Universidade de Aveiro
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EDUARDO BELMIRO TORRES do COUTO

A ALIMENTAÇÃO DA EUROPA E A POSIÇÃO GEOESTRATÉGICA DE PORTUGAL, A SUA VANTAGEM LOGISTICA, OPORTUNIDADE PARA O FUTURO

FEEDING EUROPE, THE PORTUGUESE GEOESTRATEGIC POSITION AND THE LOGISTIC GAINS, OPPORTUNITY FOR THE NEXT QUARTER

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Tese apresentada à Universidade de Aveiro para cumprimento dos requisitos necessários à obtenção do grau de Doutor em Marketing e Estratégia, realizada sob a orientação científica do Doutor Joaquim José Borges Gouveia, Professor Catedrático, e do Doutor António Carrizo Moreira, Professor Associado, ambos do Departamento de Economia, Gestão, Engenharia Industrial e Turismo, da Universidade de Aveiro

Dedico este trabalho em primeiro lugar à minha esposa Mariana, aos meus pais Lídia e Belmiro, à minha irmã preferida Rosa Lídia, Manuel e família, e sobretudo a cada um dos meus cinco filhos Sara, Lia, João, Lara e Victor, pelo incansável apoio e subtração.

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palavras-chave Portos, logistica, food commodities, produção agricola, grãos, cereais e sementes, proteina, geoestratégia, transportes, cabotagem, terminal de cereais, corredores logisticos, cadeia de abastecimento, cadeia de valor, desenvolvimento regional

resumo

A alimentação humana está dividida em duas origens principais, produtos frescos e grãos. O primeiro grupo são os vegetais, legumes e as frutas, também ainda a captura de peixes selvagens das águas do mar. Atualmente, os grãos são direta ou indiretamente, a base da carne, peixe de aquicultura, leite, ovos, queijo, pão, massas, a quase totalidade dos alimentos processados. Os principais grãos são commodities comercializadas em todo o mundo, como por exemplo o milho, o trigo ou a cevada. Estas commodities alimentares, produzidas e consumidas em diferentes regiões do globo, viajam em grandes navios. Identifica-se então uma oportunidade que pode tornar a logística intercontinental de grãos mais eficiente, particularmente a que serve a Europa. O trabalho de pesquisa desta tese é composto por duas tarefas preliminares: a análise de dados para mostrar o movimento para sul da produção média ponderada de commodities alimentares no mundo; a outra parte, a realização de entrevistas aprofundadas a líderes da indústria, envolvidos na logística de grãos, comércio de commodities e portos, para discutir se, na Europa, essa evolução deve indicar outras alternativas nas infraestruturas portuárias, para maior eficiência da cadeia de abastecimento, impactando também no seu desenvolvimento regional. Faz-se ainda uma análise comparativa de um caso de estudo. Os alimentos são vitais para a existência da humanidade, actualmente as commodities alimentares são produzidas e transportadas em grandes volumes por todo o mundo, procurando a melhor produtividade, o clima mais favorável, o solo ideal e água. A grande logística e o comércio internacional fizeram com que as commodities alimentares viajassem milhares de quilometros para chegar ao nosso prato no canto oposto do globo. Hoje, grandes volumes de recursos são dedicados à produção, transformação e distribuição de commodities, de modo que uma vasta quota da economia global mundial é ocupada pelos negócios de alimentação. A investigação e literatura sobre estes assuntos é imensa, difícil de classificar de acordo com a relevância para o uso. Uma análise preliminar dos dados de produção agrícola foi proposta, um grande volume de dados foi coligido e processado, numa segunda fase, foi proposto tratar volumes de dados muito maiores ainda, para sustentar e dar consistência à validação da hipótese formulada. A segunda fase do trabalho de pesquisa é um trabalho qualitativo de entrevistas detalhadas com informantes, conduzidas com 13 líderes do setor. A amostra representou um amplo espectro de líderes de toda a UE, América e especialmente Portugal. Devemos reconhecer que uma abordagem qualitativa pode ser intensiva, complexa, difícil e demorada, mas é rica em detalhes e revela novas maneiras de explicar uma visão futura complexa de tais questões de pesquisa. Finalmente, usando uma metodologia de estudo de caso, um fenômeno paralelo e semelhante é analisado para enriquecimento da discussão do estudo de oportunidade.

Keywords Ports, logistics, food commodities, agricultural production, grains, cereals and seeds, protein, geostrategy, transports, transshipment, grain terminal, logistics corridors, supply chain, value chain, regional development

Abstract

People's food is today divided in two main origins, fresh products and grains. The first group being the vegetables, legumes and fruits, also still the capture of wild fish from the sea waters, although fish farming production is already overlapping the wild-catch collection. So, presently, grains are directly or indirectly, the basis of meat, aquaculture fish, milk, eggs, cheese, bread, pastas, and almost all processed food products. The main food grains are the commodities largely traded in world like maze, wheat or barley. These food commodities produced and consumed in different parts of the globe, travel in big vessels. An opportunity is then identified that can make intercontinental grain logistics more efficient, particularly the one that serves Europe. The research work of the thesis is clearly composed by two preliminary tasks, the data analysis job to show the southern movement of the production of food commodities in the world globe; the other part, the collection of in-depth interviews of leaders in industry, related to food logistics, food commodities trading and ports, to discuss whether in Europe this change should appoint other port infrastructures improvement, for better supply-chain efficiency and regional development. In addition, a comparative case study analysis is considered for the discussion.

Food is a vital element for humanity existence, in modern age, food become mass produced and transported around all the globe, looking for the best productivity, searching ideal clime, soils and water. Heavy logistics and international trade, made food travel thousands of kilometers to reach our plate on the opposite corner of the globe. Today large volumes of resources are dedicated for food production, transformation and distribution, so a vast quota of world global economy is taken by food business. Research and literature about these subjects is immense, difficult to classify as per relevance for use. A preliminary data analysis of the subject was proposed, a large volume of data was collected, for a second phase study being proposed to treat far larger data volumes, to trim and give consistence to the validation of the hypothesis previously formulated.

The second phase of the research work, is a qualitative work of informant in-depth interviews conducted with 13 leaders in the industry. The sample represented a broad spectrum of leaders from across the EU, America, and especially Portugal. We must recognize that a qualitative approach may be intensive, complex, expensive and time consuming, but it is rich in details and revealing in new ways to explain a complex future vision of such research questions. Finally, using a case study methodology, a similar parallel phenomena is discussed to be added to the prospective framework emerged.

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Introductory Citations

"The growth of the food industry brings unique logistical challenges, new supply routes and demand dynamics are reshaping the future of food logistics. It is therefore essential for the industry to innovate, not only in demand management but also in order to ensure that food sources for a growing population are sustainable"

- Samir Dani, Professor of Logistics, Huddersfield

"Food industry is the first in European Community for revenues, with more than 8 million of employee. Logistics and supply chain management play a crucial role in food industry"

- Riccardo Manzini, Professor Ingegneria Industriale, Bologna

"The coming years will be a vital period to save the planet and to achieve sustainable, inclusive human development"

- António Guterres, Secretary-General, United Nations

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List of abbreviations and acronyms:

ABCD – The groupe of top food commodities traders ADM, Bunge, Cargill and Dreyfus
AI - Artificial intelligence
AIS - Automatic Identification System
AGRI – European Innovation Partnership for Agricultural productivity and Sustainability
APS – Administração do Porto de Sines, Porto of Sines Administration
ARA – The port region of Amsterdam, Rotterdam (Netherlands) and Antwerp (Belgium)
ASD - Agenda for Sustainable Development
BOT – concession model used in PPP concession, Built-Operate-Transfer
CBOT - Chicago Board of Trade, commodity exchange established 1848, merged CME 2007
CEO - Chief executive officer
CIAT - International Center for Tropical Agriculture
CIMMYT - Centro internacional de mejoramiento de maiz y trigo, Spain
CGIAR - Consultative Group on International Agricultural Research
CME – CME Group Inc. world leading marketplace, integrating CBOT, NYMEX and COMEX
CO2 - Carbon dioxide
COCERAL - European Association representing the trade in cereals, rice, feedstuffs, oilseeds, olive oil, oils and fats and agrosupply
COMEX - Formerly Commodity Exchange Inc., merged New York Mercantile Exchange 1994
CONAB – Companhia Nacional de Abastecimento, Brazilian state company for agro statistics
DOALOS - Division for Ocean Affairs and the Law of the Sea, a division of the office of Legal affairs of UN
DPWorld – Dubai Port World, a logistics Port operator company based in Dubai, UAE Emirates
DWT – Dead Weight Tonnage, the maximum weight of cargo and supplies in a vessel
EDI – Electronic Data Interchange
EMBRAPA – Empresa Brasileira de Pesquisa Agropecuária
ENRD - European Network for Rural Development
EIP - European Innovation Partnership
ESPO - European Sea Ports Organization
EU - European Union
EXCEL - Spread sheet application, Microsoft software
EIU - Economist Intelligence Unit
FAO - Food and Agriculture Organization, specialized agency of the United Nations
FAOSTAT - Food and Agriculture Organization Corporate Statistical Database
FDI – Foreign Direct Investment, usually referring to the attraction of foreign capital supporting local investments
FEDIOL - European Union Vegetable Oil and Protein Meal Industry Association
FEFAC - European Feed Manufacturers' Federation
GATS - General Agreement on Trade in Services
GATT - General Agreement on Tariffs and Trade
GCSN - global cargo ship network
GDP - Gross Domestic Product
GHG - Greenhouse gas
GM - genetically modified

IACA - Associação Portuguesa dos Alimentos Compostos para Animais
IAPH - the International Association of Ports and Harbours
ICRISAT – Institute of Crops Research in Semi-Arid Tropics
ICS - International Chamber of Shipping
ICT - Information and Communication Technologies
ILO - International Labour Organization
IMF - International Monetary Fund
IMO – International Maritime Organisation
INE – Instituto Nacional de Estatística (Portugal)
IoT - Internet of Things
IPCP - International Potato Center to Peru
IRRI - International rice research institute
ITF - International Transport Forum
ITLOS - International Tribunal for the Law of the Sea, an independent judicial body established by the United Nations Convention on the Law of the Sea
JIT - Just-in-time
LIFFE - London International Financial Futures Exchange. Electronic platform of Euronext
Kcal – Kilo calories, unit used for measure of food energy
LAC - Latin America and Caribbean countries region
LNG - Liquefied Natural Gas
LPG – Liquefied Propane Gas
LSCI - Liner Shipping Connectivity Index
PAC – European Union Common Agricultural Policy
MARPOL - International Convention for the Prevention of Pollution from Ships
MAPITO – Central north region grouping the states Maranhao, PIaui and Tocantins, in Brazil
MATIF - Marché à Terme International de France, is today in LIFFE an affiliate of Euronext
MED – Mediterranean Sea region
MENA – Middle East and North Africa countries region
MT – Metric ton, unit measure used in grains and seeds
MTO - Multimodal transport operator
NGO - Non Governmental Organisation
NOx - Nitrogen oxide
NY – New York, city in USA
NYMEX - Commodities Trading Exchange of New York, started in 1872 acquired by CME 2008
OECD - Organization for Economic Co-operation and Development
PPP – Public Private Partnership, a long-term contract between public and private sectors
REN - Rede Electrica Nacional, Portuguese national electric grid operator
R&D - Research and Development
SDG - Sustainable Development Goals
SeaRates - Trusted community marketplace for international cargo, belongs to DP World
SIDS - Small island developing states
SOx - Sulphur oxide
SPSS - Statistical Package for the Social Sciences, IBM Software
SPV – Special Purpose Vehicle, company detained by others, shedding a specific activity
SSS – Short Sea Shipping, short cargo movements usually along the coast

ST – Short Ton, used in some USA commodities quotations indexes, being 0.907 of the MT
STAPLE - Is a food that is eaten routinely, it constitutes a dominant portion of a standard diet
SVAR – Structural vector autoregressive
SWOT - Strengths Weaknesses Opportunities Threats, model of analysis
TEU – The 20-foot container equivalent unit in weight loads capacity of a vessel
TEN-T - Trans-European Transport Network
TFA - Trade Facilitation Agreement
UAE – United Arab Emirates
UNCLOS - United Nations Convention on the Law of the Sea
UN – United Nations
UNCTAD – United Nations Conference on Trade and Development
USA – United States of America
USAID - United States Agency for International Development
USD – United States Dollar
USDA - United States Department of Agriculture, federal executive department
VSM - Value stream mapping approached
WAN - worldwide airport network
WEF - World Economic Forum
WEO - World Economic Outlook
WTO - World Trade Organisation
ZAL – Zona de Actividades Logisticas, Zone of logistics activities
ZILS - Zona Industrial e Logística de Sines, Zone for industrial and logistic activities of Sines

1 Introduction:

1.1 Thesis general framework

It is believed that humanity became sedentary when it started producing its own food by cultivating agriculture products, 10.000 years before Christ. In the past, our ancestors spent their efforts on gathering, hunting, and scavenging in the wild for food to survive, since around 200.000 years before. Thus, it is a short period since people became farmers. However, throughout its brief history, agriculture has radically transformed human societies and fueled a global population that has grown from 4 million to 7 billion over the last two generations, and is still growing (UN, 2019). Gradually people began a transition from a hunter/gatherer lifestyle, towards a farmer style, cultivating plants and breeding animals for food. Like today, the need and the ability to increase food production were related to population density and technology to plant and harvest crops. Producing food made an enormous change in society organization, people could fix their living places, more protected, more stable, not traveling and searching for food, so communities were established, society became organized, socially and political. Agriculture made civilizations possible. Throughout time, civilization improved the technology to have always better harvest and better feed the populations. Progressively, the farmers learn to collect and prepare seeds, develop agriculture tools, to use animal force to prepare the soil, to create natural fertilizers, and very important, to introduce artificial irrigation. Cereals, fresh vegetables and fruits, domestic animals, milk products, just like today, were the base of food production for these ancient civilizations. The food pyramid today is more sophisticated, however, the natural products that are at its origin are still the same, and make up the base of satisfaction of our food requirements.

