Contemporary Engineering Sciences, Vol. 11, 2018, no. 36, 1757 - 1769
HIKARI Ltd, www.m-hikari.com
https://doi.org/10.12988/ces.2018.84142

The Insertion of a Multimodal Transportation System to Improve the Logistics Competitiveness of Agricultural Commodities in a Colombian Region. Foreign Commerce and Value Added

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Abstract

The study starts by providing a review of what clients and competitors in the international market are for agricultural commodities such as: oleaginous, avocado, natural rubber and cocoa. Also presents, the incidence of the river transportation in the success of a multimodal transportation model, leading to an increase in logistics competitiveness of a region, by presenting the analysis of the case of Colombia, South of the Bolivar State, recommending the establishment of a Logistics Platform, as a river port, to perform cargo consolidation and deconsolidation, connecting different transportation modes (river and road) to directly improve logistical performance in the supply chains for the different regions and agricultural sectors. Finally, a brief of the value added products is also presented to offer a larger opportunity portfolio to the potential investors.

Keywords: agricultural commodities, foreign commerce, multimodal transportation, competitiveness, logistics

1. Introduction

Colombia was ranked 98th among the 160 countries included at World Bank LPI Report, 2014, with a Logistics Performance Index (LPI) of 2.64, which certainly marks a very poor and uncompetitive situation. It was ranked 16th country in Latin America, after countries like Panama, Venezuela, Brazil, Peru, and Ecuador. These are neighboring countries, where geographical localization places an important feature to compete in terms of logistics. Consequently, any research involved on improving the Colombian's LPI would strengthen the country's export and import advantages and will certainly enhance domestic and foreign competitiveness [1].
On the other hand, based on the r at the end of 2014, around 50%, has made imperative that agricultural chains, as the ones researched in this article, had to be analyzed to make consistent proposals to improve substantially the ins and outs of logistics in the. Colombia is an excellent example of having the technical, soil, production, and labour factors duly in line to endeavour in such strategy in its agricultural sector. Colombia is also the 6th country in the world with inland waters resources [2]. The academic literature is filled with significant statements where the optimization of logistical processes of goods on less developed areas of the world has been neglected favouring the same analysis on much more developed regions [3].

In the present study, an empirical analysis was performed based on the management experience and knowledge of the region of South of the Bolivar Province, where optimization in the logistical process is favoured thru the use of a multimodal model, based on land and river transportation. The international research has also demonstrated that river transportation can be easily used to improve logistical cost optimization because of its low investment value on infrastructure and maintenance of the inland waterways. This is linked with the fact, in the case of Colombia, that 2.5 billion pesos are to be invested during a period from the present thru the next 13 years on the Magdalena River, on dredging and river traffic stability, and this river is epicentre of this study in terms of building up port infrastructure along its waterway. Finally, there are very important experiences as the ones occurring in the Brazilian and the US soy bean export markets, as documented per [4], where not only large volumes of soybean export in both countries are internally transported via river transportation producing very competitive inland freights. Being more significant the case of the US, where larger volumes of this commodity are shipped via inland waterways. This is consistent with the fact that the US and Brazil are the first and second exporters of these agricultural products worldwide [4].

2. Methodology

International trade

An exhaustive analysis of secondary information was performed about the potential international markets, as well as to determine the main competitors of the agricultural

supply chains researched, linking this with a determination of the value added products of the same chains.

Cargo logistics
For the cargo flow analysis and cost of the Multimodal Transportation River-Land for the Colombian case observed at the South of Bolivar region, a field exploratory and empirical type of methodology was used, taking into account the in and out cargo flows of the above mentioned region and the costs based on the transportation modes used as well as the related logistics services associated with such analysis [5].

Added Value analysis
The added value agroindustrial chain analysis used was performed following the methodologies applied by [6], with some modifications, also, taking into account the conceptual basis determined by [7] in order to have a global overview about the potential agroindustrial products at the South of Bolivar Province, along with its limitations presented.

