

Cabotage as an External Non-tariff Measure on the Competitiveness on SIDS's Agribusinesses: The Case of Puerto Rico

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ABSTRACT

This paper explores the multidimensional effects of an external non-tariff measure (NTM) on maritime transportation between the United States (US) and Puerto Rico (PR) trades. In particular, this research addresses the vulnerability level of PR's agrifood sector in relation to sustainability as a Small Island Developing State (SIDS) highly influenced by a larger economy. Due to the high potential of climate changes in the Caribbean, this study reviewed the effects of a maritime cabotage policy on a SIDS agribusinesses' logistic. Could a NTM affect the supply chain capabilities and the food security of a SIDS? What challenges and opportunities does the US Cabotage policy present for PR's agricultural sector's competitiveness? Based on mixing empirical analysis in an exploratory convergent design, the research categorizes the cabotage policy in relation to the effects on PR's agrifood supply chain, its port infrastructure, and its native agribusinesses' competitiveness. Results show the maritime cabotage itself is a constraint. However, the interactions with others NTMs, indirectly related to the cabotage but inherent to the political status and business relationship between PR and the US, add other limits. In addition, it revealed that internal factors have an impact on the efficiency and competitiveness of PR's agro-industrial sector. [Keywords: Food security; Small Island Developing State; Agrifood Supply Chain; Non-Tariff Measure; Agribusinesses Logistic; Maritime Cabotage; Supply Chain Capabilities; Vulnerability]

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1. Introduction

Puerto Rico has many strengths that include its political stability, literacy rates, dollarized economy, access to US markets, and absence of direct U.S. taxes (Collins et al. 2006). Ironically, Puerto Rico's particular political relationship with the U.S. is questioned due to its highly unequal society (IEPR 2018), higher than average price of goods (Marazzi-Santiago 2018), and an economic recession and staggering debt (Caraballo-Cueto and Lara 2018). To exacerbate the situation, recently, two consecutive hurricanes broke down Puerto Rico's national supply chain (Holpuch 2017).¹ These disasters helped reveal how some of the US Federal Government regulations could be affecting Puerto Rico's agrifood production and sustainable development.

It is not possible to understand the humanitarian crisis that ensued on September 2017 without considering the long-standing political and economic phenomena that preceded it. An exploration of Puerto Rico's Maritime Merchant Law, and its agricultural sector before Hurricane Maria are needed to situate multidimensional findings of this research. The findings could be meaningful to policymakers, other SIDS, and U.S. off-shore jurisdictions.

This paper does not assume a stance against the relationship between Puerto Rico and the US. This research approaches the phenomenon of the US Cabotage Act as a commercial relationship using an operational perspective focused on sustainable development and food insecurity.

1.1. The Jones Act 1920 as a non-tariff measure (NTM)

Since 1917, the relationship between Puerto Rico and the US has been linked with a "Jones Act" (Venator-Santiago 2017). Between 1917 and the mid-1930s the name "Jones Act" was popularly applied to various² US federal laws. Although different in intent (e.g., citizenship, cabotage), the term causes some confusion to this day (Rivera 2007; Dietz 1989). This paper is focused on the operational effects of the Wesley "Jones Act" or the Merchant Maritime Act. The Act was strategically designed as a reformulation³ of the US maritime trade policies but legislated in 1920 as a framework for the US Cabotage structure between the US and its territories. With World War I as a context, the initiative was also supported by the US security/military apparatus to re-ordain and register all the US flagged carriers (Pantojas-García 1990). These trade restrictions, based on the Dutch and British imperial rules, have been building up through decades of administrative structures to benefit the US maritime industry (Santos 1997), whilst diluting its cost in terms of the total welfare among its mammoth economy and its more than 300 million consumers (USITC 1991). US cabotage policies are a complex combination of regulations to protect trade among its coasts, which in the long run has shrunk its national registered fleet (USGAO 1998). Currently in Puerto Rico, unlike other non-incorporated US territories,⁴ this Act limits trades only to ships constructed and repaired in the US, operated by US citizens, and registered under the US flag (Torruellas 2017).

In some cases, policies designed for developed markets are not necessarily suitable for the less developed ones and/or small economy realities (Stiglitz 2010). That

is the case because some policy instruments (such as NTM) could affect competitiveness creating hidden costs to trade and/or business behaviors, that by their particularity, may imply indirect effects on the agents (participants) (May 2015; Beghin 2013). Literature on this subject is scarce and limited when it comes to proposing methods to analyze multidimensional effects of a NTM on SIDS.

The US maritime cabotage could fit the above description. Unfortunately, the regulation has primarily been studied based on its welfare cost⁵ (AMP 2018; Alameda and Valentín 2014; Cruz et al. 2014; Martínez 2014; Estudios Técnicos 2013; Lewis 2013; USGAO 2013). Another area which has received some attention is the market-political relations (Clar 2013; Collazo 2012; Frankel 2002; Santos 1997). Very little is said about agribusinesses or the regulation's interaction with the business environment in which chain actors operate.

Depending on location, transport costs on import values vary between 8 percent and 13 percent (Márquez-Ramos et al. 2007). Every time one maritime line buys another, two carriers merge or a group forms an alliance; the ports, terminals, and/or clients are affected in one way or another. In the next years, more consolidations are expected (Hopman and Nienhuis 2009). These maritime service patterns will have greater effects on the most dependent smaller markets, their connectivity, quality of services, local business environment, and well-being (Alameda and Valentín 2015; Chen et al. 2013). Since the agricultural sector nowadays accounts for less than 1 percent of PR's GDP and its capacity to export food is practically non-existent, promoting efficiencies in the agricultural sector has not been a priority. As a result, the literature is silent regarding Puerto Rico's agribusiness supply chain competitiveness.

On the positive side, Puerto Rico's agriculture has some characteristics of a competitive market.

1.2. Puerto Rico's agribusinesses sector in context

Puerto Rico's agricultural sector has lacked attention since the mid-1970s (Comas 2009). The disregard for local agriculture is evident when its economic contribution is considered. According to the Puerto Rico Planning Board (PRPB) (2015), PR's agriculture contributes 0.85 percent of the GDP or between \$700 and 900 million per year, of which 55 percent is from animal production. In comparison to similar small economies—such as Singapore (0.09 percent), Hong Kong (0.1 percent), Bahrain (0.3 percent) and Ireland (1.6 percent)—the percentage of Puerto Rico's agricultural contribution seems to be relatively high. Overall, however, considering other factors from the World Economic Forum (2013), such as restrictions to trade, inequality levels (GINIC) and the cost of agricultural policies to access food, PR shows a lower performance.

Geographically speaking, Puerto Rico is no different from other SIDS in the region. Like them, PR is totally dependent on maritime transportation and shows a

large imbalance in agricultural goods trade (FAO 2006). According to Setrini (2012), Puerto Rico's producers are squeezed between the low cost of industrial producers in the US and low-wage producers in the Caribbean and Latin American countries. On the positive side, Puerto Rico's agriculture has some characteristics of a competitive market. First, its market openness is as high as the rivalry between international and domestic (US Interstate Commerce Act) products and native producers (WEF 2013). Second, the local infrastructure permits native distributors to make 'just-in-time' purchases, thus giving fresh products more days on the shelf (Setrini 2012). Third, the number of producers⁶ and buyers is relatively large. For instance, in 2012 the Puerto Rican food consumption expenditures were estimated to be \$8.93 billion, making up 14.64 percent of the total consumption expenditures (\$2,400 per capita/year) in food (González and Gregory 2014).

Regarding imports, according to the PRPB (2015) using data of 2012, the value of the food and agricultural goods imported to Puerto Rico represents around 4 percent of all of Puerto Rico's importations. Interestingly, approximately 95 percent of the agriculture (livestock and food) goods imported to Puerto Rico is produced by 15 countries, but the vast majority (84 percent) comes from North American Free Trade Agreement members; namely the US, Canada, and Mexico. The highest percentage (79 percent), nonetheless, comes as domestic trade from the US estimated to be worth \$3 billion (USD).

Puerto Rico's agribusiness sector is highly susceptible to external shocks. These outside variables include other restricting factors from their trade with the US, such as sanitary and phytosanitary (SPS) measures. In addition, Puerto Rico's agribusiness is highly exposed to natural conditions (e.g., hurricanes, overflows) and a low level of added value in native production. These factors, according to González and Gregory (2014), have been detrimental to Puerto Rico's production over the last twenty years, particularly for crops—vegetables and root produce.

1.2.1. Grains and animal produce sectors

The strongest agricultural sector in PR, and the most dependent on grain imports, is animal production. It is well known within the agricultural community that animal feed constitutes between 50 percent and 70 percent of production costs in this sector. In Puerto Rico, 100 percent of grains for feedstuff are imported making its strongest agricultural sector entirely dependent on maritime transportation. In the last decade, the number of grain-importing companies in Puerto Rico has dwindled (Departamento de Agricultura 2012). It seems that their disappearance has been affected by factors such as bankruptcy or consolidations, the grains' volatile costs, and the impact of trading costs.

The grain-importing sector is broken down into animal feed manufacturing and flour milling and baking. Puerto Rico's animal feed industry, as a production system, consists of four basic activities: grain buyers' resale, grain transformation, product trading with wholesalers and retailers, and secondary product sales to consumers.