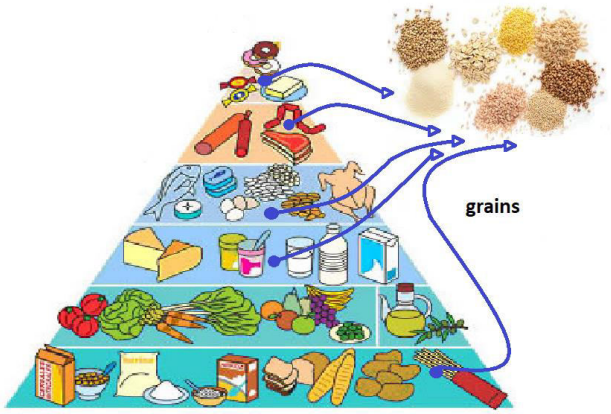


Figure 1 - Food pyramid, two thirds are grains

In modern civilization, as Fig.1 shows FAO food pyramid 2016 (Fischer & Garnett, 2016), roughly two-thirds of our food pyramid is based on grains and seeds. The content of grains in our daily meals is not detected at first sight, but looking with attention, we see they are obviously in the bread, but also they hide in the pasta, meat, fish, eggs, milk, and even a mayonnaise. All these are 98% grains. Apart from fresh vegetables and fruits, potatoes and other tubers, and about half of the demand for fish that is supplied by the seas, the rest is cereals. Cereals and seeds, what means essentially grains such as wheat, maize, rice, barley, sorghum, rye, oats and oil seeds such as soya, sunflower, rapeseed, among other small representative varieties.

These cereals and seeds became massive products in the world, especially after the industrial revolution that introduced increasingly complex and sophisticated machines, as well as fertilizing products, phytosanitary technology and irrigation techniques. Thus, when high-volume productions are achieved, with high population growth pushing extraordinary global demand, the cereals and seeds of the twentieth century have entered a new era of global commerce, being traded internationally, quoted on the main world markets of stock exchanges, traded and guaranteed in forward futures contracts and other derivatives and speculative financial products.

World food trade continues to change, grow and globalize. If we look into our plates on the table, we could trace the origin of food and its feeding components, and most likely we will find that we eat foods that are produced with grains grown in different points of the world, separated by many thousands of kilometers away, combining several continents with different hemispheres of the globe, passing throughout an immense logistic chain to reach our plate, in a few weeks or months. Imagine we enter in a nice touristic restaurant in Lisbon and order a plate of fried chicken wings with rice and salad – if we could make the geographic traceability of all components included in its preparation, simplistically, most probably, we could find something like this or a similar constellation of geographies: the soya compound from Argentina, the wheat from Ukraine and the maize from Canada, with Austrian jelly and U.S. additives. These are the main components of the feed compound made in Ribatejo, that was used to get chicken meat in Oliveira de Frades, this chicken coming in turn from Spanish eggs; the white rice traveled from China, being then peeled and packaged in Oliveira de

Azémeis, after which the flavors were enhanced with salt from Morocco, pepper from India and garlic from Greece; the frying oil for the chicken wings was a cooking mix of sunflower extracted in Romania from Russian seeds, mixed with Palm-Oil from Malaysia, the salad was probably the only local component. We live in a global society which is supported by a global economy, and necessarily, a strong logistics infrastructure sustained this new type of food trade around the globe.

This novel economy simply could not function if there were not large cargo vessels and the shipping industry, to travel and transport food around the earth. For food commodities (rice, corn, wheat, soya, others) maritime transport flows are the lifeblood of global trade, the long distance intercontinental logistics solution.

Studying and understanding the evolution trends of this logistics, a collection of origins and destinations, could bring strategic elements for infrastructure decisions. Things have changed in the last generation, so infrastructures may also have to change and follow trends. The most productive areas in agriculture are being catched by countries with less developed and emerging economies.

Countries emphasise competitiveness for the supply of the hunger market at several stages of the chain: production, logistics, food processing, and ultimately, food distribution.

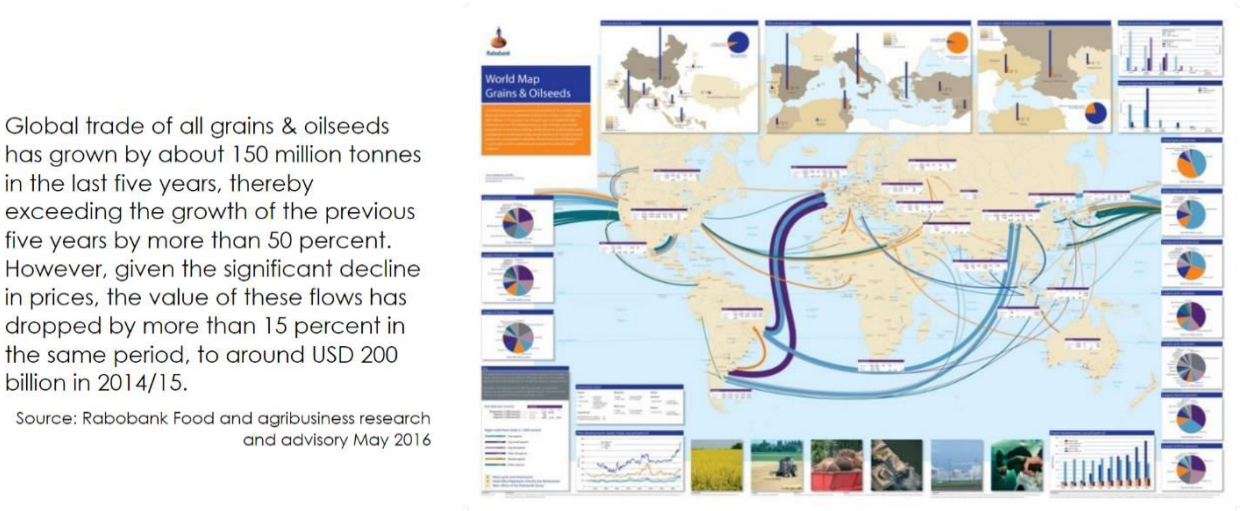


Figure 2 - Global trade of all grains and seeds; Rabobank research and advisory

The verticalisation of activities is a competitive factor for food business industries. This means those countries having production or/and large volume logistics are furthermore competitive in food processing than others having to import the raw commodities in low scale

quantities. Original commodities price per ton is a differential strong competitive factor to locate food processing industry. Consequently, the final food prices are in line with the industry. Agriculture value chain efficiency must search to minimize gaps, scale volumes, being able to benefit market competitiveness (Miller, Jones, Miller, & Jones, 2010).

Shipping is truly the sensitive point of the global economy: without shipping, intercontinental trade, the bulk transport of raw materials and the import/export of affordable food and manufactured goods would simply not be possible. Not affordable, not viable. Shipping is perhaps the most international of all the world's great industries and one of the most dangerous. “Over the last 50 years seaborne trade has seen a remarkable development. Shipping carries the vast majority of international trade with its share ranging between 80 and 90 per cent of trade" (unctad, 2018). Of all the sectors that make

Figure 3 - Dry Bulk Carriers in port operations

up the global transport infrastructure, shipping probably has the lowest public profile and the least representative public image. Its importance is not well known although not a single area of our life remains unaffected by it. The old traditional and empirical way of running a shipping business has rapidly evolved to include sophisticated and modern ways of professional governing the ship industry. Vessel owners companies look for the best efficiency on the operations, commercial and strategic management of their fleets, often gathering specialized third parties services for the best operationally (Mitroussi, 2013).

Shipping operations are present in the majority of the consumer goods and equipment's we are buying just from the local store.

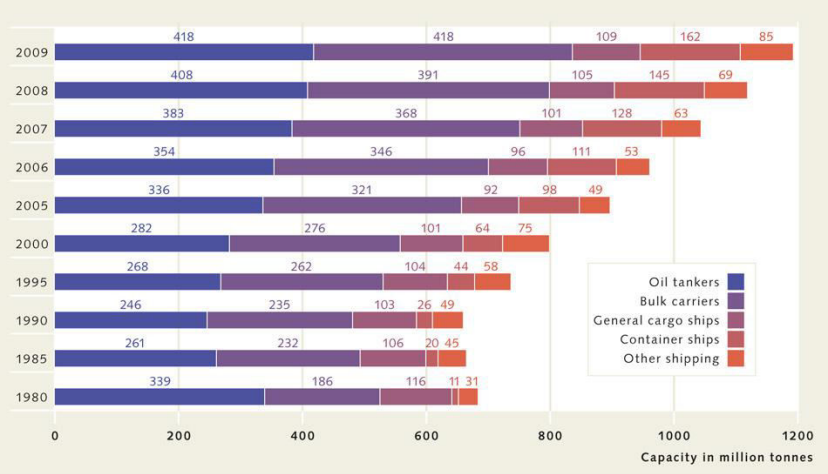


Figure 4 - The growth of the global merchant fleet according to type of vessel - Shaffer

The consumer simply does not imagine what and how big are the immense and powerful logistics operations that are behind every little thing we are buying from the shelf in the local neighborhood store.

Bulk carriers are the ones used for the transport of food commodities, grains, oils or meals. A vessel such as one of Handy size (from 20 up to 40K MT) or a Panamax (from 60 to 80 K MT) are cargo ships used to transport bulk cargo items such as food staples (rice, corn, wheat, others grains, etc.) and similar cargo. In Fig 3, we can observe some of the largest bulk cargos, sized DWT 400.000 MT for the transport of iron ore, named Valmax, belonging to the Brazilian company Val mining (Marketscreener, 2011). This size vessels, by 2021, are not used for grains transportation, but along the years size kept growing, soon this size might be also transporting food grains. The large box-like hatches on its deck help to identify a bulk carrier vessel, designed to slide outboard for loading or unloading operations. These vessels can be either dry or wet. A cargo ship or freighter is any sort of ship or vessel that carries cargo, goods, and materials from one port to another. Thousands of cargo carriers traverse the world's seas and oceans each year, they handle the bulk of international trade. Bigger size, higher speed and specialization for this vessels are in constant evolution every year in the world fleet (Schäfer & Emanuel Söding, 2019).

Cargo ships are usually specially designed for the task, often being equipped with cranes and other mechanisms to load and unload, and come in all sizes. Today, they are almost always built of welded steel and, with some exceptions, generally have a life expectancy of 25 to 30 years before being scrapped.

In recent estimates, around 90 per cent of world trade is hauled by sea vessels (Kaluza, Kölzsch, Gastner, & Blasius, 2008). An immense maritime traffic is scrabbling the sea, global shipping routes crisscross the world's oceans in this map of shipping lanes derived from a 2008 study of the human impact on marine ecosystems. Being the logistics support of world

Figure 5 - Shipping routes, 90 per cent of world trade is hauled by sea - Kaluza

trade taken by sea vessels, the global network of commercial vessels is providing today the most important mode of transportation for merchandises.

The operational cost and environmental impact of a bulk carrier, although the lowest per metric ton of cargo is considerable, due to the size and energy consumption of the vessel. It is then very important in economics, marketing, safety and from ecological points of view, that maritime transportation to be able to be rationalized and minimized in its impact.

1.2 Objectives

Along many decades, food trade became a major economic activity establishing an important role in the international trade (Krausmann & Langthaler, 2019). Especially after the industrial area, manufacturing industrial activities rapidly replaced the agriculture activities of the population for sustaining the communities, people are no longer farmers but became

labor force employees in the urban industry. So, the international commerce of food rapidly changed from the exquisite aromatics and spices between the far distant countries to massive production of base aliments, like traditional wheat and corn, for sustaining the urban populations in the large cities of the developed countries. Urban metropoles developed bases in trading activities for their agriculture food product's needs, against services and manufactured industrial products, this way sustaining the existence of the human being, in such large urban communities. Large trade and the necessary logistics infrastructures for food basis, the grains, were rapidly developed in the second half of XIX century, promptly expanding their model during industrial revolution along developed world (Torreggiani, Mangioni, Puma, & Fagiolo, 2018).

The modern citizen is a food buyer, no longer s/he produces the food s/he needs to survive, not even in a family or community base. Today, in modern societies people depend on the logistics and organized trade, restaurants to access their basic need for aliments. This made "food security" an important issue for the national security and sovereignty and independence of the states all around the world, also obliged large investments and developed a big commercial structure to supply and distribute food needs in the urban modern world (Fischer & Garnett, 2016), (Alexandratos & Bruinsma, 2012).

Nowadays, the good healthy conditions of populations depend on the logistics and distribution of food essential elements around the world. Agriculture production searches the best efficient soils and clime in the globe, this means the world has many population living in places where agriculture and meat production are not efficient, even more, the urban style of living, like we know it in the contemporary times, made people rely on markets, food stores and restaurant to feed themselves. In modern societies, families are not cultivating plants and vegetables, or are not brewing chicken and animals in the backyard for sustaining life. Food commodities have to travel to reach consumption regions, agroindustry is transforming, food distribution uses its final logistics to stores and restaurants, people are buying final food products for consumption.

This thesis is focused on two main objectives: the first is to demonstrate that the food commodities production geographic picture changed significantly in the past decades. The southern hemisphere of the globe became a big agriculture producer of food basic grains,

exporting all around the world. Countries like Brazil, Argentina, South Africa, Australia, Malaysia and others, balanced and have overpassed the agriculture production of the traditional harvesting countries in the north hemisphere, like USA, Canada, and former URSS states. And this southern displacement phenomenon is particular more expressive when we analyze the geographic movement of the source of protein of the meat production from grains.

Secondly, finding the evidence of this fact, what responses should be given by the existing trading and logistics organizations and especially their infrastructures, about a more efficient and sustainable functioning of their traditional lines and ports, receiving bigger vessels, what changes to make to respond to this new geography map. Focused in West Europe region logistics, it is relevant a discussion of alternative logistics channels for food grains and all the downstream industry, considering an eventual complementary southern food door of Europe, a new large European South West Grains terminal.