3. Result and Discussion

International Trade
Bolivar ranked fifth with respect to other provinces in imports and eight in exports [8] the commodities related to oil refining and industrial chemicals are the most exported and imported segments at the department level. However, our focus of study is the south region of Bolivar, despite their low participation to the province's economy, was considered an area of great importance, with a remarkable opportunity for economic growth, taking into account that the department of Bolívar has a strategic location for the development of international trade.
According with the conducted study, a potential for four agro industrial products that have promising characteristics in international markets was found, as shown (Table 1). Selected products were: oleaginous, avocado, cocoa, and natural rubber; but it is not only these products in its basic phase, but also for all products with added values that are consumed around the world, representing them an additional opportunity.

Table 1. Added value products

OLEAGINOUS	**AVOCADO**	**COCOA**	**NATURAL RUBBER**
Cooking Oils	Cosmetic products	Cocoa liquor	Tire Industry
Biodiesel	Margarines	Cocoa Paste	Auto Parts
Margarines	Frozen Pulps	Chocolate	Medical Instruments
Soaps		Cocoa products	

A highly productive alternative for the generation of biodiesel is the *Jatropha curcas***,** whose seeds are toxic to humans and some animals [9]. This plant has production at an economical level starting the 15th month of the first year of transplanting, with the potential to continue for 40 years after the first harvest. Unlike palm oil, this takes 7 years to achieve a useful and competitive period of production.

The *Jatropha curcas* oil has ideal properties for industrial use, preferably for biodiesel [10]. Due to the depletion of non - renewable resources, such as crude oil and coal, for their excess production of polluting gases to the environment and global warming, a research of alternative energies has been done discovering that Jatropha has less environmental impact and it is renewable [9]. It is in this way that biofuels acquired an important role in the world, bringing environmental benefits that help the conservation and improvement of natural resources. However, biodiesel must be economically competitive with petroleum to justify production profitability.

The main markets, as shown in table 3, for oils are the European Union, in countries such as Holland and Germany; however, other major consuming countries are India, China, and Pakistan. It is necessary to expand market research to other regions of the European Union, given the strong commitment to the environment and the pursuit of a healthier diet promoted there for food consumption purposes. In table 2, we show the main competitors: Indonesia and Malaysia, with about US$ 27 billion in sales by 2013, about 85% of the global volume of the product, US $33 billion [11].

Table 2: Exporting Countries of Oil Palm and its fractions

Exporting countries	**Thousands of dollars**			
	2010	**2011**	**2012**	**2013**
Indonesia	13,468,966	17,261.25	17,602.17	15,838.85
Malaysia	12,405,402	17,446,908	15,410,938	12,307,817
Holland	1,160,111	1,732,203	1,510,386	1,529,693
New Guinea	N.D	629,.015	506,.652	512,.977
Thailand	114,.000	398,.531	306,.231	433,.744

Table 3: Importing Countries of Oil Palm and its fractions

Importing countries	**Thousands of dollars**			
	2010	**2011**	**2012**	**2013**
India	4,494,039	6,739,864	7,896,374	6,966,776
China	4,710,620	6,634,042	6,502,236	4,903,739
Holland	1,448,959	1,836,388	2,749,623	2,572,321
Pakistan	1,659,241	2,355,039	2,131,602	1,842,879
Germany	1,169,592	1,357,518	1,328,139	1,402,186

In table 4, the most important world importers of cocoa and its preparations are shown. There is a huge business opportunity in the United States and the European Union. In fact, in countries such as Germany, Holland, France and United Kingdom represented about 35% of the world's consumption, for a total of US$13 billion, in 2013. In these countries the production of chocolates in all its varieties is highly developed and consumers have made this edible consumption an ethnic experience. World production of cocoa beans has historically concentrated on the African continent, representing over 50 % of this; on the other hand, the American continent contributed with approximately 14 % by 2010. In table 5, the main competitors of the raw material are listed: Germany, Holland and Belgium with a total of US$ 13 billion.