In general, these are the first basic echelons in the animal production agrifood chain. Before the animal feed product is consumed, various processes are undertaken in the chain. They include grain producers at the farm level, grain elevators and sellers, transporters, surveyors and receivers, inspectors, regulators and other secondary activities associated with them (Morgan 2000). Grains are transported and delivered in dry bulk vessels separated by hatch. For each of these processes, some buyers are searching for a combination of low prices and high quality. Price is the most traditional decisional factor used in this business. Commonly, animal producers are not well informed about the technical–nutritional requirements of their animals, but they are highly aware of the costs for their own business. Consequently, farmers searching for lower prices for animal feed may ignore the importance of quality to the detriment of their animals' yield. Similarly, feed mill agribusinesses are focused on low-cost materials rather than improving efficiency through innovation and technology (Chavarría et al. 2002).

1.2.2. Fresh produce sector

World Bank (2015) data show that like some of the smallest Caribbean nations but unlike Jamaica, the Dominican Republic and Cuba, Puerto Rico's import of its food needs are high. Popularly it is estimated at above 80 percent. Around 70 percent of this amount is imported from the US markets and almost 92 percent specifically from the Jacksonville Florida Port (Comas 2009). The literature is much less informative about which products are considered in these percentages and whether Puerto Rico's production is enough to cover its market needs. Puerto Rico's market dependence on imported food may entail several dangers, beginning with the fact that in a national emergency the population would not be able to feed itself. Second, food imports depend on volatile export markets susceptible to periodic market access disruptions and external regulations. Unlike grain, produce imports are transported in refrigerated or controlled climate storage units. Third, climate change, with more frequent and severe events (e.g., hurricanes, floods) can seriously affect food supply available on the global market.

1.3 Theoretical stance

The scholarly silences mentioned earlier coupled with the political, regulatory and geographical particularities of PR call for an eclectic theoretical stance from which to explore Cabotage as a non-tariff measure (NTM) and its effects on the agrifood system. Consequently, the worldview guiding this research incorporates tenets from the field of development, engineering (i.e., agricultural, mechanical and industrial), management and logistics.

As mentioned, NTMs may affect trade and/or its supply chain (Beghin 2013). A threat to food security may arise through higher prices—making food unaffordable for many—or through food scarcity at any price—as a result of political, economic and mechanical issues (Hubbard and Hubbard 2013, 142). Consequently, the sustainable development aims (UNSDSN 2014) on the basis of food security became an important topic to evaluate SIDS' economic vulnerability. This research relies on Briguglio's (2003)

factors of integrated supply chain and the level of dependence on strategic imports as basis to interpret national economic vulnerability. This research also considers Porter's (1985) proposal on "strategy and structure" importance in developing firms' competitive advantages but also the "forces" that might affect them. Exploring regulations with effects on the national vulnerability and firms' competitiveness, in this context, may support the local economic objectives but, more importantly, the nation's food security.

Competitiveness variables associated with market, infrastructure and government play an important role too via their different interactions with external or internal indicators. Their weight is important in competitive analyses at the firm, cluster, regional or national level (Porter 1985). At the firm level and arguing that tangible and intangible forms of resources have the potential to sustain or affect competitiveness, Barney (1991) developed the VRIO⁷ framework to evaluate controlled/private assets. In the context of this study, a private asset can be a grain mill, which bases its activity in a common product around the world, which is considered rare to the people of Puerto Rico because it is not produced there. However, it is argued that sectoral, systemic and non-economic factors could also be highly influential on the competitiveness and therefore basic for the agrifood supply chain analysis (Rojas et al. 2000).

Latruffe's (2010) suggestions about the importance of the relationship among markets and/or between importers and suppliers, as competitiveness factors, were also considered. In addition, Brandon-Jones and colleagues (2014) highlight the firms' supply chain visibility⁸—particularly during the importation process—and the way in which it was considered. In this research, because the NTM under study is related to the maritime sector, the author looks upon the ideas of De Martino and Morvillo (2008) to identify systemic key factors of port competitiveness that exert an impact on the supply chain network.

To explore the multidimensional effects of the US Cabotage Act as an NTM, this research considered cabotage as an external regulation on Puerto Rico as a SIDS. In sum, the policies, protocols and decisions related to the Maritime Merchant Act, imposed on Puerto Rico, are controlled by the US Federal Government instrumentalities applied as a "one size fits all" trade framework.

This study aims to demonstrate how the external policy measures affect the development and productivity between agents and domains,⁹ namely the SIDS's native agribusinesses' importers' as agents and their supply chain system, infrastructure, and behavior as domains. The discussion centers on the operational dimension of the Act on Puerto Rico's agrifood logistics and its complexities. Puerto Rico's vulnerability and its food security are also presented as the basis on which to study the Cabotage phenomenon.

2. Methodology

This research incorporated a heterodox economic framework in a convergent mixed method design, where the researcher uses concurrent timing to implement the qualitative and quantitative strands and prioritizes both data equally (Creswell and Plano

2011).¹⁰ This research was performed as an ongoing process starting in December 2014 and finishing in July 2016. Secondary quantitative data (i.e., reports between 2005 and 2015) of Puerto Rico from the External Trade Statistics and the US Department of Agriculture were analyzed to identify the price, origins, and restrictions of grains, respectively. Consumption analysis, national production, and farmland availability for the livestock sector were also assessed as basis of the analysis. The prices of grain in the domestic market (from 2010 to 2015) were investigated, from the end of the chain to the origin, using international market data as reference point. Additionally, the level of openness to trade in grains and the level of consumption and remoteness of those goods were considered. The quantitative analysis to evaluate the costs on the feedstuff formulations and its cost analyses are based on proportions of one macro ingredient¹¹ for dairy cattle, poultry, and hogs.

In regards to qualitative analysis, semi-structured interviews constituted the instrument for the primary data collection for the period between December 2015 and February 2015. A snowball sampling technique was used. Overall, import representatives were selected on the basis of the agribusinesses under analysis and the practical feasibility of accessing the companies. The semi-structured question instrument was designed using the variables of Porter's Diamond. Porter's framework helped identify factors related to the internal agribusiness competitiveness through the dimension of an external NTM. The instrument targeted the effect of the Cabotage Act (external NTM) on the agribusiness supply chain, the operational activities, the integration into the chain, business importing logistics, and secondary activities related to operational processes. Independent variables associated with maritime transportation, such as the role of government and non-governmental organizations, port mooring costs, handling fees, insurance and inspections were studied. Using NVivo, the data were coded for three dimensions: external, internal, and cultural factors. These dimensions were anchored in vulnerability to trade, the managers' perception of business competitiveness, the level of supply chain complexities, and the strategies implemented to deal with maritime transportation costs.

The primary data collection (i.e., interviews) was done in Spanish and conducted in Puerto Rico. The goal was to learn more about interviewees' perceptions, logistics, and strategies for dealing with the cabotage challenges in their business's supply chain. Categorical coding was applied to sort the findings into formulated concepts and areas of decisions (internal or external to the firm). Once the thematic networks had been created, the data were integrated and interpreted.

The sample was representative of the vast majority of the companies recognized in PR as native importing agribusinesses for the period between 2000 and 2015. The group consisted of seven fresh-produce importer companies in a market estimated at \$230 million per year; three of them accounted for more than 75 percent of the produce sales. The second group was associated with the importing of grain, raw material, and other goods used in the animal feed sector with gross sales of about \$200 million per annum. In this group of nine importing firms, all existing operational

firms of animal feedstuff were interviewed, as well as representatives from two firms no longer in the market. The sector of fertilizers, in which the overall sales may reach over \$40 million per annum, was not analyzed in this research. However, some of the participants were related to that agribusiness. Only some of the interview participants were predetermined in the initial selection, and the rest were chosen based on the development of the research.

3. Discussion and empirical analysis

This section summarizes the data analysis and findings regarding the agrifood trade relationship between US and Puerto Rico and directly and/or indirectly related with the Cabotage phenomena. Informative topics gathered through the fieldwork and some multidimensional effects of Cabotage are segmented in the following six subsections. Each one describes the scenario pre 2017 hurricanes considering hard-infrastructure, cross regulations, soft-infrastructure, agribusinesses firms (i.e., grain, fruit and vegetables), and emerging issues.

3.1. PR's port infrastructure

Puerto Rico has eleven official ports¹² registered under the Puerto Rico Ports Authority (PRPA) (USDoC 2015). Most of the maritime facilities are in the port of San Juan (North). Although the Ponce (South) and Mayagüez (West) ports fall under PRPA's jurisdiction, the ports were administratively delegated to public-private partnerships and municipalized, respectively.

For more than a decade, PRPA, which is governed by a board of directors headed by an executive director, has acted more like a real-estate corporation than a port-planning manager. By law (No. 125 of May 1942, as amended), the PRPA was created to own and manage all the sea and air facilities for cargo and passenger cruises in the Puerto Rican archipelago (OMB 2011).¹³ Various agencies of the US Federal Government are related to PRPA, such as the US Environmental Protection Agency, the US Army Corp of Engineers and particularly the US Coast Guard. As a result, the PRPA's planning programs and some decisions are in a direct relationship with these agencies. According to some of the participants, some grants and technical assistance are provided annually by these and other US Federal Government agencies. PRPA investments are commonly focused on the airport infrastructure rather than the maritime port. However, PRPA is facing serious financial problems.

The interviewees agreed that private companies and not the PRPA provide most shipping industry services, including tugs, pilotage, fuel delivery, water supply, provisions, customs, water supply, and vessel maintenance. Since the Navieras de Puerto Rico was sold in 1995 due to questionable considerable losses (estimated at \$350 million), the Government of Puerto Rico does not have a cargo fleet (Frankel 2002). Various interviewees support the idea that the whole operational transportation system is privatized but outdated and inefficient, with effects on Puerto Rico's market particularly on the native businesses.