1.3 The research questions

In the past century, the agriculture industry known a remarkable evolution. Food supply was a major issue to cover the need to respond to the population growth of an everyday healthier growing population with longer life expectation. Looking for good and economical soil, farmers from the north globe industrialized countries, like USA and Europe where agriculture land became scarce and expensive, searched new areas of agriculture development in the southern hemisphere. Grains had to travel longer distances but agriculture production costs could be rewarding from these new farming domains. There is immense literature about the green revolution, the introduction of technology and industrialization of farming operations. Not so much studies, about how the new agriculture geolocations of the production of grains rapidly unbalanced the geographical traditional center, demanding a growing fleet of large vessels to trade and transport the food around the globe. This logistics evolution strongly affects the existing ports infrastructures, even more, all the downstream industry, to proceed the food commodities intercontinental movements.

The research questions posed, chosen to unveil the response to the objectives of the research. *Is food production latitude moving south?* Meaning, the need to determine if there is, moreover how important it is, the eventual prominence of the new south agriculture countries in the world. It is true and common sense that new agriculture economies emerged in the recent decades, especially on the south hemisphere. But, how this phenomena is balancing in the world agriculture production picture, being or not relevant in the international context and especially focused in Europe imports of food staples.

Considering the positive confirmation answer of this first question, the second and third research questions are in a queuing logic of thoughts – *Should Europe look for alternative ports in the southern continental countries?* And if this is the case, *Is Portugal, geographically convenient and competitive to become an alternative food commodities port to South Europe?* The European Southwest Atlantic coast lacks the existence of food commodities terminals for large-scale trade, allowing transshipment operations of large vessels into smaller distribution short-sea-shipping vessels. This kind of operations in Europe ports are concentrated in the traditional zone on the North Sea area, Hamburg, Amsterdam, Rotterdam and Antwerp. The opportunity is the reception of large grains vessels in a south Europe port, splitting the commodities part to the hinterland food industry and the other part distributing especially along the south proximity zone, to serve with smaller vessels, the Mediterranean European ports, North Africa, Middle East and Black sea ports.

A fourth research question would arise from the previous logic sequence – *What are the impacts of a food terminal to the regional hinterland of the port?* The importance of the social economic development of the region, necessarily impacted by new activities, also impelling the opportunity to develop the transformation industry for food processing units, when a new grains terminal is developed in the Port.

1.4 Motivation

During numerous years, the author of this thesis took in his professional career the opportunity to contact and operate inside the mechanisms of international agriculture food trade business, assuming different positions, in different department directions and also as

board member in a group of companies, dealing farming agriculture production worldwide. Also the researcher has tackled high responsibilities in agriculture international commodities trading, for the use of agroindustry operations and transformation for food products. NUTRE is a big farming and agroindustry Portuguese group of companies, with operations developed in several countries and geographies in the world that passes through some main countries like Portugal, Romania, Angola, Mozambique and Brazil, selling commodities and food products worldwide. In all of these countries, the group established whether farming agriculture operations, mainly producing grains and oil seeds, but also agroindustry operations or food processing units. The commodities trading between these geographies was not generally direct sale/purchase, but mostly used the world market of food commodities through the international trading houses and logistics infrastructures of several global food commodities trading actor's platforms.

Observing the facts mentioned in the previous point, also focusing the attention in Portugal operations, as a south European mainly consumer importer market of food commodities, we emphasize the importance of efficiency of the food logistics chain that proves to be vital for the industrial food processing competitiveness as a whole. The southern industrial food processing needs more efficient access to the food commodities to become more competitive and proficient. The issue is not only business economical oriented, but should consider a global package of reflections on the environment, climate change, sustainability, logistics corridors, ports infrastructures, among many other disciplines involved in the regional development discussions.

1.5 Relevance and Actuality

This thesis wants to find out if the European South West seaborne traffic originated by the trade of food commodities, grains and seeds, has the best lay-out solution today. Looking for maximizing operations efficiency in its different aspects of cost, economic, environmental, time-consuming, is a multivariable, very straightforward approach in the world of commodities logistics that matters to main operators and involves the countries administrations to care about their own infrastructures responding to this efficiency search

from the industry side. The global maritime logistics tends to be a “perfect as possible” infrastructure for the transportation of goods. Today, a worldwide network of cargo ships can handle merchandize in large volumes, all around one thousand ports around the globe with efficiency and low cost.

The global network of cargo vessels fleet makes the displacement of cargos between ports, looking for the best efficiency. Conventionally, before and after the logistics movements, there is a trade operation that previously determine the delivery, on quantity, time frame and value. After, the logistics operators make all effort to minimize the physical logistics costs of that trade operation. Many cargo movements might seem without sense in the seller-client direct connection path. For long distance transportations, frequently merchandizes use lines that bring the cargo in big vessels between ports looking for efficiency. These big quantities allow smaller costs per unit, and then the cargo is split and transshipped to another port, until it reaches the final destination port. Big vessels do not make many calls on ports; this is typical for the short sea shipping operations. In addition, merchandize is not in a pendulum move, meaning the movements of cargo are not equilibrated back and forward. Containers accumulate in Angola, and the most of them return empty, because they are of an importing country, so flows of merchandize are predominant in their sense. Lines that are using direct connection between two ports are very asymmetric, verifying that 59 per cent from all linked pairs of ports are connected in only one direction (Kaluza et al., 2008). But we can observe that in only a few steps through the interconnection network we can get a cargo from one port to another specific port. The shortest path length between two ports is the minimum number of connections that must be taken to transport a cargo between a certain origin port and a specific destination port. In the global cargo ship network, the average over all pairs of ports is considerable short, 2.5, and the maximum case between any two ports (e.g. from Skagway, Alaska, to the small Italian island of Lampedusa) is only of length max. 8. In fact, from the majority of all possible pairs, origin port to destination port, around 52% can be connected by two steps or less. Comparing these findings to those reported for the worldwide airport network shows interesting similarities. Reducing interconnections and shortening navigation paths are important objectives in the planning of maritime routes.

Any geographical change on a logistic infrastructure will impact on all the subsequent industry, being feed by this logistics. Implementing a new logistic infrastructure will attract activities commixed with the transactions of goods in the location, developing the opportunity for new economic zones, new investments and new activities.

1.6 Methodology

The investigation uses different methodological approaches, in the various phases and tasks of the research, as we will discover along the chapters. Also in order to answer thesis's questions, we employed different tools. The first research question of the work was based in data mining and processing, a quantitative method, to demonstrate that the agriculture production of grains and seeds is progressing to south in the global agriculture picture along the past decades, and a special focus was made on the protein southernization production. Also, literature review shows that the world fleet is coming bigger, specialized, and the ports have to adapt in operations capabilities for the new scenario developed in the past decades. In the end, this paper seeks to answer the obvious main research question, if and how the European logistics could or should adapt to this new reality, traditional port infrastructures and installations oriented to the north Atlantic coast of Europe being today probably obliged to find alternative Atlantic options in the South. For this second research question, a series of interviews have been conducted with industry leaders, covering the several geographies in focus. The methodology uses the in-depth interviews, followed by exploratory discussions and analysis. A comparative analysis using case study was included in discussion considering the similarities of factors, between the Terminal XXI project, and the eventual new European south west grains terminal.

1.6.1 First research phase, the quantitative data analysis

Using the giant data base of FAOSTAT (OUN Food statistics of FAO), the research could use four decades of all the "tradable agriculture commodities" of the world. Almost 200

countries statistics are present in this data base, with data credible and validated by FAO, being available for free exploitation of citizens and especially for research purposes. FAO even has special assistance offices to help research initiatives basically in counter balance of free sharing the results.

By accessing this data, in this first phase of the investigation, we will seek to demonstrate that the agriculture production of the world is displacing to the South. The farming importance of the south hemisphere is growing more than the north hemisphere in the last 4 decades. We calculated the medium weighted latitude of the agriculture production for each year, considering the main commodities, and drawing the moving average along the 40 years of world grains and seeds production.

This data base, although referring each of its data values to geographic elements, referenced only as “country” of production origin, doesn’t offer the units of agriculture production referenced per geographic coordinates. So, we have the data, but not georeferenced data that we could directly use in a quantitative mathematical numeric processing. For this purpose, the research work combined the IMO (International Maritime Organization, UN) georeferenced data base of each country by capital city, referring each correspondent data element of agriculture production, the latitude of that coordinate of IMO. For the purpose of this investigation, taking in consideration that the production accuracy for geolocation of this data base is the “country”, which is not a numeric variable to make weighted medium average calculations, numeric values of latitude had to be combined with each agriculture production data element.

Furthermore, the fact of not detailing the evolution along 40 years inside the each country geography introduces a small impact in the evolution of the position, that might be considered on final global world results. What matters, ignoring the evolution inside the country, is therefore the balance evolution between countries georeferenced latitude showed consistency along the period of analysis. This was the purpose of the corrections made between the all country productions, due to some changes in countries geographies along the period of analysis. In the end, it does not matter whether this georeferenced production is in the capital or other corner of the country, matters that the data georeferenced origin is stable for the same territory, and so, figures did not become either more, or less accurate because

of changes in political geography. In 40 years of analysis, several countries changed as we will see later.

Quantitative data, as we will detail further down, was exploited using numeric software, SPSS and Excel beign the main tools used to import data, proceed Data clearance and validation, and also to make the construction of several intermediate variables, to the studies purposes. The graphics presentations similarly were exploited using these tools.

1.6.2 In-depth interviews

Several international industry leaders were interviewed for the assessment of theirs point-of-views during the research. These were interviewed as source opinion experts to exploit considerations on the scenarios of possible evolution to the Southwest European logistics port systems in exploratory discussions. Not easy to access these professionals, due to their constant traveling and international affairs responsibilities, a panel of experts in trade and logistics, with professional expertise and experience in their curricula, selected to cover the main continents involved also in analysis. South America, as well as West, East and Mediterranean Europe experiences were considered as crucial for this evaluation. This panel of experts revealed high experience in the topics and were representative by covering the geographies and the main activities considered for the discussion in this research work.

1.6.3 The comparative case study findings

The research also considered a case study of a new terminal in the port of Sines, called Terminal XXI, that was brought to Sines by a concession procedure, for the selection of BOT operation, a build exploit operator. The opportunity and phenomena of unpredictable growth of this terminal made possible to reflect a possible extrapolation of the operations in container logistics to the grains and seeds commodities logistics, establishing a parallel between the causes and opportunities of this terminal. The exploratory discussions on this case study, followed in some in-depth interviews as a perpendicular theme, that was brought

up in some of the experts interviews related to the operations of this port, allowed a deeper reflection with extra fundaments, feeding the conclusions of this research.

1.6.4 General discussion interpretative method

The author considered to develop a vision of understanding the evolution along the last decades, of the logistics phenomena of grains and seeds in the Atlantic sea, of the movements South North of cargo vessels, with strong impacts. The constructivist methodology, based on literature review and evidences from the data findings, nourished the in-depth interviews discussions with several industry specialists.

For interpreting these discussions, it was conceptualized a construction of variables identifying facts, concepts and idea strategies. The variables tree was built with 3 levels of variables, in a first phase with 40 elements, and after the in-depth interviews the model being revised for 43 variables, and called the “empirical model”, later used to interpret and discuss the results.

Within the First level of coding themes are identified, using units of meaning words and sentences, as people express them empirically. The Second level of coding uses more theoretical words and concepts, focusing in observed facts and common concepts contained inside the First level variables. The Third level of coding focuses the attention on analysing the models, understanding systems, efficiency factors, geolocation factors, services.

The empirical model restructured made the base of reading and interpreting the panel composed by 13 international specialists, covering diverse areas of agriculture commodities production, grains and seeds trading and moving, international seaborne logistics and ports that support the industry. The participating sources of information were industry leaders experienced from Portugal, Brazil, USA, Algeria, Romania, ARA region and Switzerland, where a cluster of the majors global trading houses is located. Moreover, the participants sources of information, the interviewees were selected according to their long experience in the sector, as senior experience professionals that could transmit an advisable point of view, based on international experience at first hand. Valuable vision shall be obtained from these senior experienced professionals that are people making international trading of food commodities,

or making agriculture management of operations, people exporting and importing, tackling logistics problems, people hiring vessels and lines, executive politics and administrators. Finding the available panel of participants, inviting and introducing the investigation objectives, matching the geographical encounters in 4 different continents was not a stress-free task, very time consuming, long lasting and rather complicate during the pandemic period. From 17 international invitees accepted, 13 interviews were completed and considered.

1.7 Expected contribution

This thesis is an “opportunity study”, identifying development possibilities for new investments, investigating the projects in an “idea phase”. This is preceding a later “feasibility study”, if authorities consider following the project idea. Later followed by and “technical and economic study - the business plan”, if a possible development would follow, whether by the port authority, or under a concession.

Taking the main facts revealed in this research work in consideration, the world agriculture production “is coming to South”, meaning the evolution along the past decades of agriculture production in the world showed that the South hemisphere countries took a bigger growth in the agriculture production, than the north countries, moving to shouthern latitudes the weighted average agriculture production center; the protein source for meat production tended to be based on the soybean complex products, also increasing in South hemisphere its production; vessels got bigger and specialized for better efficiency of logistics, demanding ports with deeper waters and assigned specialized terminals for grains and seeds, and their cargo lines targeted a long distance destinations for later transshipment trough short-sea -shipping. Still, West Europe keeps its trading tradition focalized and based above the North Atlantic European coast, in ARA and Hamburg region North Sea ports.

With this thesis, the author expects to open further research for the strategy of the south maritime logistics of Europe. A new European Southwest Grains terminal is the eventual opportunity to validate. The findings and discussion shall sustain that the research questions are relevant and deserve more profound and deep evaluations, already for an

operational business oriented strategy, eventually contributing for new ports infrastructures of south Europe maritime entrances. The facts highlighted show that the opportunity to develop a terminal for grains commodities transshipment and trading is generating value for all parts involved, agriculture producers, traders, industry and, in the end, for the final consumers. From bringing efficiency to the supply chain will benefit the final consumer with less costs, better access and more competitive goods.

An eventual new port infrastructure in the South West Europe zone, for grains and seeds, will develop a downstream of activities in the close economic zone, progressively along time, taking the opportunity to place the transformation activities close to the port, raw materials source, the prime access to the imported grains, maximizing efficiency. Jobs creation and economic growth in the region are immediate benefits expected from the development of port activities in consistent and long-term reliable new areas of activity.