Table 4: Importing countries of Cocoa and its preparations

Importing countries	**Thousands of dollars**			
	2010	**2011**	**2012**	**2013**
Germany	4,136,407	4,696,946	4,088,202	4,259,034
United States	4,299,539	4,686,269	4,102,625	4,164,281
Holland	3,203,181	4,183,098	3,337,099	3,545,010
France	2,911,125	3,319,193	2,902,675	3,070,164
United Kingdom	2,355,644	2,448,718	2,254,913	2,416,166

Table 5: Exporting countries of Cocoa and its preparations

Exporting countries	**Thousands of dollars**			
	2010	**2011**	**2012**	**2013**
Germany	4,240,546	5,079,715	4,754,518	5,320,623
Holland	4,567,730	5,017,859	4,552,166	4,718,465
Belgium	2,637,734	2,980,745	2,926,584	3,331,974
Ivory Coast	3,826,923	4,158,530	3,377,002	3,121,252
France	2,029,604	2,353,762	2,244,028	2,297,553

About exports and imports, as it´s seen in tables 6 and 7, we find China leading the group of importers covering almost 30 % of the market in 2013, within a group of Asian countries, however we see the United States in second place with 12 % for the 2013. As competitors also leads China, followed by Canada and the United States.

Table 6: Importing countries of Natural Rubber

Importing countries	Thousands of dollars			
	2010	**2011**	**2012**	**2013**
China	11,234,863	15,857,712	14,937,030	18,768,838
United States	12,190,755	11,981,921	13,720,198	16,142,791
Japan	10,462,314	12,554,538	11,951,919	12,467,368
Germany	8,075,408	9,059,729	8,459,080	8,566,342
United Kingdom	5,298,918	5,345,384	4,888,318	5,765,455

Table 7: Exporting countries of Natural Rubber

Exporting countries	Thousands of dollars			
	2010	**2011**	**2012**	**2013**
China	9,651,542	11,354,387	12,315,248	12,748,096
Canada	8,494,124	9,159,830	10,015,877	12,348,363
United States	7,048,265	7,886,230	7,866,181	8,956,522
Germany	8,849,585	9,366,216	8,377,608	8,812,582
Russia	6,093,699	6,973,753	6,735,497	7,330,192

Looking at the US trade balance on rubber products, Table 7, since imports are almost double the amount of exports, further research here is required, to determine if an aggressive plan to grow industrial rubber in this area could be funneled to the US market, taking advantage of the Free Trade Agreement (FTA), Colombia-USA and the USA automotive industry growth.

Cargo Logistics

The origin and destination of cargo flows in and out of Southern Bolivar Province would determine the main feature of this area as a cargo generator and could be constituted as a ZODES (Zonas Económicas de Desarrollo Económico y Social) to which it belongs. Port activity is complemented by storage, transshipment, handling and cargo services. The output cargo flow has its origin throughout the area that comprises the southern region of Bolivar, especially San Pablo, Cantagallo, Simití, and Santa Rosa del Sur, and its destination ports are Barranquilla and Cartagena, and other areas of the country. The geographical area and the freight corridors are shown in Figure 1. Likewise, the origins of the inflows to the area come from the ports of Cartagena and Barranquilla.

Figure 1: Origin and destination of the cargo flow in Southern Bolivar

The main cargo type to be mobilized.