San Juan's port is the only port in the north of the main island that is naturally protected from the strength of the Atlantic Sea. While San Juan is Puerto Rico's main port with 26 piers or dockyards, Ponce's (in the south) has the deepest draught (15 m in 3 dockyards and a road) and is the most recently redesigned. The cargo port of San Juan has a relatively tight entrance, and exiting might require a harbor pilot. According to the interviewed PRPA officials, the port offers a total of 4.6 hectares (ha) of space for loading/unloading cargo. All facilities are rented to private companies. In this port area the relationship is mixed. For instance, one of the three agribusiness grain importers has its own dockyard. Regarding the docking places of the other two grain firms, although the PRPA is the landlord, these are lent to them by long-term contracts. It is estimated that PR may have more than 30 private cargo dockyards, none of which pay fees to the PRPA and the majority of which are linked to an industrial business, but data to validate this claim were not available.

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Due to the limitations in public investment funds, the PRPA's investment plan is currently based on a kind of public-private partnership promoting the terminals' modernization by its current operators. The interviewees report that the PRPA is using some formulas and fixing rent fees in the long term that are contingent to the investment. However, the draughts represent a limitation.

On the west coast, Guánica and Mayagüez specifically, some raw materials for agribusinesses and pharmaceuticals are received (USDoC 2015). However, in both municipalities the cargo dockyards used for agribusiness importers are private, which means they are totally administered by their owners. Fieldwork revealed that Guánica's bay is operationally limited by its natural draught (9 m at the entrance and 6.5 m at the dockyards). In the past, two agribusiness importers (i.e. Pro-Granos and Ochoa Fertilizer) had operations there. In Mayagüez, since Star Kits tuna shut down its factory, the regional port has had a comparatively insignificant operation. Currently, its activity is basically nil. Although this region is historically less affected by destructive hurricanes (Mujica-Baker n.d), its lack of critical-mass (population) affects its business potential.

The US authority on ports is spread throughout all three levels of government—federal, stateW and local—but its Constitution grants the federal government exclusive jurisdiction over domestic waterways (Sherman 2002). Since Puerto Rico's bays are federalized, many activities are subject to control by the US Federal Government and a

plethora of overlapping regulations. For example, investments must be authorized by the US Army Corps of Engineers and various other federal agencies. Before hurricane Maria, Puerto Rico's main lane in the port of San Juan was limited to 12.2 m (40') in depth.¹⁴ Authorization of maintenance extraction procedures in the bay is relatively easy to undertake, but according to some of the interviewees authorization could take almost a year and for major dredging extractions is very unlikely—if not impossible—to obtain. Additionally, the cost of extraction procedures would imply a huge expense for Puerto Rico. The cost of renovating every pier and dockyard in the port should also be included because many of them were designed in the 1940s under different conditions and requirements. Lower draught limits sea trade mostly to modern and efficient vessels. To offer a comparison, the South America's main ports show—an overall draught average—1.3 m (4.2') deeper than Puerto Rico's main port. Wilmsmeier and Sánchez (2015) report that between 2012 and 2014 the average draught on the east coast (ECSA) of that region is 13.3 m (43.6') and the maximum draught 14.5 m (47.6').

Another weakness of Puerto Rico's port system is its infrastructure, which is basically owned by domestic (US) firms; thus, foreign direct investment in the maritime infrastructure is practically non-existent (Estudios Tecnicos 2013). According to some of the interviewees, the lack of services to repair vessels is another disadvantage. So far, the majority of the tugboats, barges, ferries, ships, and other commercial and public vessels are repaired abroad. The Dominican Republic and a few small islands in the Caribbean or the south of the US are the most common places, but for Jones Act vessels, their repairs are limited to US territories. Apparently, for decades, PR's market has had no interest in providing this kind of service. Burns (2015) sustains that generally vessel maintenance programs are a lucrative business in high trade markets because they have ramifications for logistics and reduce the number calling for services.

Finally, the lack of stability in the PRPA's direction is an internal (Puerto Rico) issue that was presented as one of the causes for the loss of regional competitiveness. Between 2008 and 2017, the PRPA had seven executive directors. Certainly, the high turnover of managers may affect negatively long-term planning actions. However, in summary, Puerto Rico's ports seem affected by overlapping jurisdictional regulations, the lack of a system of proactive improvements, and clear direction focused on logistic performance, facilities' optimization, and a culture of efficiency.

3.2. Maritime firms, containerization, and cross regulations

Various maritime companies hold their main service in the area, but literature on this particular seems limited. Since 2013, whilst the claims¹⁵ for cabotage liberalization in Puerto Rico have become more popular, some of these firms announced aggressive investment plans and terminal modernization programs. Interviewed PRPA officials informed that the biggest coastal areas in San Juan are rented to Crowley and Sea Star Lines. It is understood that, overall, around 16 maritime (domestic and foreign) service providers¹⁶ operate in Puerto Rico. However, the vast majority of the infrastructure and terminal operations are carried out by these two main domestic firms.

The US maritime firm Crowley has been one of the biggest in the US for more than a century. It has served the domestic market of Puerto Rico (approximately 38 percent)¹⁷ for over five decades and has over 200 employees. In the US, it is a huge maritime firm providing services from the most basic logistics to naval design and building. Its operation in Puerto Rico (in 31 ha) is based on roll-on/roll-off (RO-RO) vessels, but in 2014 it reported the acquisition of new ships for 2017. Two brand-new Liquefied Natural Gas (LNG) ships with capacity for 900 containers will be part of its fleet to serve Puerto Rico's market. Additionally, Crowley will invest approximately \$45 million in a new maritime cargo terminal (in San Juan), as part of a long-term contract lent agreement with the PRPA (Sin Comillas 2015). In 2015, they conducted a full renovation and draught of the dockyard and acquired three new cranes for containers, power stations for refrigerated containers, new generation containers and ISO tanks, and equipment to manage containers on the ground. In addition, a new logistics yard design for easy trucking access started in 2016. They reported that the whole investment is over \$400 million (Han 2017).

According to the interviewees, TOTE Maritime operates the second domestic firm: Sea Star Lines. Its Puerto Rico operations, based in Jacksonville, Florida, started in the 1970s and represent approximately between 25 percent and 32 percent of all Puerto Rico's domestic traffic (as of 2014). Whilst Sea Star has previously concentrated on domestic cargoes, they recently acquired the firm Tropical Shipping exclusively dedicated to international trade (TOTE Service 2014). In addition, between late 2016 and mid-2017, two new LNG high-tech ships were added to its fleet. So far, Sea Star Lines is the only paperless terminal operator company in Puerto Rico. Many of its procedures to track, trace, and pick up containers are digitalized or performed by a scanning system. As part of its transformation, in 2017, Sea Star announced an investment between \$10 and \$25 million in its terminal to become more modern with a full containers tracking system (CTS), chassis, drivers, buyers, and other security devices (Sin Comillas 2016).

While it should be highlighted that the purchasing pronouncement made by Crowley and TOTE—each buying two new LNG ships made in the US— a business decision, it is also highly influenced by the US Merchant Maritime Act and its overlapping regulations. The literature sustains that international shipbuilders are well experimented and also significantly cheaper than their US competitors (Donga 2015; UNCTAD 2013; Hopman and Nienhuis 2009).

The third-biggest area of (30 ha) was administered by Horizon, but during this research, the firm decided to close operations and the PRPA was selecting a new operator. According to the research participants, Horizon was a mixed company attending to approximately 35 percent of the international and 30 percent of the domestic carriers to/from Puerto Rico with particular interest on reefers.

Another domestic company that operates in Puerto Rico is Trailer Bridge, based in Jacksonville, but in comparison with the companies mentioned earlier, it has limited space, managing around 15 percent of all Puerto Rico's domestic trade. It is more

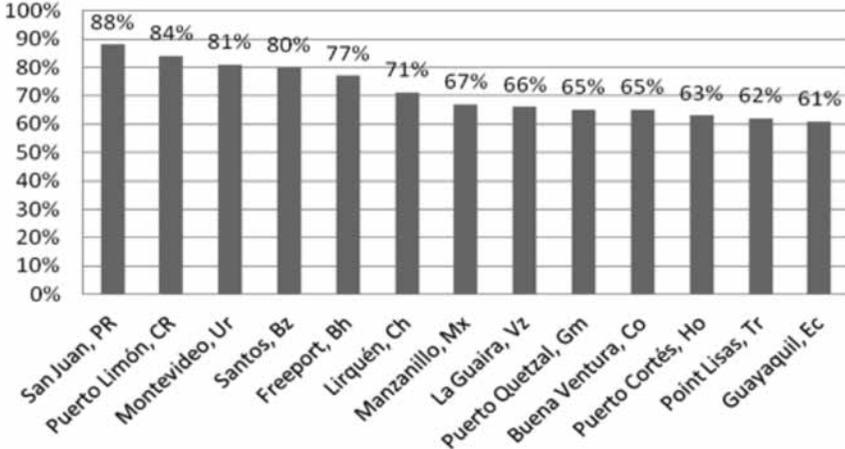
focused on lift-on/lift-off (LO-LO) and RO-RO vessels but also manages highly diversified containers. Although not a contractor of the PRPA, it is in partnership with the maritime firm International Shipping, which is a native company dedicated to international trade and stevedoring with a PRPA long-term contract. It is an example of a partnership between two relatively small maritime service providers, one based in Jacksonville and the other based in San Juan, offering global access to Puerto Rico. Luis Ayala-Colón SCs, focused on international cargoes, is the fifth maritime firm. It is an experimented local-native operator, which although limited in resources provides stevedoring services to international carriers, as well as some domestic ones.

