 17.89%, approximately 18,714 million tons. Those three states together correspond to approximately 65.75% of all soybeans exported.

Figure 1. Three largest exporters of soybeans in Brazil.

Especially analyzing the state of Mato Grosso do Sul in the Central-West region of Brazil, which is the largest exporter of soybeans, it is distant from the region of ports and the largest port in Brazil, the port of Santos, located in the Southeast region, in the State of São Paulo.

The port of Santos, in São Paulo, handled approximately 29% of the whole national soybean load. From the total amount of soybean exported from the state of Mato Grosso, approximately 51% passes through the port of Santos. Therefore, the port of Santos concentrates the greatest demand for soybeans for export from the state of Mato Grosso.

The extension of the soybean transportation corridor between the state of Mato Grosso (in the Center-West region) and the Port of Santos (Southeast region), is approximately 2,116 km. In that corridor the following modals of transportation are used:

– the road is used in the first part of the route, which corresponds approximately to 819 km. In the second part, the railway is used, being 1,296.6 km away from the Port of Santos, on the coast of São Paulo, to be exported to Asia, mainly to China. The average speed of the rail mode is around 27.3 to 24.1 km/h, but when the train arrives in the urban area, the speed is around 12 km/h. As for the road modal the average speed is 30 km/h, because of roads of very precarious conditions for the transport.

When the trucks arrive to supply the silos, which store the soybeans to be loaded by the rail mode, they find huge queues to release the goods. This is a hindrance to a green corridor in soy transport. The highways between the producing areas and the storage silos are badly conserved, in general, causing a reduction of the speed of the truck and, consequently, increasing the travel time, logistical costs, emission of polluting gasses, etc. There is not, either, an information and communication technology system to manage transportation operations, to provide logistical support to workers and drivers, and to manage the operations of queuing and unloading of soy in silos.

The fleet used in road transport is more than 10 years old. It does not use any technological system or innovation to reduce polluting gasses. In addition, there has not a type of fuel that collaborates to reduce the emission of these polluting gasses emitted by the trucks yet.

There are no appropriate locations to support truck drivers, with an adequate space and infrastructure for rest, to contribute to their good physical and mental health.

As for the rail modal, the infrastructure is not appropriate. There is a lack of public and private sector investment to improve those conditions.

Investments in Logistics in Brazil are still very incipient, as the public sector does not have the financial resources to invest in infrastructure and also finds barriers to obtaining financial resources from the private sector, given the legal problems and rules that make it difficult to attract private financial resources. There are constant changes of regulations and political turbulence, besides the great corruption that Brazil has experienced along many years.

Brazil falls short of the expected when the performance indicators (KPIs) are applied, according to the literature, referring to the green corridors implemented in Europe.

The indicator of logistics costs related to freight is high in Brazil, due to infrastructure problems, labor agreements, transshipment costs, storage, etc. This indicator weighs negatively when one assesses the feasibility of a green corridor for Brazil.

Both road and rail modals have a poor quality indicator in services. Transportation time is very high for soybeans from the source to the port of Santos. Another indicator of evaluation is reliability in time. Brazil is precarious on this item too, which hinders logistical operations and brings obstacles to the system.

The use and application of information technology in the transport of soybeans between Mato Grosso and the port of Santos is practically nonexistent and requires a lot of investment, mainly from the private sector to improve logistics operations. The frequency of the service is also not a positive item in the system. Cargo safety is precarious, especially in the road modal, due to the conditions of the roads and the vehicles used, besides the ability of the drivers to carry out operations.

4.2 *North-South sort sea shipping logistic corridor*

Part of the soybean produced in the state of Mato Grosso is transported by waterway and exported through the North of the Country. However, the lack of infrastructure in the terminal, located in Porto Velho, in the state of Rondônia, hinders the implementation of a logistically sustainable green corridor. After Porto Velho, the soybean is transported by waterway along the Madeira River to the port of Itacoatiara in Manaus (Amazonas) or to the port of Santarém (Pará), both in the Northern Region of Brazil. However, one can find problems with the Madeira River depth, which during drought season is around 2 meters deep, as well as finding a lack of adequate signaling. Both problems are surely obstacles to more intense and effective use of this route as an alternative for sustainable logistic transport.

In addition to the transport of soybeans, it is possible to mention short sea shipping along the Brazilian coast, which could be a future example of a green corridor to interconnect the North, Northeast, Southeast and South regions. There is a huge flow of goods between those regions of Brazil. However, road transport predominates having, approximately, 60% of the national transport matrix.