The major contribution of the thesis would be achieved if the strategy of a port in the South-West European zone would bring to life a grains terminal, as it is pointed as an opportunity in the conclusions. Portugal, Spain, Algeria or Morocco are the most well positioned candidates, according the findings of the research. Portugal does have strategic advantages considering its geolocation and the physical characteristics of its south Atlantic coast.

2 Literature review and research on the topics

In this literature review chapter, seven main themes are covered by the assessment of literature review, considering the same topics embraced in the analysis and discussing of the thesis. First theme is the Agriculture production evolution in the world, in the preceding century, especially the past decades. The world population increased substantially and agriculture responded to its volume using new production areas, technology and bio techniques. The second issue, related to this previous point, and the main cause of this thesis, is that, although this evolution was globally observed, the swelling rate is much substantial in the South hemisphere than in the northern part of the globe. In fact, both these evidences are shown by the data analysis quantitative research performed with credible figures from data bases of FAO, so no other literature review would be necessary to sustain these points. Nevertheless, many authors, especially focused in the global farming and food security issues, are discussing this matter. The third theme is about the vegetable origin of the protein for meat production. In the past decades, humans increased meat consumption and this meat feed composition changed from traditional grains, like maize and wheat, to essential soybean base compounds, whose production also has an increasing tendency in the South hemisphere. Though, the agriculture commodities imports to Europe and other destinations are increasing from southern regions of the planet. The fourth issue on the literature review is focused on the maritime seaborne trade. Intercontinental trade logistics of the food commodities world nowadays use a vast number of big vessels dedicated to grain commodities, the bulk carriers. These vessels are getting everyday larger, navigating around the world seas, supporting the trade of agriculture commodities worldwide, understandably looking for efficiency in logistics. Next, the competitiveness of the ports is a well-established topic in the literature covered from different scholars, and gave the base for the concept-model used in this research interviews second phase, where interviewees are asked also to evaluate this competitiveness factors of the ports, guiding further discussion on this thesis. The impact of this enormous logistics operations is immense, so the next points of literature review focus on the “time to market”, financial and risk exposure costs in one side, and the all sustainability and environmental worries issues on the other side, reviewed in the last two points.

2.1 The food production and population evolution along 4 decades

The Green Revolution is the great period of development of agriculture after World Wars, industrial equipments and technology increased the world agriculture production, also to meet the food security needs of increasing healthier population all around the world. It started on the 50's, after the wars period, introducing both industrial machinery, chemistry, the biotechnology in Agriculture, on seeds, fertilizers and phytosanitary products, to meet higher demands of production per hectare. The Green Revolution was a policy for the transformation of agriculture in developing and least developed countries, initially based mainly on the intensification and use of varieties of cereals with high yield potential, like maize, wheat, rice, barley, sorgo and others. This action combined three elements: the varieties selected with high yield, many times using transgenic seeds; inputs, which are fertilizers or phytosanitary products; the importance of introducing machinery and artificial irrigation. The term "Green Revolution" means the expansion of the agriculture, the industrialization of the agriculture practices, transforming fields into green areas. It designates the technological jump made in agriculture during the period 1960-1990, mechanizing, opening new agriculture areas, following a political and industrial will supported by scientific and technical progress made in the fields of chemistry to fertilize, treat soils and plagues, powerfull industrial machinery applied to the land work and biotechnology for the seeds. This agricultural step took a great advantage of the industrial capacity made during the First and Second World Wars, and continued during the interwar period, this industrial capacity of producing chemicals and machinery being rapidly reconverted to agriculture development, as it was needed for the population increase demand. It was also made possible by the development by seed companies of new high-yielding varieties (often hybrid or transgenic), in particular of main cereals (wheat, maize and rice), thanks to varietal selection and laboratory genetic manipulation. The use of mineral fertilizers and phytosanitary products, mechanization and irrigation also contributed to the Green Revolution.

The result was an intense increase in agricultural productivity, it is said to have prevented starvations, resulting in unprecedented demographic growth of world's population

since the 1950s. It is also a cause of generalized pollution by pesticides, of eutrophication of the waters also generalized, as well as of a massive loss of biodiversity and agrobiodiversity, accompanied by phenomena of degradation and erosion of soils, salinization or even loss of groundwater. The rural exodus and the appearance of gigantic slums are also consequences of this period. A continuation, the evolution towards a more sustainable and responsible agriculture, can be found today, which allows to combine the knowledge and practices of ecology with agronomic techniques, in order to create a more sustainable production system and meet population consumption demand keeping food in a low cost level.

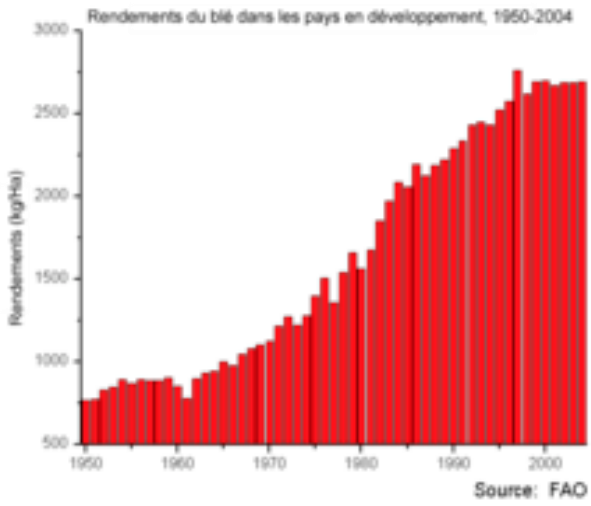


Figure 6 - Wheat production yield, 1950-2004, FAO

We can date the launch of the Green Revolution in 1943, with the creation of the Office of Special Studies, born from the collaboration between the Rockefeller Foundation and the Presidential Administration of Manuel Ávila Camacho in Mexico. Camacho's predecessor, Lázaro Cárdenas, was a supporter of land reform, protected in the Mexican Constitution of 1917, but abandoned by his predecessors until his election in 1934. Upon entering office, he established a political alliance with the Mexican peasantry by supporting the constitution of the "National Peasant Confederation", which was placed in the orbit of his party. In six years, he managed to redistribute more than 15 million hectares of land for the benefit of around 750,000 peasant families. The arrival of Ávila Camacho, however, marks an obvious change of course. The latter is primarly concerned with making Mexican agriculture capable of supporting the country's growing urbanization and industrialization. He will find in his American neighbours solid supporters in this new direction. American Vice-President

Henry Wallace, who sees Camacho's ambitions as an opportunity for the American economy and military interests, plays a major role in convincing the Rockefeller Foundation to work with the Mexican government (Ritchie, 2017).

J. George Harrar, later president of the Rockefeller Foundation, took the wheel of the small structure that originally constituted the Office of Special Studies. It brings together American geneticists and phytopathologists (Norman Borlaug, Edwin Wellhausen, William Colwell), and Mexicans whose main research areas concern the development of varieties of corn and wheat with high yield potential; Borlaug received the Nobel Prize in 1970 for his work on the cultivation of wheat. At the same time, the Mexican government is investing heavily in infrastructure for the irrigation of semi-arid plains and plateaus, and the adoption of new wheat seeds was spreading, mainly among big farmers in the north and northeast of the country, where farms are historically the largest and have the lowest climate risks. Throughout this period, a public body, governemental organization named Conusapo, continues to protect Mexican agriculture from variations in the world market.

The increase in wheat production is one of the most spectacular effects of the Green Revolution in Mexico. If it had been increasing steadily since the 1920s, it experienced a significant quantitative jump, due both to the increase in yields and to that of cultivated areas. Mexico became self-sufficient in wheat in 1951 and began exporting this cereal the following year, while at the same time its population increased.

The relative success of the Green Revolution does not mean that malnutrition will disappear. The cost of seeds and investments in equipment, prohibitive for a large number of peasants, leads to an intensification of the rural exodus. The industrialization which the country is experiencing in parallel, highly mechanized and therefore not very labor-intensive, cannot absorb a population which is growing the slums around the big cities. It was also during this period that emigration to the United States accelerated. It will remain legally admitted until 1964.

At the origin root of the Green Revolution was the idea that genetics would be the key factor determining the level of production of food crops. This is what led its promoters to focus their efforts primarily on research in agronomic matters. Building on the Mexican experience, perceived as a success by the majority of the political decision makers involved,

the Rockefeller foundation endeavors to spread the idea of Green Revolution through the establishment of new research centers around the world. In Mexico, the Office of Special Studies became the International Center for the Improvement of Maize and Wheat, or CIMMYT (from Spanish Centro Internacional de Mejoramiento de Maiz Y Trigo) in 1963. The American agronomist Norman Borlaug, Nobel Prize winner of peace in 1970, officiates there. In 1960, the Rockefeller and Ford foundations jointly established IRRI (International Rice Research Institute) in the Philippines, helping to spread the use of high-yielding varieties in Asia. Indonesia, Pakistan, Sri Lanka and other countries in Latin America and North Africa are following this path.

The effectiveness of the varieties produced by these research centers remains, however, subject to the establishment of complex and costly cropping systems, calling in particular on agricultural mechanization and chemical inputs (fertilizers, especially nitrogen fertilizers, and phytosanitary products - pesticides, fungicides and insecticides), which themselves require significant sources of petroleum (in particular for fuel oil for tractors and other machinery, as well as for the production of nitrogenous fertilizers). Wherever it is successfully carried out, the Green Revolution therefore requires a proactive state policy which generally results in: subsidies for the use of chemical inputs (pesticides, fertilizers, etc.); land management in terms of water control (irrigation); seed purchase subsidies; price protection for agricultural materials.

This Green Revolution spread in all countries in the second middle XX century, but had various policy approaches, knowing the need of collectivization of the land for big parcels production, trough cooperatives (like in France, Spain or Portugal, the “reforma agraria”) or by the nationalization of land by the state, like in the former Soviet Union, and the east European countries.

The transition from traditional agriculture to the model advocated by the Green Revolution, requiring heavy investments, has led to the development of rural credit, a factor of financial fragility for many small farmers. In Mexico, the debts contracted by the latter forced them to sell the land they had received during the land reforms, stimulating a dynamic of re-concentration of the land. In general, farmers who owned large farms and had access to credit primarily benefited from the Green Revolution. Certain regions have, for climatic,

geographic or political reasons, more easily adopted the principles of the Green Revolution. In India, it has only been implemented in the northeast and in some enclaves in the south. The Green Revolution has therefore often led to an accentuation of social, economic and regional disparities and in certain countries to an acceleration of the rural exodus.

The Green Revolution marked a decisive stage in the constitution of a globalized agronomic market, and food trade. At its origin lies international research groups, often funded by the foundations of multinational companies. Mainly agro-pharmaceutical companies essentially based in the United States and Europe has benefited from the emergence of these new markets in the field of seeds, fertilizers or pesticides. The Green Revolution seems to be the most effective model of development in the agriculture world.

This revolution had many non-agricultural effects. It has caused profound cultural changes: massive rural exodus, loss of traditional agricultural knowledge. The same revolution was also accused of helping to reduce biodiversity and putting farmers under the dependence of the agro-pharmaceutical industry.

It is a fact, in the global world, agriculture production soared after the World Wars period.

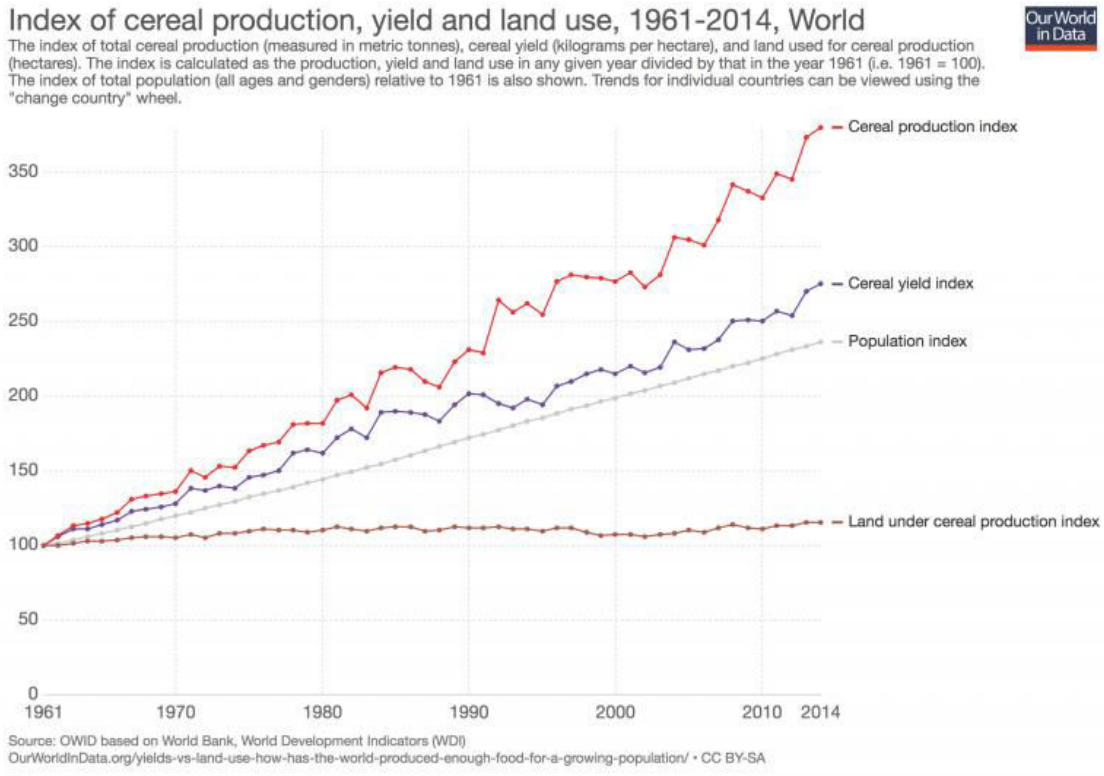


Figure 7 – Index of cereal production, yield and land use 1960-2014, OWD

Globally, at world level, cereals are the base component of food intake in the majority of the diets. They account for more than half of the caloric intake of the population in many countries. Cereals also rule in the use of arable land in the world.