To contrast Puerto Rico's domestic maritime firms, the two US off-shore states, Alaska and Hawaii, have only two main operators each: TOTE (Sea Star in Puerto Rico) and Matson, and Matson and Pasha, respectively. These are highly specialized container management companies. Nevertheless, the new configuration in these markets reduced competition and strengthened the players. For instance, Matson bought Horizon's Alaska service and competes with TOTE. In Hawaii, the firm Pasha, which operates RO-RO tonnage in this market, acquired Horizon's Hawaii operation to compete with Matson.¹⁸ However, unlike the mentioned US off-shore states, Puerto Rico's population, market, and container traffic are higher.

Although all of these companies are recruiters of local talent, only Horizon and Ayala-Colón boards are in the majority local investors. The maritime firm Island Stevedoring is a small, local company dedicated to carrying construction materials, such as wood and pipes, paper, less than a container's load (LCL) and cars. Many international lines of transport, such as Maersk, Norton Lilly International, Oceanic General Agency, Henríquez & Assoc and Pérez & Cia use Puerto Rico's ports (*Notical* 2015); however, they have service agreements with the maritime service providers mentioned above. Therefore, international companies have no similar infrastructure or investment in Puerto Rico's ports. Among other reasons, the majority of imports to Puerto Rico are domestic, and the costs of initiation in this business are very high. As a result, partnerships with the operators mentioned above seem to be an acceptable business model for them.

All the mentioned maritime firms in Puerto Rico are well equipped to manage containers efficiently. It is important to clarify that containers' sizes are measured by density thus using equivalent units. For international trades, the sizes were standardized in 20' (TEU) and 40' (FEU), while in domestics the sizes are determined by each country (Burns 2015). For instance, in the US, container sizes are 45', 48', and 53' long. This offers more options to trade but as the volume becomes higher (in equivalent units), its relative gross cargo weight (gcw) becomes lower because its dimensions are not yet designed to handle the same rigors as sea (international) containers. Perishable produce such as vegetables and fruits are transported regularly using refrigerated or climatized containers named reefers. Containers over 45' equivalent units are relatively rare for reefers, but this situation may change in the future. Nevertheless, interviewed produce importers reported challenges to maritime

Figure 1: Port efficiency in Latin America and the Caribbean; Extracted from: Morales-Sarriera et al (2013).



firms since Horizon's closing, including: the availability of vessels suited to transport high number of reefers at once, adequate space equipped for reefers once in the yard, and high density for storage. Regarding the first challenge, reefer ships differ from general container carriers in their power generation and electrical distribution equipment (Burns 2015). Although limited, reefers can be carried in general design vessels, but this is a challenge because in addition to the lack of space and good balance for containers' stackability, they are generally limited in power connections. The reported issues of adequate space and storage might be related to lack of investments and issues of flows and terminal designs. Grain traded in domestic journeys is commonly transported in dry-bulk vessels or barge carriers due to its capability to travel inland (across rivers). The fieldwork shows that in Puerto Rico these cargoes are directly managed by the importing grain company rather than some of the "port service providers" or "terminal operators"

Using data between 1999 and 2009, the Inter American Development Bank ranked the technical efficiency of containers at the port of San Juan as first among other 62 ports in Mexico, the Caribbean, and Central and South America (Morales-Sarriera et al. 2013) (Fig. 1). Between 2008 and 2016, the port of San Juan was ranked (63, 71, 72, 79, 80, 92, 94 to 94, respectively) in the list of top 100 world ports in container traffic (AAPA 2017). In 2017, based on container traffic, Lloyds Maritime Intelligence launched its top 100 ports rank (Nightingale 2017). On that list, the lowest traffic was 1.4 million TEU. Puerto Rico's numbers are even lower, thus not included. At the domestic level, the US Department of Commerce (2015) classified San Juan as 13th of the 38 US ports in total volume (MT) transported. In the value of goods im-

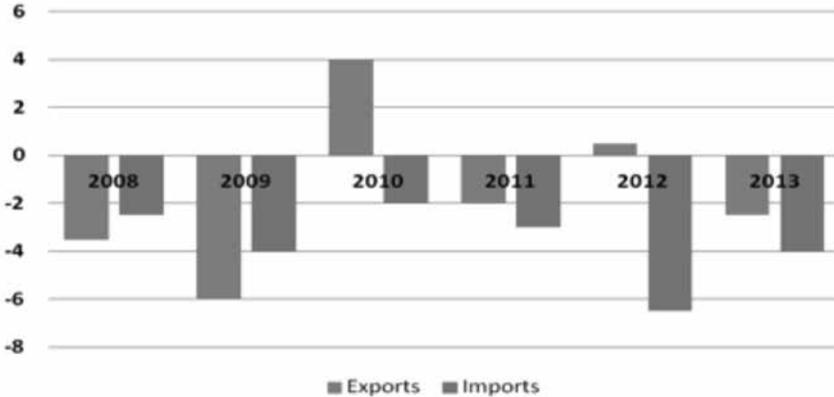
ported from the US, the port of San Juan is classified 17th of 38 (\$11.7 billion in 2012) and 19th of 38 in the value of goods exported to the US (\$4.4 billion in 2012) (USDoC, 2015). The majority of goods (food and grains) imported to Puerto Rico are carried through San Juan. Clearly, while these rankings show that at least 1.2 million TEU are annually managed by the maritime firms in Puerto Rico, a reduction in container traffic is evident. However, not much has been said about logistics, efficiency, infrastructure, dry-bulk activities, and/or performance variables of Puerto Rico's port.

According to Szakonyi (2014), the southbound rates of transport from Jacksonville to San Juan are between \$2,600 and \$3,400 per twenty-foot equivalent unit (TEU), with dry-box prices on the lower side and reefers priced higher. Although not specifically clear, these TEU rates probably imply a higher cost to trade forty-foot equivalent unit (FEU) containers. Furthermore, he affirms that northbound rates on the same route are between \$500 and \$700 per TEU. He suggests that the export cost per dry container from PR to Jacksonville is basically non-existent because the vessel's operational costs and drayage to Florida might be equivalent to the number of full containers loaded (FCL). Maritime transportation providers should develop logistics to guarantee the full return of containers and worst-case scenario with no less than 25 percent FCL; otherwise, operational costs would become more expensive or unsustainable (Burns 2015).

Currently, the costs on Puerto Rico northbound domestic routes are lower than that percentage¹⁹ (Szakonyi 2014). Although recognizing that Puerto Rico's market is far more crowded than that of Alaska and Hawaii, there has been a reduction (around 12 percent) in the total of containers at domestic imports to Puerto Rico, which could be associated with Puerto Rico's economic depression (Fig. 2). However, a pattern of reduction in the number of containers from Puerto Rico to the US was previewed by Frankel (2002) almost two decades ago.

At the International Convention of Safe Containers in 1972 a resolution for the safety traffic of containers was adopted. It promoted among members some human life safety measures during container management, such as maximum gross weight or ratings, handling, stacking, and whether under a single bill of lading or under separate bills of lading (IMO 2014). In the US, since 1997 containers have faced some management restrictions by the Intermodal Safe Container Act (Public Law 102-548, Oct. 1992). This act regulates the loaded container from its place of origin to its place of destination in multimodal transportation. The gross cargo weight (gcw) is also regulated according to the container size. Currently, at the international level, this kind of regulation is common in developed and in some less developed countries. However, this research revealed that the gcw limits in the US are lower (40' max gcw 20 MT) than in Mexico (40' max gcw 21 MT), Canada (40' max gcw 21.8 MT), or the UK (40' max gcw 26 MT) and Japan (40' max gcw 30 MT). Furthermore, the gcw is even less strict for shipping containers from less developed countries such as the Dominican Republic (40' max gcw 31 MT). This limit on gcw could have an impact in PR's container traffic but also on space optimization, efficiency, and cost analysis.

**Figure 1: Percentage of change in the US container trade with PR (2008–2013);
Extracted from: Szakonyi (2014).**



Unlike domestic ships, foreign vessels and/or containers require authorization from US agencies, such as the Coast Guard, Custom Border Patrol, the Department of Agriculture (APHIS & PPQ), and in some cases the Health Department. The Government of Puerto Rico has very limited or no jurisdiction over this matter. As a result, the intervention of a registered “custom broker” is required. Around 22 brokers are recognized and authorized by the US federal agencies to provide services in Puerto Rico (Anaya-Oviedo 2012). On the contrary, the protocols in Puerto Rico for domestic (US) cargoes are relatively fast or unnecessary because they are considered to have been inspected or to be from a safe place. The interviewees reported that once these containers have been unloaded, the importers may receive the cargo in as little as two hours. However, for international cargoes these processes may take between 24 and 48 labor hours after the docking. The Puerto Rico ratio of container volume per year (domestic: international) could be estimated as a ration of 70:30; hence, it is a predominantly domestic market. To contrast this average time with other SIDSs’ processes, Puerto Rico’s protocols seem to take longer than those of the Mauritius Islands, which according to official data average between 30 and 60 minutes (World Bank 2015). For perishables, freshness is related to quality, and thus longer container times mean the product’s shelf life is affected and the time for consumers’ use is lessened. Therefore, consumers pay for a short-life product.