The equivalent of a distance of more than 5,000 km between origin and destination is transported in Brazil via highway. The highways are often precarious and lack public sector investment. The regulation to have the private sector participating in investments in infrastructure is still incipient and bureaucratic. The concession of public services to the private initiative is low, slow and bureaucratic too.

The lack of rules in the medium and long term hinders the acceptance of national and international investors.

Improving logistics between the Southern and Northern regions of Brazil with Short Sea Shipping might be a way to start a green logistics corridor. There is potential for implementation. However, there is a need for government support at federal, state and municipal levels. According to Figure 2, Brazil has enormous potential to explore the use of maritime transport of goods, allowing the main Brazilian ports to be interconnected and intermodal, linking rail, road and waterway modalities to supply the entire national market, since about 80% of the population live on average 200 km from the country's coast.

Once the use of maritime transport predominates over the road, the emission of greenhouse

Figure 2. Short sea shipping in Brazil.

gasses (GHG) may reduce, as well as the emission of carbon dioxide (CO_2), sulfur oxide (SO_x), nitrogen oxide (NO_2) And Atmospheric Particulate Matter (Liljestrand, 2016; Zis and Psaraftis, 2017; Jafarzadeh et al., 2017; Pålsson, and Kovács, 2014).

Public policies focused on the development of Short Sea Shipping are essential. Today this type of transportation does not significantly attract shipping companies to operate in Brazil. It is also necessary to reduce bureaucracy and documentation required to carry out this type of transport and promote intermodality, using only electronic and integrated documents.

Therefore, if the international rules that limit the Nitrogen Oxide (NO_x) emissions of the new maritime diesel engines are applied, the contribution of that factor to sustainable transport would be relevant and would corroborate a green corridor in Brazil. Limiting the values for the emission of harmful gasses from the new engines of locomotives and waterway vessels would be an important step for Brazil to enter the era of sustainable transport (Liljestrand, 2016; Zis and Psaraftis, 2017; Jafarzadeh et al., 2017).

5 CONCLUSIONS

Brazil demands structure to implement a green corridor system, with a focus on short sea shipping. That demand is explained by the size of the country itself and by having the largest part of the population living around 200 km close to the coast. Integrating modals and using them optimally is the most feasible and economical solution to reduce the emission of pollutant gasses from the means of transportation.

There is a need for public policies with partnerships between companies and public institutions and the private sector to increase investments in this transportation segment, building ships with technology and innovation in the use of more efficient fuels, in order to eliminate or reduce polluting gasses (GHG—Greenhouse Gas). Using engines with new technologies, investing in information and communication technology, and empowering people with new technologies of innovation in the sector, can insert Brazil among nations that use sustainable transport systems and contribute to a cleaner planet.

Several structural problems hinder the rapid development of the use of short sea shipping in Brazil. In general, companies that transport their products have many complaints about operational issues. They cite, for example, the high shipping time in the maritime modal (Short Sea Shipping) and the low supply of ships for the routes interconnecting the Southern and Northern regions of Brazil; as well as little reliability in deadlines.

Companies intend to increase the use of Short Sea Shipping with personal hygiene products, cleaning products, cosmetics and pharmaceuticals.

In recent years, the ports of Suape (Pernambuco—Northeast of Brazil) and Vila do Conde (Pará—in the North) presented the highest percentage increase in tonnage handled by short sea shipping. On the other hand, Manaus (Amazonas—North Region), Santos (São Paulo—Southeastern Region) and Paranaguá (Paraná—South Region) are identified as the ports with the highest potential for sending cargo. Manaus, Santos, and Suape are those with the highest potential for receiving short sea shipping cargo. The route Manaus (North)—Santos (Southeast) has the highest growth potential for Brazilian short sea shipping in the near future.

Some favorable factors of the short sea shipping are lower unit cost, low loss ratio, reduction of damages, accidents reduction, lower fuel consumption and, consequently, the reduction of CO_2 emissions.

Short sea shipping companies expect greater reliability, consistency, security of supply and frequency of ships. Shipowners, however, expect an increasing offer of competitive costs and greater flexibility for urgent shipments.

According to the shipowners, the main obstacles to the Short Sea Shipping are the high cost of bunker and bureaucracy. They call for a tax treatment of fuels similar to that given to long-haul ships. As far as bureaucracy is concerned, it is known that the cargo of short sea shipping is managed in much the same way as a foreign trade commodity.

The merchant navy does not encourage investment in productive capacity, the supply of new ships, or improvement of port infrastructure. The provision of exclusive terminals so that the short sea shipping would not compete with that of the international vessels within the port terminals would, for example, be a very reasonable improvement.

ACKNOWLEDGEMENTS

Research supported by FINEP and CNPQ.

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