From 1961 to 2014, global cereal production has increased by 280 percent (Ritchie, 2017). If we compare this increase to that of total population, which increased by only 136 percent over the same period, we see that global cereal production has grown at a much faster rate than the population. Cereal production per person has increased despite a growing population.

We achieved this increased production through land expansion or improved yields. As we can see in the next chart, expansion played a very small role: over the last few decades land use for cereal production has increased only marginally. In 2014, we used 16% more land for cereal production than we did in 1961, approximately equivalent to double the area of Germany. Overall, this means we use less land per person than we did fifty years ago.

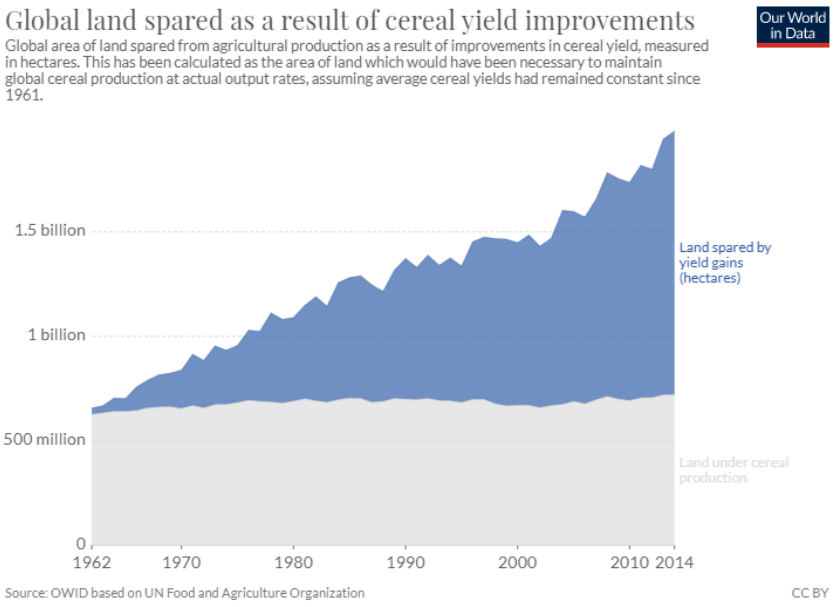


Figure 8 - Global land spared as a result of yield improvement 1961-2014, FAO

Most of our improvements in cereal production have ascended from improvements in yield, the kilos of cereals produced per hectare. The average cereal yield has increased by 175 percent since 1961. Today, the world can produce almost three times as much cereal from a given area of land than it did in 1961 (Alexandratos & Bruinsma, 2012).

Although food is globally traded, the relative distribution of food production is crucial to food security. The evolution of these trends at national and regional levels is therefore critical. Below we have explored a number of varied and interesting examples of these trends across the world. The change in cereal production, population growth, and the relative contribution of yield gains and land expansion are different in each region. International trade of food commodities is then balancing production and demand geographies, contributing to the compensation of the population hunger, making the necessary food supply movements. International logistics, big vessels, are taking care and moving the commodities around the world, as market demands.

The FAOSTAT is a main database for the credible figures of agriculture production in the world countries. FAO (Food and Agriculture Organization of the United Nations) is an international sub-organization inside OUN, based in New York city, responsible for the world wide data collection of agriculture production figures, and is also organizing a powerful data base, with all production, trade, consumption, of the world main agriculture and foods items, available as open information resource for governments, researcher's and professionals of all fields ("FAO | Food and Agriculture Organization of the United Nations," 2019). FAO is also publishing periodical world reports about agriculture and food subjects (FAO Food Outlook, 2015). All countries participating in OUN are engaged to provide FAO statistics (FAO ONU, 2020) with the real figures taken serious and standard criteria, and methods in each country, according to the FAO technicians indications. This immense data base has been fed, progressively accurate, with data from all countries since the early five decades ago, when the FAO organization emerged. Since then, FAO also surveils and informs, with periodical outlook thematic reports, about all relevant particular events in the agriculture and food world, focusing special features on the news with predominantly global impact in food security, episodes like "aquaculture expansion", or "sharp rise in food imports by china", or "African swine fever", or "medium term outlook for bananas".

Trough datamining FAOSTAT (FAO ONU, 2020) we could closely observe the evolution of every food commodities item production, trade and consumption, per country, per year. The research work in first phase was based on several empirical observations and supported by a preliminary FAOSTAT data evaluation work from where this research thesis made its path

to a more dense and serious evaluation. The research aimed to prove the fact that the medium latitude of production of food items is diverting to the South of the globe in the past decades, bringing new challenges for food logistics worldwide. It is common sense for Food commodities professionals that big countries like Brazil or Argentina became in the past decades powerful producers of grains and seeds, fueled by the opening of new agriculture areas, applying modern harvesting technologies mainly in seeds, fertilizers and phytosanitary treatments, also using sophisticated powerful agriculture machinery.

The FAOSTAT data is available up to two years behind the present date. The first phase of the research work, the quantitative analysis, was made in two different phases as we will see later. The first datamining was in 2014, using a few countries, 3 commodities, and discrete 3 years with an interval of one decade. This first phase had data updated to 2011. Later, the datamining was extended to a 4 decades range, considering all world countries, all years, and all tradable quoted commodities on stock exchange. This second phase quantitative research job, which started with the datamining phase in 2017, brought the most recent data of agriculture production up to 2014.

Focused in the past few decades evolution, this research work focuses 40 years, from 1975 to 2014, using agriculture production data from FAOSTAT. The growth of agriculture in the world is transversal to all countries, but proportionally, the southern countries where growing at a high rate, obviously starting from a lower production and technological level, also having the opportunity to operate the conversion to agriculture use of large scale territories. Some of the big southern countries, examples like Brazil, Argentina, Malaysia, New Zealand, South Africa, among others, as we will see later in more detail, entered in the same process of adopting agriculture technology taken after de World Wars, the so called “Green Revolution” later, but much more rapidly. In southern hemisphere, up to the XX century, the domestic agriculture, meaning the family farm, self-sustaining practices encompassed along generations in the rural areas. The civilization and society with farming tradition was not generally spread like in other “old” continents, like Europe of even North America. Therefore this countries mixed together in the same period the opportunity to open new arable land areas, deforesting, correcting and fertilizing soils. At the same time accessing the technology of the “Green Revolution”, machines, fertilizers, phytosanitary chemicals and biotechnology

seeds. In the XX century, the new South American independent countries could watch the world economic growth and development, followed by a population progression in number and income, at the same time having to feed these people. The world prosperity was fostering a new agriculture, global tradeable commodities market to feed the countries that without sufficiency became importers. All this being supported by a modernizing world of trade logistics and ports infrastructures. This phenomenon changed the hunger portrait of the globe, emerging after 1945, rapidly transformed the agriculture landscape of the world, and it keeps changing.

Focusing this research work in the West Europe logistics port system, based on the early industrial revolution scenario of 1900, it is clear that the configuration of the existing and traditional port system for grains and seeds must be questioned and reevaluated towards a global most efficient, environment protective, low carb, low energy, alternative scenarios.

All regions, all countries in the world have to tackled the food security problem as one of the priorities for politics and governments actions, improving the ability to address the shortage of food to sustain their populations, with a reserve for a certain extended period. The reserve is a stock of grains, cereals. Since long time in history, civilizations made its security stocks, preventing not to fall in starvation. Like family patriarchs, the country rulers, kings, presidents or governments, always took actions for the warranty of food security, necessary for their population's survival. Prevailing and protecting agriculture land use for grains production, as necessary for peoples and animal feed, also carrying and protecting grain stocks, developing techniques for silo and warehousing grains conservation. Food is essential for human kind, grains are the basis of human food and animal feed. Easy to transport and stock, grains are the food compound made by Mother Nature to be persevered and assure the species, feeding along the yearly climate cycle. We know we may seed and crop once a year, therefore we can and must preserve to consume along the complete year. From little familiar grains boxes to today modern world trading and logistics of grains storage silos, the aim is food security for world population. Food is a vital element in the daily life for every human, for all living beings.

Food is, as always was, the main basic concern of humanity. Recently, in 2015, ONU started the discussion of the 2030 Agenda (UN, 2015), defining the main themes in the

sustainable development goals road map. This a master plan for peace and prosperity, based in a pact of Nations, taken in a strong resolution of UN defining 17 major sustainable development goals, grouped in five big dimension, 5Ps. All of them are directly, or closely directly related to food sustainability.

"People - We are determined to end poverty and hunger, in all their forms and dimensions, and to ensure that all human beings can fulfil their potential in dignity and equality and in a healthy environment.
Planet - We are determined to protect the planet from degradation, including through sustainable consumption and production, sustainably managing its natural resources and taking urgent action on climate change, so that it can support the needs of the present and future generations.
Prosperity - We are determined to ensure that all human beings can enjoy prosperous and fulfilling lives and that economic, social and technological progress occurs in harmony with nature.
Peace - We are determined to foster peaceful, just and inclusive societies which are free from fear and violence. There can be no sustainable development without peace and no peace without sustainable development.
Partnership - We are determined to mobilize the means required to implement this Agenda through a revitalized Global Partnership for Sustainable Development, based on a spirit of strengthened global solidarity, focused in particular on the needs of the poorest and most vulnerable and with the participation of all countries, all stakeholders and all people."

Cited, (UN, 2015)

UN Assembly has provided a plan for shared prosperity in a sustainable world, a world where all people can live productive, vibrant and peaceful lives on a healthy planet. The year 2030 is just over a decade away, and people must ask themselves if their actions are laying the right foundation to achieve the "Sustainable Development Goals".

The Sustainable Development Goals (UN, 2015) respect the sovereignty of the countries, and at the same time it answer the request of a growing demand by the common engagement of respect and partnership in global solidarity of all and for all. "In these Goals and targets, we are setting out a supremely ambitious and transformational vision. We envisage a world free of poverty, hunger, disease and want, where all life can thrive (...) a world where food is sufficient, safe, affordable and nutritious"; "We are also determined to end hunger and to achieve food security as a matter of priority and to end all forms of

malnutrition. In this regard, we reaffirm the important role and inclusive nature of the Committee on World Food Security" (UN, 2015).

The second Goal of the declaration is very precise dedicated to assure food security in all countries, establishing the objective of the double agricultural productivity and incomes, especially for small-scale food producers, underlining the important role of a more distributed access to land and distribution of the production players. Also the UN is concerned with volatility of the food commodities markets expressing its will to "adopt measures to ensure the proper functioning of food commodity markets and their derivatives and facilitate timely access to market information, including on food reserves, in order to help limit extreme food price volatility".

This agenda recognizes international trade as an engine for development, where every local national development effort need to be supported by an enabling international economic environment, including coherent and mutually supporting world trade, monetary and financial systems, and strengthened and enhanced global economic governance. Where processes are tools to develop and facilitate the availability of appropriate knowledge and technologies globally, as well as capacity building, are also critical. Where the countries express the commitment to pursue a policy coherence and an enabling environment for sustainable development, and to reinvigorate the Global Partnership for Sustainable Development.

Also in Rome, the FAO 2014 conference, with all world countries representatives, came out with an important statement document, the "Rome Declaration on Nutrition" (FAO Second International Conference on Nutrition, 2014), reaffirming the right of all populations to access safe, sufficient, and nutritious food. This declaration also observes that markets and logistics are fundamental elements within this assurance. The declaration acknowledge that the trade is a key element in achieving food security and nutrition and that the trade policies are to be conducive to fostering food security and nutrition for all, through a fair and market-oriented world trade system.

So international trade, when has transparent rules and equitable multilateral trading, is recognized as an engine for inclusive economic growth and a strong tool for poverty reduction in the world. The countries declared of great

importance ensure the trade-related capacity-building for other countries, including least developed countries, for the promotion of regional economic integration and interconnectivity. And port systems are major and important infrastructures concerning food trade between countries.

After the World War II, the world economy was developing and rising figures in all countries, people were getting more income and becoming richer, population was increasing, standards of living get more refined, and largely everywhere health and live expectation was getting higher and longer (Shah, 2015). As we saw before in the text, very strong relations between economic growth and agriculture production increase are observed after the First and Second World Wars and interwar period. The world in peace generates more progress, economy flourishes and population growth is a result, although some spots of poverty and unfair disequilibrium in access to goods and services. Chintan Shah, revising many other authors, performed a data regression analysis using GDP, cropland, agriculture production, commodities trading, for each country, values from 1960 to 2014, and his main findings conclude that crop production, arable land, agriculture machinery usage have positive relationship with GDP for all nations, also despite technological differences in rich and poor nations, agriculture production and economic growth has similar relationship for all nations.

The national policies for rural development are the main tool for food security of a country, governments are in general engaged with agriculture production growth policies and instruments in order to get the objectives in rural development fulfilled. All word countries, both developed or least developed, allocate state budget support to agriculture sector to increase productivity, trade and better usage of land. Large countries and conglomerates like USA, China, EU, as well as small countries, allocate structural funds to agriculture improvement and productivity. Some authors analyzed the relations of country budget expenditures for promoting factors of developing rural activities and its productivity and consequent autonomy in food production levels, and trade capacity after exceeded internal demand. Czyżewski and others (Czyżewski, Kata, & Matuszczak, 2019) confirmed that the significant increase in budget expenditure on agriculture and rural development since 2004 has contributed to positive changes in this area. The allocative effects of budget expenditure

growth contributed to the improvement of the economic effectiveness of production factors in agriculture, including the increase of land productivity and profitability of work.

World global population is reaching 7 billion people, and UN predicts to achieve around 9 billion habitants by 2050 and 12 billion by end of the XXI century (United Nations, Department of Economic and Social Affairs, 2019), so food security is a concern, for sure agriculture productivity has still to be increased to face this challenge. The scale and rapidity of these changes in turn will affect the productivity and stability of agriculture systems in the world's major food producing areas.