Data about the domestic maritime transportation rates are limited, and for this research it was generated through interviews (Table 1). It should be mentioned that the majority of the participating firms were reluctant to share their official annual contracts showing the fixed prices rate for containers. Nevertheless, the differences in price are noticeable among importing companies (Co), more specifically in trades from Jacksonville. Higher freight rates have an impact on all aspects of the economy, all the way down to the consumers themselves.

Table 1: Price per FEU refrigerated containers and distance (n.m.) from the port of origin to the port of San Juan, PR.

Origin	Distance (n.m.)	Days	Value in USD			
			Co 9	co 10	Co 11	Other
Jacksonville, US	1333	4	5,350	4,500	4,000	6,300***
California, US [‡]	*	9	N/P	9,000	10,500	-
Miami, US	1057	3.5	N/P	N/P	N/P	6,688
Philadelphia, US	*	8				-
Sto. Domino, DR	300	0.7	2,200	2,300	2,250	1,057-1,240*
Pto. Limón, CR	1342	2.5	2,800-3,300	N/P	2,500	-
Nicaragua [†]	1500	3.5-5.5	2,400-3,300	N/P	2,500	-
Columbia [†]	-	-	3,450	-	-	-

Note: 12th of December - 10th of February. [‡]Inland to Jacksonville. [†]Port was not mentioned

** 45 foot NOT refrigerated container from Haina Port. The rate varies by volume; the first is 7 containers vs. 1 container, respectively.

*** The price for 45-foot containers is \$300 higher.

3.3. Digitization, environment, route optimization & cost of energy

Digitization in this field stands for a highly technological system to identify, track, and trace containers during the stevedoring process. It includes assigning chassis, tracking and measuring the whole process until the container is exported from its origin to its arrival. In Puerto Rico, such technology system is in early stage, not widely used, or inexistent.²⁰ Although the process is quite dynamic digitalization of Puerto Rico is limited in comparison with other SIDSs markets, such as Singapore and Hong Kong. Unlike airports, it seems that seaports have the disadvantage of a relatively low traffic of people and thus fewer funds to improve areas, logistics, and efficiency in processes. Seaports lack priority unless a union declares a lockout and/or during a climatic phenomenon or a humanitarian crisis.

Environmentally, sea ports' locations are highly vulnerable to climate effects such as rising sea levels, intensive hurricanes, among others. These events can cause heavy flooding at ports and operation disruptions. For example, in 2000 Hurricane George caused serious damage and destruction to practically all the basic port facilities and terminals, blocking the main entrance of the port of San Juan, devastating Puerto Ri-

co's economy for months. Fortunately, during hurricanes Irma and Maria the damages to infrastructure on Puerto Rico's main ports were not as serious as they were in the 2000. However, many of the commercial port terminals in Puerto Rico are outdated. This is particularly obvious in the private terminals of the grain-importing firms. For instance, the majority of dockyards and commercial terminals in the ports of San Juan and Mayagüez are very close to the sea level. Therefore, ordinary operations would be affected if the level rises by more than a meter. Since most port activities in Puerto Rico are privatized, the PRPA is not directly responsible for implementing environmental initiatives associated with clean air programs and emission controls imposed by some other local and federal agencies. Hence, little effort has been made to adapt Puerto Rico's cargo ports and their infrastructure to the impacts of climate change.

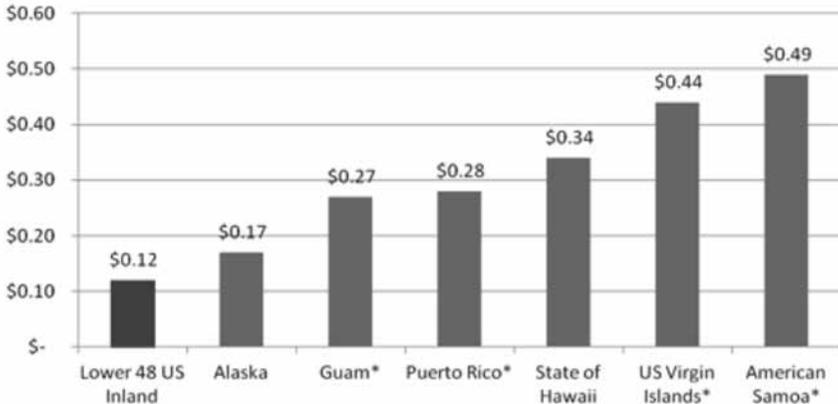
Transporting dry-bulk materials requires different supply chain management from transporting containers. An increase in annual rainfall or precipitation rates may affect its logistics. For example, grains delivered in dry bulk vessels are unloaded under an open sky; thus, an increase in the frequency of heavy rain periods would bring delays in the process and demurrage fees.²¹ With regards to fresh produce containers, their refrigeration needs, such as electrical devices, entail risks of storm-water effects.

On the other hand, Ponce's port is spacious and ready for containers and investments.

During this research, I was informed that the Government of Puerto Rico does not have an executive plan or maritime analyst to promote the optimization of commercial sea routes as is happening for airlines and cruise lines. Through a cross-analysis of commercial sea routes, more possibilities to trade with other Latin American countries could be identified, helping in planning and profitability. On the subject of space optimization, the ports of San Juan and Mayagüez are substantially limited in growth and storage areas. Areas for storing containers are practically non-existent in Mayagüez. San Juan is a highly populated port city where urban growth takes priority and has a great influence on the limited space available. This space issue will represent more challenges to adapt the facilities to the local contexts, and it will probably affect the insurance cost rates. On the other hand, Ponce's port is spacious and ready for containers and investments. Although it was designed for a trans-shipment operation, it has been underdeveloped since its inauguration, arguably, due to its lack of critical-mass.

Companies hold additional inventories to respond to delivery delays and product unreliability. This practice may increase costs for inventory, storage space, energy, and so forth. In the case of produce importers, due to its perishability, the inventory levels are low, but its climatized storages demand high energy consumption. In regards to the grain importers, an efficient goods unloading and its transformation requires highly

Figure 3: Cost of energy (kW/h) in US jurisdictions (2012); Extracted from: US Energy Information Administration (2015)



energy dependent colossal machinery. As a result, on these two sectors the price of energy is an important internal variable for competitiveness (Fig. 3). However, Puerto Rico's energy system is poorly maintained and highly dependent on petroleum. Thus it is substantially influenced by the oil price, which is an external variable with impact on the cost of all its derivatives (transportation, fertilizers, pesticides, etc).

3.4. Grain importers

Puerto Rico's animal feed mill sector currently consists of eight firms, but three of them were recently consolidated. Altogether, they represent around \$250 million in sales per year. Their domestic and foreign imports could be estimated to be approximately \$130 million and \$35 million, respectively, per year.²² None of Puerto Rico's grain firms have a logistics division or internal personnel dedicated to or specialized in optimizing the freight cost. In all of them, the grain-importing process is led and authorized by the manager or CEO. Two firms are not factually grain importers but raw material importers for animal feed production. In this research, these two importers are considered to be 'complementary companies.' One of them imports liquids; and the other, vitamins and minerals. Both are vital echelons in the elaboration process of the feedstuff. Certainly, these two firms are not directly affected by the volatile international cost of grain, but they are importers affected by the cost of maritime transport.

Grain imports in Puerto Rico are carried in barges and charter ships, all of them directly contracted by the grain importers. All firms have external (outside Puerto Rico) agreements with grain exporters and/or business advisory services based in the US. Sea transportation is supplied by external providers because none has vessels as part of its inventory. One has a long-term agreement with a domestic maritime firm providing a barge used twice or more per month.

Grain is considered to be a storable commodity that is produced every year. Its prices are forecasted and set on future prices affected by many variables; thus, its purchase and delivery may represent challenges. For instance, in addition to the cost of grain, the barge sets its rates for this journey, which may change weekly. The rates could vary by the grain's city of origin, the carrier's number of stops, fuel, volume, weather conditions, storage costs, local conditions, supply and demand, and other factors. These factors are named the '*basis*,' because they are the difference between the current local cash price and the future price of the contract with the closest delivery month (Hofstrand 2009).

Puerto Rico's tropical weather affects grain storage. Regularly, it is limited to a period of three to four months once received. Nevertheless, the firms are technically working below their storage capacity level. Except for one firm, the lack of a dockyard infrastructure and draught may limit PR's grain importers' firms to vessels no more than 7 meters in depth. In this case, docking dry bulk cargo ships with 25,000 tons or more (7.50 m) will be problematic in grain importers facilities. This is not a problem for the river barges frequently used by the grain producers in the US, but commonly limited in capacity (between 12,000 and 18,000 tons).

Due to the limits of Puerto Rico's animal feed market, grain importers share vessels and commodities to reduce their cost of transportation or to take advantage of bigger volumes in the commodity for a better price. Although negotiations and accords between the local grain importers seem not to be complex, the logistics and shipping coordination require precision and operational agreements.

The grain-importing firms have a direct relationship with equipment, ships and their crew, and many other processes related to their goods. In this research, none of the interviewees identified negative experiences with the crew of a foreign maritime provider. On the contrary, the majority of the participants highlighted their professionalism, particularly that of the ship leaders. Regarding ship maintenance, various participants said the foreign ships that generally arrive in PR show a level of maintenance and sophistication that is higher than that of the domestic fleet. The conditions of the domestic fleet were seriously criticized by many of the interviewees.

My experience with foreign crews is that they are very skilled, they are people with ... Just as an example, in the last foreign ship arrival that I had the captain was a veteran, an ex-commander of a Russian nuclear submarine. What if both vessels would require the most highly trained personnel? We were talking frankly for a while.