General cargo: All types of cargo presentation are of different nature (sacks, bags, big bags, drums, boxes, cartons, bottles, metal sheets, etc.) and are transported and stored together in small amounts in separate units. Its main feature is that the number of packages or parcels are counted and handled as units. The 50 kg bag fertilizer is the main product to be mobilized through the river terminal [12]

Liquid Bulk: Represented in chemicals, oil, gas, and other fuels. It is operated via the conduction system of pumps and pipes or special vessels. It includes areas for storage tanks. The main product mobilized will be the crude palm oil [13]

Special cargo, Livestock: Cargo handling or cattle and horses, is provided through unloading chute facilities, holding pens, and loading funnels mode to board the river equipment. The engineering of this infrastructure must be consistent with the technical standards established in the Colombian environmental legislation and the nature of special system load that the transportation of livestock has [12]

Comparative analysis of freight and port costs.

Comparing the costs generated by road transport, based on the routes originated in Cartagena and Barranquilla and destinations in the South Zone of the Department of Bolivar against the costs that a multimodal River-Road model with modal split in San Pablo Bolivar will generate. The result is crucial to establish the economic

viability to use a multimodal freight model for mobilizing cargo flows in and out of the area [14].

By freight we mean, the cost of renting a boat, or a part of it, for merchandise transport. Logistics-port operations are all activities of services provided directly for port operators, in this case river-maritime, such as loading and unloading cost river - land, and land loading and unloading, ground handling or inter port transportation, crane services, storing, container loading and unloading, cargo inspection, pilotage, towage services, tallying and counting, stevedoring, lashing and unlashing, dredging, and classification. The present cost analysis only takes into account the costs of loading and unloading, land-river and the multimodal port services. [15]

To prepare the analysis, information was provided by various institutions and land/water transport companies: Sole Carga S.A.S, Transportes OLC y SOLUTRANS S.A.S. The information was gathered in December 2014.

The Table 8 is prepared based on river freight of $55.000/mt, valid in 2008, and adjusted yearly by the Consumer Price Index (IPC), for the years 2009, 2010, 2011, 2012, 2013 and 2014.

Table 8: River rates

Cartagena - San Pablo	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**
IPC %		2,00%	3,20%	3,70%	2,44%	1,09%	3,24%
Cost Freight/ Ton	$55.000	$56.100	$57.373	$60.037	$61.502	$62.173	$66.500
Cost Ton/Km (561,9 Km)							$118

It should be noted that during 2014, the freight is increased above the IPC (Consumer Price Index), due to an increase on the value and cost of wood pallets transport used in the operation, as well as the cost of using Cartagena port facilities (taking as reference the one charged by Buenavista Port, in the case of the traffic Cartagena - San Pablo Bolívar)

The cost of ground transportation charged by transport companies from Cartagena to San Pablo Bolivar, including loading and unloading is between $125,000/ton to $130,000/ton, including cost of the ferry from Curumutas Santander to San Pablo Bolivar which is $120,000/crossing, for trucks of 35 tons capacity.

Mobilization cost of the river cargo Cartagena - San Pablo – Cartagena route

According with information obtained in 2015, carrying one ton of general cargo between the Port of Cartagena to San Pablo Bolivar (561.9 km) via Multimodal will cost $103.256 / ton projected and $98,266 / ton without the costs of port services in San Pablo. The cost of road transport from Cartagena to San Pablo today, including the costs of loading and unloading is $125,000/ ton.

Performing sensitivity analysis of transport cost, multimodal freight against road is less expensive. Savings of 17.40% are obtained with a river terminal project in San Pablo and without the project, a saving of 21.39% is reached. The difference in cost / ton with a river running terminal vs any one is 5.08%, equivalent to $4.990 cops/ton, only in the operation. Fees incurred in San Pablo for use of facilities, port operator, and others are also charged by the Port Society of Barrancabermeja SA.
Also, further analysis can be performed by looking into the recommendations to reduce cost, time, and uncertainty, provided by [16], in such way to look for freight cost reductions to export palm oil and rubber end products on containers, specially the last one as we recommended above in the international trade segment.

Added Value analysis

From the results of the field work conducted in the municipalities of the southern Bolivar Province and the full set of constraints and opportunities identified throughout the supply chain analysis, key variables were constructed and food efficiency [17]. This construction was to group the opportunities and limitations with some kind of relationship. Representing the variables in the Table 9 and the SWOAT analysis in Table 10.