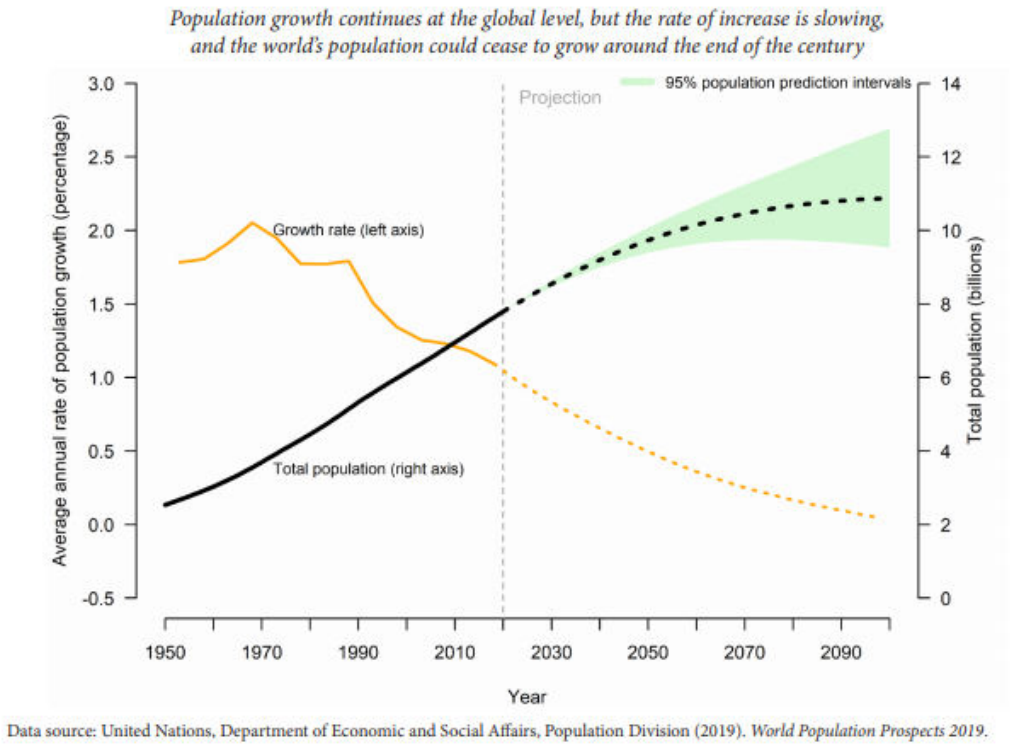


Figure 9 - Population size and growth in world, estimates 1950-2020, UN

As societies react to these pressures on food production, choices between economic and humanistic goals will become more prominent political issues (McQueen, 2000). Especially because the resources are finite and the planet limited, the management of this human carrying capacity of the planet is an issue that worries governments and scholars (Cohen, 1997). Research work is showing the limitations of Earth's capacity to support people, this aptitude is determined both by natural constraints and by human choices concerning economics, environment, culture (including values and politics). and demography. Cohen says

that human carrying capacity is therefore dynamic and uncertain, varying along with human choice that is not captured by ecological notions of carrying capacity, not only food, but also energy, water, space. In 1798, considered by many as the father of demography Thomas Robert Malthus (1766-1834) described a dynamic relation between human population size and human carrying capacity: "The happiness of a country does not depend, absolutely, upon its poverty or its riches, upon its youth or its age, upon its being thinly or fully inhabited, but upon the rapidity with which it is increasing, upon the degree in which the yearly increase of food approaches to the yearly increase of an unrestricted population." Thus, Malthus was convinced that the happiness of the population is depending of its nutrition contentment. Not only agriculture, but the debate on the physical limits and constraints to the economic growth of globalized society, that is today widespread (Burlando & Tartaglia, 2017), exploring the physical and economic aspects of the conflict between humans, with their thoughtless focus on growth through material production, and environmental constraints. Burlando explores many considerations around the finitude of the resources of the planet, talking about issues like climate change, resources depletion, technical innovation and the interactions between these, within the socio-economic-institutional systems we live in.

Without food, people cannot survive, so it is essentially that countries can manage food production systems on a sustainable and continuous basis. This is one of the most critical challenges for the future of humanity. Food, based in agriculture and livestock, is fundamentally dependent on the planet factors like atmosphere, clime, soils, fresh water, and bio resources (Naylor, 2009). Both agriculture and animal production are also the largest global consumers of land and water, the greatest threats to biodiversity through habitat change and invasive species, significant sources of air and water pollution in many locations, and major determinants of biogeochemical change from local to global scales (Matson, Parton, Power, & Swift, 1997). The inherent interplay between human welfare, food production, and the state of the world's natural resources underscores the need to manage these systems for resilience, to anticipate change, and shape it in ways that lead to the long-run health of human populations, ecosystems, and environmental quality (Meyer & Turner, 1992).

The study of the correlation between the evolution of agricultural productivity and economic and population growth at the global level was made by Lanz, Swanson and Dietz, using a two-sector Schumpeterian model of growth. Agriculture demands land as an input, as previous mentioned, a scarce resource. In their model both population and sectoral technological progress are endogenously determined, and key technological parameters of the model are structurally estimated using 1960-2010 data on world GDP, population, cropland and technological progress. They showed that more land has to be converted into agricultural use, as a hedge against production shortages (Lanz, Dietz, & Swanson, 2018).

From long time, ecological concerns of population growth demanding more food, and at the same time, sustainability apprehensions demanding the minimization of deforested area in favor of agriculture soils impose that cereal yields should be efficient, maximized. This means the volume of production per unit of arable area will approach the yield potential ceiling in many of the world's most productive cropping systems within the next three decades. Ecological intensification of these high-production cropping systems is fundamental to achieve food security under this scenario and raises several questions. It is argued that the present state of knowledge is far from sufficient to answer to these opposed objectives, despite the need for answers and widespread application of this knowledge within a relatively short timeline. It is concluded that global food security 30 years hence will depend on rapid scientific advances in understanding the physiological basis of crop yield potential, the processes governing the relationship between soil quality and crop productivity, and plant ecology related to the many interacting environmental factors that determine crop yields (Cassman, 1999).

It is a reversible question, the increase of population leads to an agriculture demand push, and also poses huge challenges for the sustainability both of food production and of terrestrial and aquatic ecosystems, and the services they provide to society. During the past five decades the food demand doubled on the planet, intensive food production systems have contributed substantially to anthropogenic emissions of greenhouse gases, contributing to the global warming of the planet, also pollution in the form of nitrates and other oxide elements, notably a large variety of pesticides (Tilman, Cassman, Matson, Naylor, & Polasky, 2002). The three largest crops being maize, rice, and wheat, which provide 45% of the calories

consumed by the human population, they are grown on almost half of the total arable cultivated land and account for over half of the synthetic nitrogen fertilizer applied to agriculture worldwide. Avoiding expansion of cultivation into natural ecosystems, increased nitrogen use efficiency, and improved soil quality are pivotal components of a sustainable agriculture that meets human needs and protects natural resources. Achieving this outcome depends on raising the yield potential and closing existing yield gaps of the major cereal crops to avoid yield stagnation in some of the world's most productive systems (Cassman, Dobermann, Walters, & Yang, 2003). On a global basis, agricultural lands extend over 5 billion ha (34%) of the earth's terrestrial surface. To meet the world need for future food security and sustainability, food production must grow substantially while, at the same time, ecology demands agriculture's environmental footprint to shrink. Tremendous progress can be made by halting agricultural expansion, closing the yield gaps on underperforming lands, increasing cropping efficiency, shifting diets and reducing waste. Together, these strategies could double food production while greatly reducing the environmental impacts of agriculture (Foley et al., 2011), due to the increasing rate of population growth, land functional shift, degradation of land resources and water, as well as environmental pollution and climate change.

In nowadays, food production has not been able to meet the needs of the population continuously. Therefore, the food policy paradigm must change (Ansar & Fathurrahman, 2018). The tremendous increase of agriculture production after World War II, supporting the population rising demand and supported by the technological capabilities introduced in the farming operations, all this scenario created the proper condition for the rise of new big agriculture companies, controlling and trading the food commodities between the world zones, meeting production were soil and climate is more favorable, and the consumer demand were rich population demand the food for a high living standard. Mercantile movements around the world developed ship industry, and trading as in fact a long historical activity record in civilizations (Giraldez, 2001). Giraldez resumed how world trade was an essential process of the last five hundred years of history. These were the centuries in which all populated continents began to interact in a continuous and incremental way. Plants, animals, germs, people, commodities, and ideas were exchanged among continents transforming the life and landscapes of world population.

This was also the time when the big trading houses of the world emerged and created a new awareness of the governments of the world on their power towards food security and sustainability of global peace in the planet, constituting today a powerful player of the world economy, but also a frightening menace for security and hunger. A few great companies control food commodities in the all world. The big majors on food commodities, ADM, Bunge, Cargill and LDC , nowadays the word's big four food merchants, control 80% of global food trading market, food becoming a kind of important strategic resource (Li, Zhu, & Zhu, 2011).

From Asia continent, the important new market region, fresh emerging trading companies are entering today in this chess of the food commodities, in a world of grain trading that is like a gerontocracy (Economist, 2019). The four giant firms that dominate global agricultural flows—ADM Toepfer, Bunge, Cargill and Louis Dreyfus, collectively known as the ABCD—were all founded over a century ago, dominating the food trade globally. Their experience, infrastructures, experience and trading relations is an edge, these companies own their unique networks of infrastructures and storage silos, port terminals, vessels and especially the farmer relationships, built along over many decades and generations, what makes these companies indispensable middlemen in the trading process. But a toddler, a new comer from China, is threatening to put a pitchfork in the works. It is about COFCO International, state owned trading arm of food commodities and vegetable oil Chinese player, that wants to become a global agribusiness, with a strategic vision not only focused in trading. Other new traders from Asia zone, like Noble, Olam, Wilmar and others, are popping up. China needs to feed 1.4 billion people and does not have enough arable land for a sufficient national agriculture production for all these people, as also, requirements are upgrading in the population nutrition, differing from the traditional Chinese solid cereals base diet, especially on the protein content desires. As a rising middle class consumes more meat, that gap worsens, the animal feed is mostly made of grain. The Chinese government has been promoting and taking part on large operations to buy farmland in countries abroad. Chinese agribusiness firms have been stimulated with subventions to do so, today they cover more than 30 countries, an example being the Chinese investors are the largest foreign owner stake of agricultural land in Australia.

The concentrated power of a few corporations in global agro-food value chains and their ability to influence the agro-food market dynamics and networks throughout the world impose asymmetric conditions for reaching not only global food security, but also water security. Sojano and Larson analyze the different forms of power exercised by the corporations, and the extent to which their value chain position and stakeholder interaction reflect or drive their actions. Due to their vast infrastructural and technological capacity and major role in the global agro-food political economy, food and agribusiness corporations cannot avoid increasingly engaging, for endogenous and exogenous reasons, in multi-stakeholder initiatives and partnerships to devise methods of managing the agro-food value chains and markets, and to promote global water security. However, their asymmetric position in relation to their stakeholders demands continuous scrutiny (Sojamo & Larson, 2012). These companies are also focused on technologies to automate grain and oilseed post-trade execution processes, upgrading their value supply chains even more, standardizing and making more automated the world trade of commodities, as they represent a highly manual and costly part of the supply chain, with the industry spending significant amounts of money every year moving documents around the globe. The elimination of the inefficiencies would lead to shorter document-processing times, reduced wait times and better end-to-end contracting visibility. “We are pleased to join the effort to foster modernization and standardization of data and documents in the global agribusiness value chain.” said Juan Luciano, ADM’s chairman, and “By working together to design and implement a digital transformation, we will bring hundreds of years of collective knowledge and experience to simplify processes and reduce errors for the benefit of the entire industry.” (Holly Demaree-Saddler, 2018).

Ian McIntosh, LDC’s CEO, said, “In January this year (2018), LDC completed the first agricultural commodity transaction through blockchain, which showed the technology’s capacity to generate efficiencies and reduce the time usually spent on manual document and data processing. By working with the industry to adopt standardized data and processes, we can truly harness the full potential of emerging technologies to improve global trade.” So we may expect that systems automation, technology integration, although facilitating operations

and making food more affordable to populations, will bring even more power to the actual actors, blocking the entry of new players in the world commodities trading market.

2.2 The evolution of agriculture in the southern hemisphere

As the global population growth started after the Second World War, agriculture together with industrialization have grown in all parts of the globe out of the need to support population growth and its demand for food. Consolidated agriculture countries with long history in industrial agriculture also grew, but the new developing countries especially in the southern hemisphere grew much more. We take two representative countries as examples to illustrate, considering the most expressive production grain in its respective territory and compare the growing rate in the same recent period.

We pick data from FAOSTAT for these two well-known countries and commodities comparison: in 1975, the production of wheat in France was 15 million tons, 40 years after, in 2014, was 39 million tons, representing a grow a bit more than doubling the production ; for the same period, if we consider the Brazilian agriculture production, the most significate grain is the soybean, having in 1975 a production of 9 million tons, the same period after in 2014 the production value is of 87 million tons, which means a growth rate of almost 10 times more. We can observe that a traditional agriculture industrialized country had an important growth in this 40 years period, but a southern country had 4 or 5 times more growth that the northern countries for the same period (FAO ONU, 2020).

Internal agriculture production is the first pillar of the food security politics of each country in the world, and based on that all developing countries and strong economies of the southern hemisphere have implemented in the recent years politics towards the development of their own agriculture production commodities. It is general consensus that Asian and western countries, in the northern hemisphere, are ancient civilizations, with long historical civilization roots, where agriculture historic line is counting many century's or even thousands of years of experience allowing a strong, established and capable agriculture development, long time facing the challenges of food security and sustainability of its populations along time. This situation contrasts with recent born countries in south

hemisphere, with only some decades or last century experience in agriculture serious production as an economic activity.