The cost of the domestic product versus the foreign one should not include other expenses associated with shipping. Although it could be logical to think the value of the commodity would not take the transportation cost into consideration, two of the participants categorically affirmed that, on the contrary, this is the case for foreign im-

Table 2: Over-cost of transportation (\$8.00) per maize (MT) for Puerto Rico's farmers by sector**A. Dairy Farms**

Year	% Domestic origin/yr	Cost per unit/yr	Fixed No. units 2012	Total cost for the sector	Farms		
					100-199 units	200-299 units	300-350 units
2010	72%	\$15.12	90,000	\$1,360,800.00	\$2,260.44	\$3,764.88	\$4,914.00
2011	57%	\$11.97	90,000	\$1,077,300.00	\$1,789.52	\$2,980.53	\$3,890.25
2012	48%	\$10.08	90,000	\$907,200.00	\$1,506.96	\$2,509.92	\$3,276.00
2013	36%	\$7.56	90,000	\$680,400.00	\$1,130.22	\$1,882.44	\$2,457.00
2014	75%	\$15.75	90,000	\$1,417,500.00	\$2,354.68	\$3,921.75	\$5,118.75

B. Poultry Farms

Year	% Domestic origin/yr	Units per farm/C	Cost per farm/yr	Total cost for the sector
2010	72%	30,000	\$2,801.87	\$196,141.14
2011	57%	30,000	\$2,218.15	\$155,270.49
2012	48%	30,000	\$1,867.92	\$130,754.09
2013	36%	30,000	\$1,400.94	\$98,065.57
2014	75%	30,000	\$3,648.27	\$255,379.09

C. Hog Farms

Year	% Domestic origin/yr	Cost per unit/yr	Fixed No. units 2012	Total cost for the sector	Farms			
					100-199 units	200-299 units	300-399 units	400-499 units
2010	72%	\$0.77	55,000	\$42,588.00	\$255.53	\$425.88	\$596.23	\$766.58
2011	57%	\$0.61	55,000	\$33,715.50	\$202.29	\$337.16	\$472.02	\$606.88
2012	48%	\$0.52	55,000	\$28,392.00	\$170.35	\$283.92	\$397.49	\$511.06
2013	36%	\$0.39	55,000	\$21,294.00	\$127.76	\$212.04	\$298.12	\$383.29
2014	75%	\$0.81	55,000	\$44,362.50	\$266.18	\$443.63	\$621.08	\$798.53

ports. They posited that the price per MT reported by the foreign exporters includes all transportation services until delivery, and that is not the case for domestic suppliers. Following their experience, they estimated that overall, although varying monthly, the domestic transportation cost is between \$8 and \$30 per MT higher than the foreign cost. In the low-cost scenario, their decision to import is based more on quality than on price. However, the quantitative data to support their argument were not provided.

The suggested over-cost was considered to estimate the effects on the cost by unit of production. Variables such as the average volume of feedstuff consumed by the three main animal production sectors of PR (dairy cow [9 Kg/day per unit]; poultry farms [8.5 MT/day per flock]; swine farms [1.2Kg/day per unit]), the proportion of maize (65-70 percent) in a basic formulation in PR, and the percentage of domestic imports of maize per year were considered (Table 2).

These analyses only considered the over-cost of maize as a heavy grain. Soy meal, corn gluten, fishmeal, and wheat-meal are also common ingredients used in feedstuff formulations in Puerto Rico, and many of them are imported. However, the data available on these other ingredients are mixed with data on other products, not accurately classified or, in the case of corn gluten, the percentages in the formulations are relatively smaller. In addition, some of the ingredients or wheat by-products used in formulations are produced in Puerto Rico, and the data are not available.²³

For contrasting services, other factors were presented and described to the participants to particularize the differences between domestic and foreign maritime services. These factors were punctuality, intercommunication, product management, and cultural issues (Table 3).

3.5. Fruit and vegetables importers

The majority of the fresh-produce importers in Puerto Rico are native-family agribusinesses. Although few in number, they supply almost 75 percent of the imported produce to feed the total market. The remaining 25 percent is from transnational companies that focus on processed products rather than fresh goods.

For fruits, the cycle begins on the (US) west coast, then moves to the south coast until winter when Peru and eventually Chile become the suppliers until late spring, when they return to California.

Puerto Rico's data on the value of imports, particularly for agriculture and food produce from the US, show a pattern of increase in foods and some reduction in the agriculture group. However, Puerto Rico's dependency on other markets to sustain its more basic needs for food is certainly more dramatic when the transportation service is totally privatized, and the market is relatively limited in its ability to adopt counterbalance measures. In addition, the purchasing strategies, in this importing

Table 3: Puerto Rico's agribusiness importers' perception of Latin American exports

		QUALITY				
		Firm	Packaging	Product	Handling	
PRODUCE	10		HQ	HQ	HQ	
	9		HQ	Good	Good	
	11		Medium	Good	Medium	
	13		Medium	Low	Good	
GRAIN	1		N/A	Medium	-	
	2		N/A	HQ	Good	
	3		N/A	HQ	Good	
	5		N/A	Medium	-	
	8		N/A	-	Good	
		INSECURITY				
		Firm	On Trade (Distrust)	Technical	SPS Regulations	Political Stability
PRODUCE	10		Low	Medium	High	Low
	9		Low	Medium	VH	Low
	11		Low	Medium	High	Low
	13		Medium	VH	VH	Low
GRAIN	1		VH	-	VH	-
	2		Low	Medium	VH	Low
	3		VH	VH	VH	Medium
	5		VH	VH	VH	VH
	8		VH	High	Low	VH
		INTERCOMMUNICATION				
		Firm	Language Issues	Phone/Fax	Online	
PRODUCE	10		Low	Low	VH	
	9		Low	High	Medium	
	11		Low	Medium	High	
	13		Low	Medium	Medium	
GRAIN	1		High	High	Low	
	2		VH	VH	Medium	
	3		VH	High	High	
	5		High	VH	-	
	8		High	High	High	

sector of Puerto Rico, follow the US season of production, which means that when the US market lacks some produce, its importers look abroad.²⁴ As a result, except for some roots or tanniers (so far not produced in the US), the fresh-produce importers have their itinerary of purchasing starting and ending with US production. For instance, for green leaves, their main suppliers are the West Coast of the US, then in mid-autumn Mexico, then in the spring the southeast coast of Canada, and then California until the next cycle. For fruits, the cycle begins on the (US) west coast, then moves to the south coast until winter when Peru and eventually Chile become the suppliers until late spring, when they return to California. These systematic forms of trading follow the US market because, from the perspective of volume, they can buy at lower prices in comparison with Puerto Rico. As a result, the US purchasers and consolidation firms, in partnership with Puerto Rico's importers, may supply foreign products in accordance with the restrictions of applicable SPS measures at relatively competitive prices for their standards. Inevitably, the domestic (US) maritime service providers have to be contracted to carry these supplies to Puerto Rico.

Due to the fact that perfect substitution is not always possible in this business, the Cabotage Act is a given constraint on this market. We have to deal with it, hence reducing the time and many of our efficiencies.

Liberalization could bring some changes to competition and the cost of trade might be lower. It is likely that the cost of importing raw materials would be lower, as well as the rates for transporting manufactured food. The latter scenario may need more analysis, particularly from the perspective of the current limited national food production. Currently, native food manufacturing in Puerto Rico is practically non-existent, and around 65 percent of products are imported from the US. The remaining percentage is imported from countries to which the US Cabotage Act does not apply. Therefore, a reduction in the cost of domestic transportation should also reduce the cost of domestic imports made under a similar sanitary and phytosanitary (SPS) framework to PR.

The negative effects of this would be on the local producers. They would have to reduce their prices to compete with the domestic imports in unfair conditions and lack of volume. In that sense, a relaxation in the Cabotage Act on the manufactured goods would be beneficial for the importers and supermarkets, but it might be a hard punch for the native agriculture rather than a benefit. However, if it is about price competition, currently the native producers are highly affected by the produce from the Dominican Republic that has a similar productive season and lower cost to produce than PR.

Puerto Rico's importers are not restricted to importing products only from the US market; thus, the market could be considered as an open market. However, for importing food and agricultural products, other NTMs have to be taken into account. Consequently, the application of all the US regulations to food, labeling, canning, and so forth on Puerto Rico's market reduces the number of places to trade. Furthermore, whilst for the domestic imports the inspection protocols at the port are practically non-existent, at the foreign imports they are complex. The delay in trucking a container will depend on the ship's arrival time and the number of containers queuing. It is not unusual for foreign arrivals between 15:00 and 17:00 to schedule an inspection time 24 hours later. For instance, once the containers have been discharged from the ship and the process of container recognition begins, consisting of inspection, fumigation and other red-tape procedures, they are normally completed in 12 to 72 labor hours.²⁵

In my professional experience dealing with the elements of quality, produce management and packaging, I have not noticed big differences between foreign and domestic produce. However, the SPS inspections and port complexities on imports from abroad are the major obstacle to looking more to Central and South American suppliers.

To contrast the maritime services, the participants were invited to identify the differences between domestic and foreign companies. These factors were coded in three groups: quality,²⁶ insecurity, and intercommunication (Table 4). Regarding delays or inaccuracies in the delivery schedules or ETA, the participants affirmed that it would depend on the maritime firms. Some lines are much more punctual than others, but interviewees categorized the foreign maritime firms as the group with the most frequent occurrence of unpunctuality. Since Horizon's closure, the domestic transport is showing more problems due to the lack of space.