Table 9: Key variables for the competitiveness of the productive chain of cocoa, rubber, palm and avocado

Relevant variables	**Definition**	**Actual Situation**
Existence and impact of the Academic Community and engineering (Professionals and Research groups Linked to the chain)	Existence of professionals from different disciplines who can provide solutions for the development of integral productive chains	At present, the productive chains do not have enough professionals who work permanently in research, development (R & D)
Technification and quality benefit of the processes from the cocoa bean and rubber latex collection	Standardization of processes that allows to conserve and ensure the quality of the grain and latex, as well as the use of technology that contributes to this goal	Productivity processes are handcrafted, without the use of any technology.
Using sophisticated tracking systems to the products of the chain.	It refers to the development of monitoring systems, from planting to final products. Specifying the sources, transformation processes to which they are subject and the variables of them, among others, to ensure the quality of raw materials	Actually, an efficient monitoring of the processes and products generated by the chain is not strictly conducted, showing that there is not an effective traceability system.

Table 9: (Continued): Key variables for the competitiveness of the productive chain of cocoa, rubber, palm and avocado

Technology transfer mechanisms in the management practices and integrated pest management	It refers to the transfer of technology and knowledge to farmers on the most efficient practices for integrated pest management.	Low or no transfer
Absence of laboratories or institutions dedicated to research and development in the region (south of Bolivar) of the value chains	It refers to the establishment of centers, institutes and research institutions in the region to enable the improvement of the current techniques and the production of innovative value -added products	No Research Centers
Appropriate mechanisms for the production stages and merchandizing of raw materials	It refers to the mechanisms available to properly integrate the stages in production and the merchandise of the raw materials.	There is currently a lot of intermediation between producers and manufacturers, which generates significant increases in raw material prices at the end of the supply chain.
Profitability of the producers of cocoa, rubber, palm, and avocado in relation to production costs.	Seeks to determine what the exact profitability of producers is.	Currently, the production processes are unprofitable because of the high costs of agrochemicals used in production

Table 10. SWOT analysis for industry in Southern Bolivar

Strengths	**Weaknesses**
- High use of labor in industry and in the primary sector **- Quality of life, roots, stability and formation of social fabric.** **- Multipurpose crops.** **- The Soil and climate conditions are optimal for the crop**	- Dependence on imports. - High cost of labor and shortage of it. - Low technology in the benefit and transformation processes. - Low access to technologies of research and development.
Opportunities	**Threats**
Access to international technology research and development. **Domestic demand unsatisfied.** **Crop absorbs CO2 and the carbon footprint**	- Lack of standards for raw material. - Difficult access to the area.

4 Conclusions

The Multimodal transport model provides a competitive solution to the major logistical needs of a region, by generating development in logistics infrastructure and managing trade flows that move cargo to and from other regions, and increasing competitiveness, among which are: Convergence and interaction of the modes of transport most used in the area, generation of essential logistical conditions such as storage area, modal split, cargo freight and passenger services, financial services and logistics operations, heavy vehicles transit and so on, generation of the infrastructure required for the development of logistics activities in different economic sectors, especially the industrial, mining, and agricultural, increase road infrastructure, connecting networks Road-River, allowing different scenarios for transport modes. Increase Processes involved in agro industrial chains were handmade with the exception of palm, which is partially technified. However, only crude oil is obtained without any added value. This is a great disadvantage and weakness of the sector given the extensive time spent on the preparation of the raw material. Also, the tools and local conditions do not allow handling large production volumes. Another disadvantage that arise is the lack of control variables (temperature and humidity) and processing conditions (no isolation), which promoted the growth and proliferation of microorganisms that ultimately affected product quality.

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Received: April 17, 2018; Published: May 27, 2018