Revenue levels as well as urbanization increase worldwide, régimes are changing from food staples (a food that is eaten routinely and in such quantities that it constitutes a dominant portion of a standard diet) to other diversified foodstuffs, counting in with meat and further high-value cultivated and agriculture products. This tendency is predictable to continue to increase demand for feed grains, oil seeds and protein feed compounds, above all from soybeans, the higher protein used feed commodity, for animal meat production for food. The swift expansion of poultry production and consumption in developing countries is a major driver behind the growing demand for feed and protein meals.

Soybean exports are today driven by feed compounds for meat production around the world, the volumes depend on the demand and policies of importers, today very strict and driven by international big trading companies of food commodities. Actually, the United States and Brazil account for over 80 percent of global soybean exports, although also China is a big producer, it accounts for internal consume and still imports high volumes. Much of this trade is influenced by the policies of importers, including China, many Asian countries, and the EU. Brazil is today the world's largest soybean exporter, and is projected to increase shipments between 2016/17 and 2025/26 by 35 percent to 76.4 million tons. Soybean exports from the next largest exporter, the United States, are expected to grow 6 percent to reach 52.4 million tons in the same time period (Lee, 2016).

The EU is currently the world's largest soybean meal importer because its limited domestic soybean production levels cannot supply its large domestic livestock and feed industry, the production of feed compounds for meat production, which volumes increased significantly in the last decades. While rapeseed is the major oilseed produced in the EU, livestock nutritional considerations limit rapeseed meal use in feed rations, leading to the EU's demand for soybean meal imports. Soybean meal remains the most efficient and cost-effective protein for feed rations in poultry and swine production feed, the two major origins of protein meet in the European countries. EU production of rapeseed oil biodiesel increased after individual member states began producing biofuels in the 1990's and the EU's Biofuels Directive took effect in 2003. The Directive established voluntary targets for biofuels to

account for a growing share of the EU's transportation fuels. Although EU soybean meal imports are projected to remain high over the next decade, imports decrease slightly from 20.2 million tons in 2016/17 to 19.4 million tons in 2025/26, as the region's livestock production shrinks (Bureau & Swinnen, 2018).

Domestic European soybean meal production from EU soybean imports has declined as processing margins decreased from low demand for soybean oil. Crushing activity in the soybean complex is driven by the meal for the feed compounds, representing around 80 per cent of the total weight after oil extraction, less than 18 per cent. Edible soybean oil consumption in the EU has been discouraged by food-labeling requirements, which require packaged foods to specify whether ingredients were produced from genetically modified (GM) crops, which is in general the case of the soybeans origin. The EU's biotechnology policies and slow approval process for the use of GM soy products delay USA soybean and soybean meal exports entry on the market.

It is well know that developing economies are southern globe countries. In 2014 crop, Brazil for the first time overpassed USA in soybean's agriculture productions. In 2018, the corn crop in Brazil also exceed USA production (OECD-FAO, 2019).

Being South America countries, like Argentina or Brazil, recent players in soybeans farming, these regions rapidly immersed the techniques and inputs provided by the developed agriculture technology providers, namely USA and Canada growers. Many farmers from the North America region went to South America in the early 80´s looking for cheap and extensive land to produce soybeans, in vast areas used in extensive agriculture production. With large broad land farms, initially quite inexpensive although in natural state still, needing to be deforested and treated for farming, and with favorable weather and climate, Brazil could rapidly reach the world leadership in vegetable protein production, also developing the agribusiness flow, logistics, meals, compounds and meat production (Telles, De Fátima Guimarães, & Roessing, 2009). Telles, cited before, explains why the soybean is the main crop of the Brazilian agricultural sector, both for the area it occupies as by the impact on the gross domestic product of the country. The comparative technological advantages in the production of this commodity place now Brazil as the first largest producer and supplier of the world.

Together with Brazil and Argentina, many other southern countries and regions in the globe also developed their food commodities production in the recent decades, like Australia, South-Africa, Ecuador, Indonesia, Tanzania, Paraguay, Congo Madagascar, among others. Even considering the traditional northern big food producers countries grow, or just keeping their high production levels, these new entries in the global food production made the general weighted food origin to come down in latitude towards south of the globe (European Comission Agriculture and Rural Development, 2011).

Sediyama, relying on the Industrial Economics theory, made a profound study focused in studying the soybean processing industry structure, also the corporate conduct of the companies and their performance in the Brazilian agriculture industry. This agriculture development of the beans in south America continent was the key generator of a downstream industry, that rapidly made a relevant market of soybean processing companies. It was analyzed the concentration index of soybean processors with sales and strategies determinants of the plants location of major companies that process soybean (Bunge, Cargill, ADM and Louis Dreyfus), analyzing changes from 1990 to 2010 (Sediyama, Castro Júnior, Calegario, & Siqueira, 2013).

The LAC, Latin America and Caribbean countries region, accounts for more than 2 billion ha and englobes 34 countries with an accounted total population in 2018 of 660 million people. With very low value average population density of persons per hectare of 0,35 p/ha. From all countries total area, 38% of the available land is used for agriculture, being 9.5% destined for crops and around 28.5% for animal pasture, and still other 46% of the area is accounted with forests, virgin territories. This LAC region represents 15% of the land of earth's total surface, receives 30% of total rain precipitation and generates 33% of the world's fresh water. These findings make the LAC region one of the greatest reserves of agriculture land and forests in the world. The latitudinal range variation is enormous between the different LAC countries, also the mountains, plateaus, lakes and valleys, with many varied topography and rich biodiversity, LAC region having probably one of the most varied and also most complex collection of farming systems of any other area in the globe. In terms of trade activities, the LAC countries grouped and became a major supplier of grains and seeds to the world commodities market, as well as coffee, sugar, bananas, but large differences can be

observed between the different countries and sub-regions. One example, the countries of the "south cone" of the continent, meaning Argentina and Brazil, are today among the world leaders and biggest exporters of cereals like wheat, maize, also oilseeds like soybeans, whereas the other northern Caribbean countries fulfil their food requirements from world international commodities markets, even if buying in the region neighbor countries (OECD-FAO, 2019) .

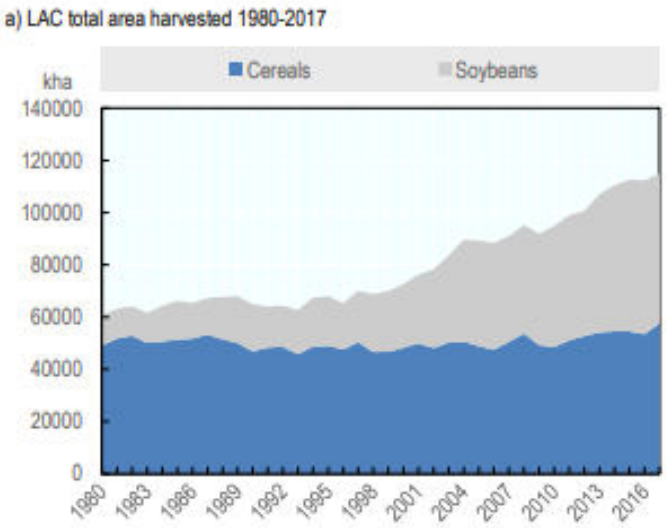


Figure 10 - Area harvested includes double cropping in LAC, OECD-FAO

All this agriculture development in South America, although triggered by the soybean rush for meat production, leads others tradable agriculture commodities also to developed. American GM corn (maize) is today also a main commodities produced in this continent, but Brazil rapidly took the leadership in maize production in 2019, overpassing USA.

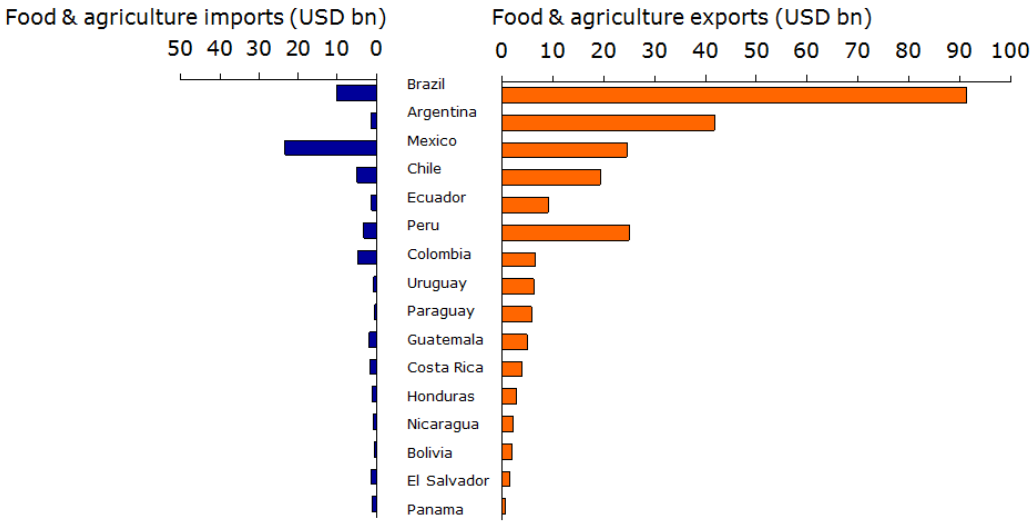


Figure 11 - LAC agricultural imports and exports (USD bn, average 2012 – 2014)

(Source: UN Comtrade, FAO, Rabobank)

No doubt, Brazil and Argentina became in the last 4 decades big agriculture producers, feeding the world demand, distinguished realities from any other country in the South America continent. Both these countries make the LAC region an important net exporter of food and agricultural commodities, accounting for 16% of total global food and agriculture exports, “Latin America is therefore important for the global food and agriculture sector. Furthermore, it is equally true that food and agriculture is important for Latin America”(Allard Bruinshoofd, Selma Heijnekamp, 2015) .

The LAC region is one of the few parts of the world with significant resources of unexploited agricultural land (concentrated in Brazil and Argentina), suggesting that the region will continue to play a pivotal role in global food production and exports in the future. Many of the region´s countries have achieved respectable rates of agricultural productivity growth in the recent past. Nevertheless, raising productivity will be essential to meet domestic food needs or to maintain and enhance export competitiveness.
It will be equally important to the region to sustainably increase the agricultural productivity and the production of smallholdings, and also to boost the output of export powerhouses such as Brazil and Argentina.

We are focusing further analysis in the West Atlantic coast of Europe, but other countries in the South made significate progresses in agriculture production. Nevertheless, in

the south hemisphere countries like South Africa, organic fertilizers (manure, calcium, shells, urea, bones, lime) have been traditionally used to improve the chemistry of the agriculture land. Many synthetic fertilizers were developed and emerged on the market in the 18th century, and the industry multiplied production units for those chemicals after the World Wars, when industrial facilities employed to industrial production of ammonia and nitrates used in war bombs explosives were reconverted to produce fertilizers like nitrogen. In South Africa, the development of the fertilizer industry came up also with mining industry, a very important activity driver in South African economy, which also needed the internal production of explosives for mining use in South Africa. When correctly applied, the fertilizers use has a positive effect in the soil fertility and vegetable growth, beign one of the main drivers of the Green Revolution of last century. By increasing the production potential of land, fertilizers also protect the natural environment from agricultural expansion (Goldblatt, 2010).

2.3 Soybeans became the source of protein for meat production

Soya, or soybeans as they referred to in international trading, is one of the most expressive sources of vegetable protein known in the present, used for feed compounds in meat production. With Asian origin, China and Japan, today spread all around the globe, the name “soya” having its origin in the Japanese term “shoyu”. The bean is one of highest protein seeds and the plant has a higher yield per hectare in farming production of vegetable protein. These two factors explain why Soya became a major source of protein, having high content of protein per grain, and having a good yield in agriculture production, which means more tons per hectare.

All oilseeds in general (soya, rapeseed, sunflower, others) are source of vegetable protein, being used for the production of feed compounds for meat production industry, but their structure is different and their vegetable protein part could fluctuate depending on species between around 15 to 40 per cent protein content. However, being a very good source of vegetable protein, the soya plant in its natural varieties is very sensible to production, causing many losses to farming operations. Historically, along time many losses are observed, due to the climate, plagues infections, and inefficiency of pesticides and other

phytosanitary treatments because of the sensitiveness of the plant. The harvest of natural soya plant is many times compromised, many factors can disrupt the desired production yields of a farming entrepreneur.

Nonetheless, on the middle of last century, the “Green Revolution” brought everywhere the post-war technology, introducing biotechnology in farming feeds, reaching a collection of transgenic varieties of soya, resorting to genetic manipulation of the plant. This way, the industry reach new varieties of the plant more resistant to treatments, at the same time more productive, leading the two exceptional factors of soya, high protein content and high yields of production per hectare, due to which it was chosen by meat producers and farmers to provide vegetable protein in animal and fish feed compounds.

Today, the biggest and increasing fraction of crop production of oil seeds is not used for direct human consumption, and is diverted towards feeding livestock to produce animal protein. This was also the driver for the surge in production of and trade with oil crops, the net-export of soybean meal reaching 80 million Metric tons in 2020, while doubling the figures of year 2000 around 40 million Metric tons (ODonoghue, 2018). Oil cakes are also used as animal food, vegetable oils, especially from soybeans,being channeled into human consumption, fueling the “oilification” of western diets.

Soybeans, due to its protein content and easy to assimilate vegetable structure, rapidly became the source of protein for animal breeding. The bean became the leader “oilseed”, supplying the protein for animal feed in order to produce meat, all around the world. With less kilos of feed, we can provide more protein content producing more kilos of meat rapidly.

As we observed before, meat demand on the population diets is simultaneous with abundance and richness of populations. In the past decades we noticed high increase in meat consumption, and in many zones of the globe this increase is still being expected to grow, although regions like Europe tend to stabilized. As fig below shows, the world meat production almost tripled, with an increase like 170 per cent in the past 40 years, from 127 million tons of meat in 1978, to 341 million tons in 2018. As we remarked before, the progressive welfare of this population lead to changing nutrition habits and a significate

increase in protein consumption from meat. North America, Europe and especially Asia and South America are the regions that represent the most in this increase.