Concerning the intercommunication issues, which are those associated with identifying problems in shipping or tracking containers, all participants said domestic firms are more diligent or at least it is easier to obtain information from their website or by email. Apparently, domestic firms are perceived more "client oriented"²⁷ about informing issues on board that may cause delays or other problems that would be managed in advance, if the importer was informed. One of the participants said that a reason to hire a third party contractor was precisely to reduce logistical uncertainties due to the lack of communication of the foreign maritime firm contracted by its produce supplier in Latin America.

One dimension that is not directly associated with the Cabotage Act but may influence the cost of trade is the years of business partnerships between importers and suppliers. Purchasing teams are focused on the same companies that traditionally were trading with without seeking competitors. This is not a negative point when it is part of a dynamic market analysis but it might be when purchasing decisions

are taken without an ample analysis of providers. The interviewed firms are based on 'high reliability' of their suppliers; thus, searching for new providers is undertaken sporadically. Although the rates for transporting inland are higher than the sea freight rates,²⁸ a business partnership extending over years has a higher probability of trade than searching for options abroad and in better conditions.

You are making me reflect hard about it. I have to admit that with some frequency we begin the searching process to eventually supply a client, but at the end of the day my purchasing team selects the same provider that traditionally supplies us. We are always doing the same. Although it is 'better the devil you know', we are in a comfort zone. Lack of doing different things and trying to search for options at least to identify other possible providers.

All of the participant firms in this category expressed their disagreement with the application of the US Cabotage Act to PR's market. Their most common argument was based on the over-cost added to imports. A few of them argued the lack of competition of maritime transporters in PR is the most problematic issue, but a bigger problem is the lack of vessels properly prepared for reefers. According to them, both scenarios are having serious effects on their businesses, increasing the cost for the consumers.

The maritime market needs more service providers because currently the fresh-produce importers are choosing between a single, faster, limited-space company (Sea Star) and a firm with space in a slow vessel (Crowley). Both scenarios limit our businesses. I am of the belief that having more ways for transporting imports or having faster ships to trade, the local businesses would be much better and our consumers too.

Here is an example of how cabotage may restrict the supply chain logistics on this economic sector. One of the most frequent suppliers of potatoes in Puerto Rico has its origins in the port of Halifax in Canada, which also carries other supplies to some of the British Caribbean Islands. Consequently, to optimize the shipping and reduce inefficiencies and time, one possible option could be to stop in New York to collect some products for Puerto Rico. However, this is not allowed by the US Cabotage; as a result, the importer should schedule a US-flagged vessel to obtain these products or transport them by inland trucking to the Jacksonville Port, which has more frequent trips to San Juan.

The cabotage limitation for the use of foreign vessels affects my logistic optimization and as a result the price to do business and my produce on the shelf.

3.6. Other emerging topics

A basic flow chart about the Cabotage's layers was developed (Fig. 4) to show layer of elements affected (directly or indirectly) by the Act during the agrifood importing activities. Certainly, many other elements might be considered.

The following example of costs was used by one participant. He said a 40 percent reduction in the current cost of domestic transportation would reduce the basic cost of farming.

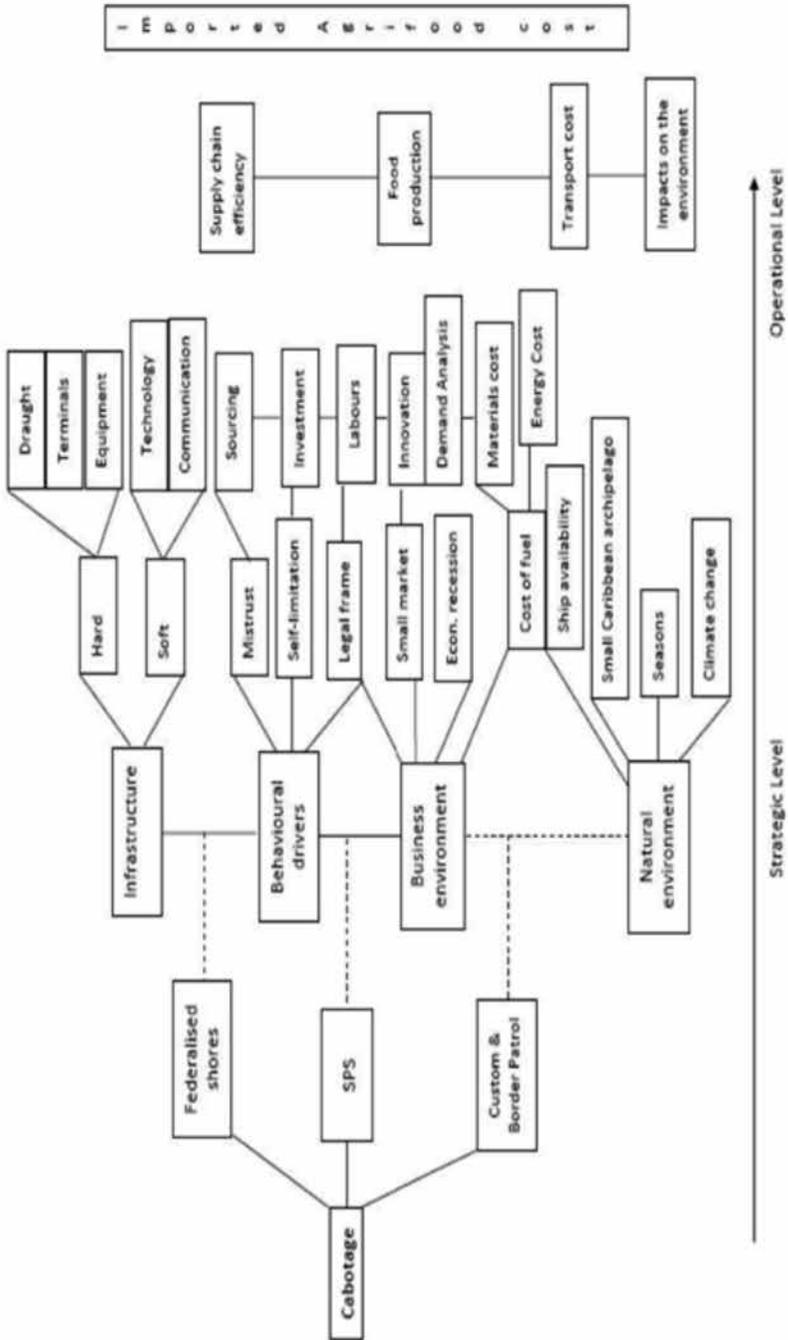
A 100 pound (45.4 kg) bag of fertilizer in the US is around \$3.50, but in PR due to the freight cost it is between \$0.10 and \$0.14 per 50 pounds (22.7 kg) over the original cost. As a result, the importer is paying around \$0.22 extra just for bringing the produce from the US. It means that the basic price of 100 pounds (45.4 kg) of this fertilizer will start at \$3.72. However, the importer should add its expenses and profit, almost 9% of the cost (\$0.37); therefore, the consumer will be paying easily \$4.10. Certainly, this is not a big deal for a casual consumer, but the \$0.60 means money for a regular farmer.²⁹

Many additional variables over the price of the commodity affect produces cost, such as the cost of its management, refrigerated containers, transportation (inland and ocean), logistics and regulatory frameworks. Additionally, the elements of relatively low volume, little competition in the market (lack of production), and low availability of domestic maritime transporters cause the price of the affected goods, such as fruits and vegetables, to rise disproportionately.

It is like a tax to preserve inefficiency but in a category of products that, according to the international health organizations, should be more consumed by the people.

Another dimension was presented by the expectancy of new higher capacity ships that will be incorporated into Puerto Rico's market in a year. Undeniably, new and efficient vessels to transport reefers are highly necessary. The pace of the international maritime providers in the last decade was moving in a similar direction to become more efficient (Burns 2015). However, sustainability patterns in Puerto Rico's businesses are not well known; thus, business decision-making tends to consider limited scenarios of almost five years without much analysis of the underlying elements. Therefore, if Puerto Rico's economic situation is taken into account—a reduction in population and exportation; the cost of energy; and the reduction in the annual family expenses at the supermarket level³⁰—how will the (four) new ships exclusively for Puerto Rico's route be cost-effective for the current domestic³¹ maritime providers?

Figure 4: Diagram of some interrelated elements



4.0 Conclusion

Puerto Rico's development is immersed in a historical structure of dependency in which government intervention, production inefficiencies, and a large economy (the US but previously Spain) had control over Puerto Rico's growth. To guarantee this, customs control, cabotage, and other regulatory frameworks in favor of the US corporations were established. The "US Jewel of the Caribbean" seems to be an inefficient, uncompetitive, and expensive place to produce, highly controlled by US multinationals and experiencing a high level of brain drain (out-migrants to the US). Its soon-to-be-decade-old depressed economy and approximately 12 percent sustained unemployment in a restricted trade framework, limits the possibilities for participating actively in the global economy and trading with more flexible markets. Some lessons from Puerto Rico's experience could be meaningful to other territories, and this research offers a different approach through mixed method to evaluate the effect of a NTM to trade on SIDS agrifood supply chain.

1. A restriction on the main transportation on a SIDS market (without any inland connection among suppliers) affects the importers' capacity.
2. Cabotage requirements and its cross regulations have direct and indirect effects early on Puerto Rico's agribusiness supply chain activities.
3. The US Maritime Merchant Act limits the range of suppliers affecting the supply chain of PR's agribusinesses based on imports from the US.
4. Puerto Rico's agribusiness importers, despite having options to import from abroad, are limited because they have to comply with other factors affecting their decisional process to purchase. For instance, the US sanitary and phytosanitary restrictions, the US weight limits on containers, the lack of volume in their market, lack of cash flow, obsolete infrastructure on their terminals, and the lack of consolidation services from abroad.
5. The data on the costs associated with freight are under the control of the maritime transportation firms, thus private. Its rates or patterns are neither published nor centralized or collected by the Government of Puerto Rico. This lack of access to data only allows the shippers to allocate specific routes among themselves at predetermined rates. Those with higher volumes get the better rates and priority.
6. The vulnerability of Puerto Rico's market was highlighted by the closure of Horizon in December 2015. After hurricane Maria (September 2017), maritime domestic firms in Puerto Rico did not have enough (cost-benefit) capacity to deal with extraordinary situations to ensure a continuous flow of cargo to Puerto Rico. In addition, the lack of sustainable operations on the ports of Mayagüez and Ponce, constraint even more the supply chain. Currently, a few fleet ships are suitable for fresh food containers and/or reefers, but some importers said although the scenario is improving. Hundreds of containers are still left-behind in Florida due to lack of space on cargo vessels. Maria's emergency demonstrated maritime firms' limitations of space. However, during the period of this re-

search, it was anticipated because the number of ships available for reefers was only one.

7. Areas of opportunity at the internal level regarding supply chain competitiveness of the sectors under exploration were identified.

Bearing in mind this research was founded on most of the sustainable development goals, the analysis of cabotage shows multidimensional effects on food availability and accessibility trigger vulnerability. The cost of energy in Puerto Rico, influenced by its obsolete and highly dependent fossil fuel system, is also affected by the US Cabotage when equipment and some fuel are transported from there. In addition, port maintenance activities (e.g., dredging, electric submarine cable), exploratory activities as seen and renewable projects such as ocean wind farms are affected by the Act. The energy cost and the extra cost of transportation (on fuel, containers, grains, etc.) are considered by the participants as the most important factor with effects on Puerto Rico's agrifood supply chain. Unfortunately, sea transportation restrictions and their complex structures and layers of service costs developed through the years make it difficult to estimate the real cost of NTM on the agribusiness sector. However, the most frequent journeys to Puerto Rico are made by domestic vessels. The importers expressed their preferences for the US market and in the case of animal feedstuff, Puerto Rico's farmers are absorbing that overcost.

The sum of all these factors—internal and external—affect Puerto Rico's agri-food sector. Liberalizing cabotage without any investments or internal changes could reduce the price of many goods related to farming in the short term, but in the long term would have a negative effect on Puerto Rico's native agribusiness importers. Probably, they will be affected by the foreign price structure of goods with potential effects reducing the number of native agribusinesses and eroding Puerto Rico's food sovereignty potential. On the other hand, preserving the law as it is would maintain the same business structures and its vulnerabilities without a sustainable solution for Puerto Rico and its competitiveness. Strategic investments in commercial ports' lanes and terminals' infrastructure, automating and digitizing processes, promoting rivalry among maritime firms, strengthening the local industry firms' supporters, and manufacturers' product diversification would be the key to a healthier competitiveness environment. Other dimensions such as fiscal (inventory taxes), geographical (incentives for densification of two of the main port-cities), firms (operational inefficiencies), and anthropological issues related to the local producers' behavior are indirect dimensions that might bring vulnerabilities to PR's food supply chain.

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NOTES

¹ For this purpose, agrifood is considered as a business of producing food linked to agriculture production, which in a system is developed according to the local resources, cultural, and social productive characteristics. The food supply chain, on the other hand, considers the variables on an effective system between “farms and forks.” It includes production, infrastructure, delivery, technological changes, environmental issues, sustainable management, and governance structures.

² During that period the US Congress approved, at least, three different laws named Jones Act. The Jones-Shafroth Act that regulates PR's citizenship; the one about Land Grant Colleges (UPR-RUM) Bankhead-Jones Act, 1935; and the one related to Cabotage, which is the one written by Wesley Jones, as the Maritime Merchant Act of 1920 (46 USC Title, Chapter 24; many sections on related topics).

³ Since 1789, the U.S. Law requires US workers, crew, and flagged ships for domestic maritime transportation. A few maritime laws were approved between 1810 and 1887. Eventually, due to its lack of competitiveness for shore-side support functions and many US shipping firms disappears into consolidations. US shipping faced significant cost disadvantages from the turn of the 20th century (Sagers 2006).

⁴ American Samoa, Mariana Island, and the Virgin Islands.

⁵ Cabotage welfare costs on PR's economy, although without agreement from the academic community, have been estimated between \$0 million and \$400 million per year.

⁶ Overall around 11,000 farmers and native agribusiness for the time of the fieldwork

⁷ VRIO (Valuable; Rare; costly to Initiate; Organized to capture value). These four segments are conformed by variables (infrastructure, location, reputation, economic performance, environment threat, social complexity, operational, innovation, and capabilities) to evaluate firms' competitive advantage cycle.

⁸ Visibility in the supply chain refers to risk reduction, proactively tracking products, identifying potential disruptions.

⁹ Gorton and associates (2013) outlined a framework to evaluate the relationship of elements and determinants of competitiveness in agriculture supply chain.

¹⁰ Due to the limitations of well-defined theoretical frameworks for the analysis of NTMs, this exploratory research follows a pragmatic stance.

¹¹ In a basic formulation for animal feed mill, the most common macro-ingredients are maize, soy, wheat, and fishmeal. The quantitative analysis was analyzed using a gravity model (formula).

¹² San Juan, Guayanilla, Humacao, Jobos, Ponce, Mayagüez, Fajardo, Guánica, Aguadilla, Arecibo and Yabucoa (USCoC 2015). So far, the last two are limited to oil imports. Ponce & Mayaguez are delegated port thus not administered by PRPA.

¹³ Puerto Rico's archipelago includes the ports of Vieques and Culebra.

¹⁴ Some atmospheric phenomena such as hurricanes may provoke high movements of sediments reducing port depths.

¹⁵ Between 2011 and 2013 some organizations, the 2012 political campaign, and eventually a few Puerto Rican Congressmen, the Governor of Puerto Rico, and the US Resident Commissioner of Puerto Rico, publicly converged on the needs of a solution in benefit of Puerto Rico's competitiveness. By the Recovery Act of 2009 many projects of infrastructure in the US were developed. Eventually, the sea-port activities were included.

¹⁶ Private firms dedicated to any activity related to the shipping process of importing and exporting, such as terminal operators, maritime lines, docking or vessel repairs or mechanics, stevedoring, port logistics distribution, docking support, and so on. Anaya-Oviedo (2012) explores this in more detail.

¹⁷ Percentages were mentioned during the interviews. No quantitative data to sustain it were provided or analyzed. However, similar approximations are presented by Szakonyi (2014) and Comas (2009).

¹⁸ See e.g. Szakonyi (2014) for a succinct analysis.

¹⁹ The effects of containers reduction towers northbound could be associated with the deindustrialization process described by Caraballo-Cueto and Lara (2018).

²⁰ Anaya-Oviedo (2012) reports that 36 percent of the custom-brokers in Puerto Rico consider the use of the technology in this process to be below the regular level (4/7); 80 percent of the maritime service providers consider that inland access to terminals and port facilities in San Juan is poorly maintained and/or underdeveloped, and 40 percent of them believe that sea roads of the San Juan Port are underdeveloped. Similarly, 50 percent of them have the same opinion about the lack of cranes and equipment in terminals.

²¹ Demurrage fees could vary among firms but in some cases could be such as \$2,000 per hour and other \$10,000 per day or fraction.

²² Available data on Puerto Rico's external trade as an animal feed data segment show lower values because they consider as cereals some particular grains that are frequently used in animal feed mills; hence, they are not classified in their section.

²³ This is the case of wheat mesh and the premixed micronutrients' formulation. The formula used is basically 70 percent of maize. Unit is a cow in production for dairy farm. In Poultry Farms, the analysis considered four flocks per year but five in 2014. In hog farms, the production cycle (C) is between 125 to 200 days under ordinary conditions.

²⁴ Particularly to the Latin American markets but it is fundamentally lead by seasonality.

²⁵ The working hours of the port inspectors of the USDA and the PRDA differ by season and are fewer than those of the private service providers.

²⁶ The code related to Quality included: punctuality, packaging, product, and handling. The code of Insecurity included distrust on issues related to sanitary and phytosanitary policies to trade, political stability, and technical or management issues at port level or with carriers. The code of intercommunication focused on cultural issues (such as language, meanings, and metric systems), and most frequent methods of communication.

²⁷ Participants perceived that the domestic maritime firms are more informative and diligent than the foreign one.

²⁸ An anecdotal example was the case of purchasing green leaves from California and transporting them to Jacksonville. The inland rate is over \$6,000, and the sea rate from Jacksonville to San Juan is around \$4,000. Consequently, a container of 900 cartons of lettuce is almost \$10 per box over the produce price as a result of the cost of transport.

²⁹ Although fertilization is a relatively common routine practice and its volume depends on soil conditions and crop requirements, in tropical soils the use of 2,800 kg per acre is considered to be a very basic measure. Using that on the example, the extra cost of transport only will represent \$616 (USD) per acre over the cost of the product.

³⁰ MIDA (2014) estimates a reduction of 14 percent less than in 2013.

³¹ The price of Crowley and Sea Star new LNG ships (two each) for Puerto Rico was estimated to be over \$150 million per ship.

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