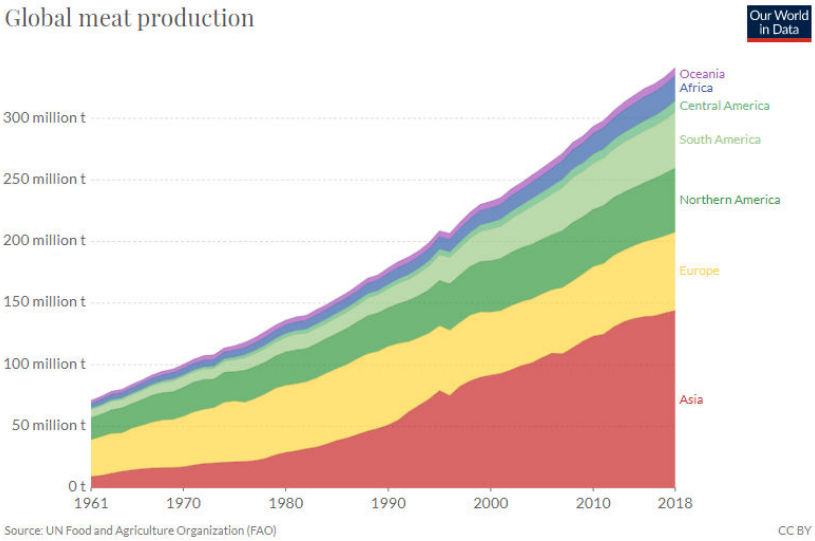


Figure 12 - Meat production by region 1960-2018, FAO UN

This increase in meat production, steered by consumption demand, is far more important than the increase of population in the world. For the same last 40 years considered, the world population increased around 77 per cent, from 4.3 billion people in 1978 to a population of 7.6 billion people in 2018.

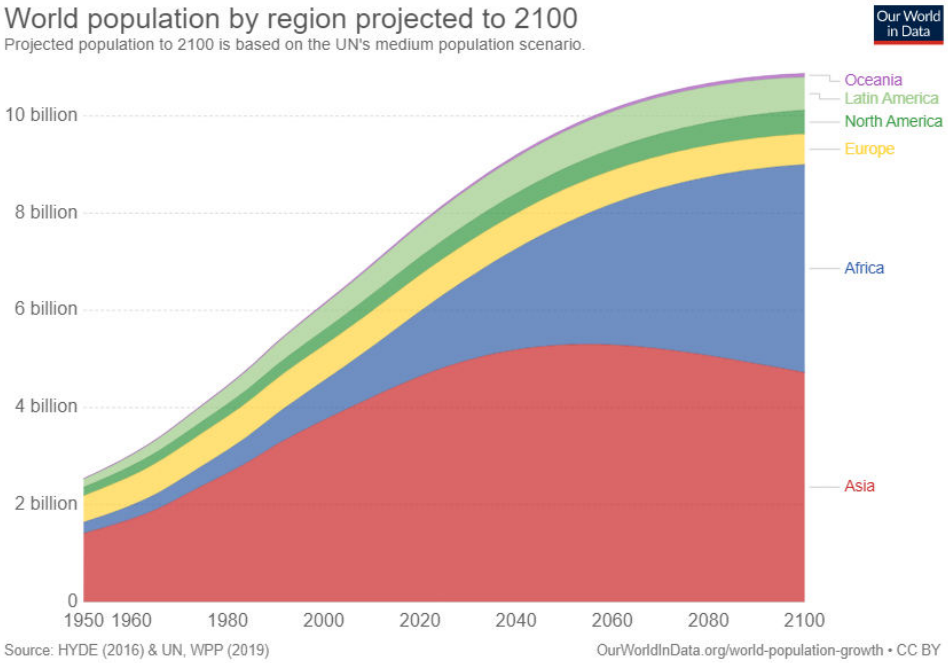


Figure 13 - World population by region, UN

This means, although the fairness of this consumption rise when divided in regional distribution and especially if we analyze per country is not equal, in global terms the world population is consuming much more meat in this past 40 years in a per capita equation.

These two factors, more meat consumption and soya becoming the source of vegetable protein in feed compounds for animal breeding, in a generalized way in food industry around the world, made an enormous increase of soybeans demand. And agriculture production respond, as we can observe in figures (Lee, 2016). Big farming companies, taking the best knowledge and technology in agriculture production, rapidly extended large portions of land for soybeans production, supplying the feed industry for livestock production, responding to meat consumption demand.

Earlier we saw that the soybean plant is very sensitive to plagues and its treatments, the reason why transgenic OGM varieties made quick evolution from the agribusiness labs of the big players in the seeds business. Europe and many other countries in the world maintain restrictions to the use of OGM varieties in farming operations. This is why the massive areas and adequacy of soils and climate of South America have remained essential stages for the soybeans agriculture farming companies.

The meat breading animal conversion rate, meaning the use of vegetable protein to obtain the same animal protein, is not the same for all animal species. Farmed raise aquaculture fish, chicken broilers and pig meat are leading this efficiency ratio (National Geographic, 2020) .

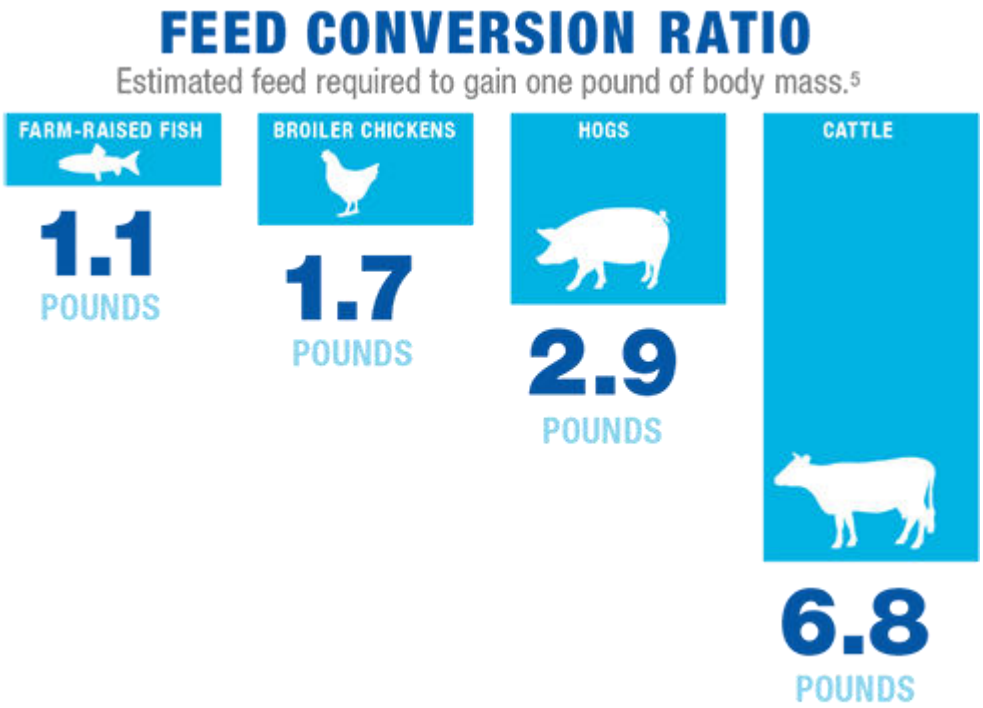


Figure 14 - Feed conversion ratio, National Geographic, foodfeatures

Developing countries are expected to lead the increase in livestock production, boosting the demand for vegetable protein to feed this meat production. The tendency shown by figures for soybean products for feed use, especially for poultry, is due to its efficient conversion rate. Poultry meat, the world popular chicken broilers in particular, are raised with a low conversion rate, 1.7 kg of feed to produce 1 kg of chicken meat.

The current technology for the production of chicken broilers is the result of the integration of genetic improvement, nutrition, health and management. The formulation of balanced and economical rations, which meet the nutritional requirements of the broiler in different stages of the breading process of the bird, is fundamental for the success of production conversation ratio performance.

Soybean meal and maize are today the staple foods of diets in all stages of creation. Research has shown that the addition of amylase to diets based on corn and soybean meal improves the digestibility of diets and the performance of bird meat breading. Enzymes produced with the help of biotechnology methods have good potential for use in poultry diets to improve the digestion, hydrolyzing feed components and promoting improvements in the efficiency of nutrient use (Carvalho, Bertechini, Fassani, Rodrigues, & Pereira, 2009).

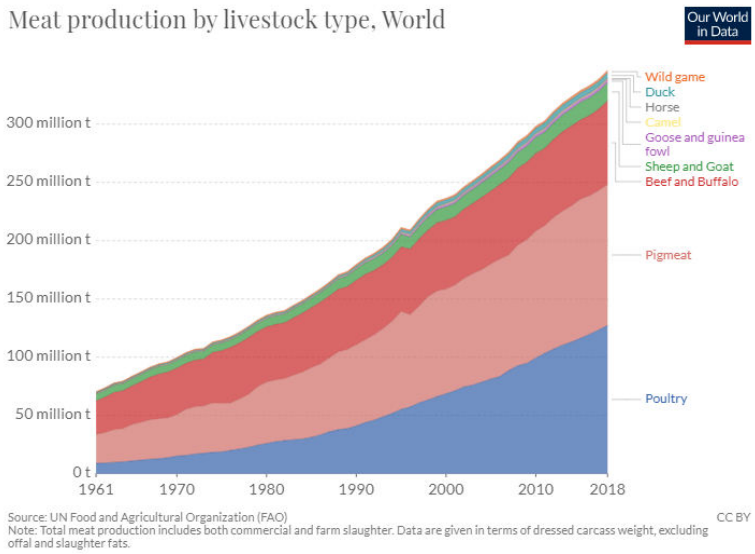


Figure 15 - Meat production evolution by type, FAO

The world soybean sown area had reached 83 Million ha in 2010, from 52 Million ha in 2005, a 60 per cent increase; but in South America, the change went from 18 to 43 Million ha during those same years, an increase of 140 per cent in agriculture area. In 2012, Argentina, Bolivia, Brazil, Paraguay and Uruguay harvested 50 Million ha with soybean (McFarlane & O'Connor, 2014). South America became the preferential world region for soya development production, due to its climate, soil, rapidly open large harvesting areas, and at the same time GMO allowed territories.

Needing to meet production and high consumption demand in Europe and Asia, strong trade and logistics made the way to solve this call from the market. Soybean soared production, and its trade overpassed rapidly all the other coarse grains used in feeding, even wheat.

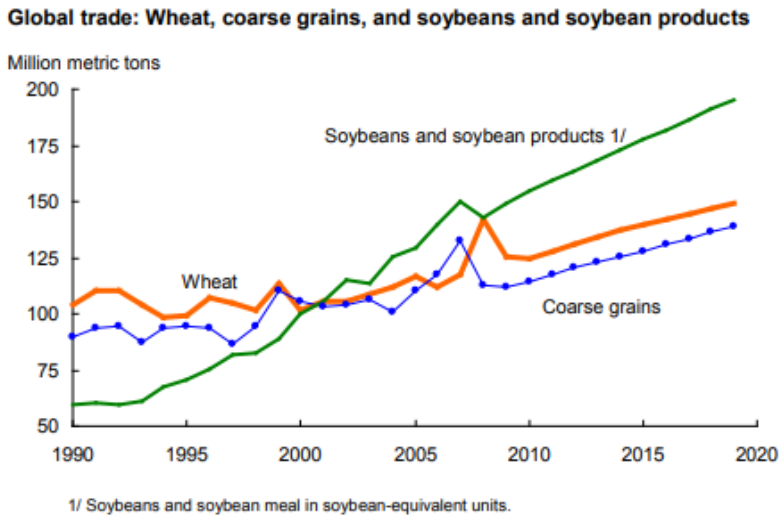


Figure 16 - Soybeans global trade, FAO UN

Note that soybean, 40 years ago, was not the basis of animal feed. Maize, wheat, sorgo and other cereals were constituting the basis of feed compounds. Rapidly, after the 90's, soybeans, once it became GMO, took the leadership in the feed compound for meat.

Although soya is recognized as a very reach grain in vegetable protein content, it could also be used as human direct food stuff, as a result of a trend in many vegan vegetarian regimes, but production for human consumption is very far from the livestock production demand.

As example from USDA analysis use of soybeans for food and feed applications, we can observe that only 2 per cent of the soya is predestined directly to human consumption food products.

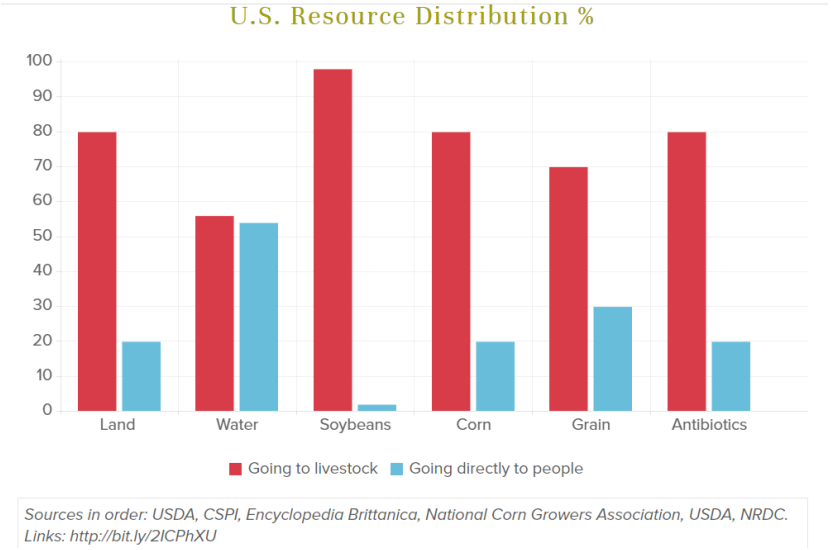


Figure 17 - USA split of farm resource usage, USDA

Due to leading technology applied innovations, particularly the adoption in agriculture land preparation of zero tillage, accompanying with the outline of GMO varieties of soybeans highly herbicide-tolerant since the 90's, also the use of inoculants and precision agriculture using sophisticated machinery and satellite data to adjust seeding process and fertilizer dosage to land. The use of this new technologies and the opportunity of land availability had as a consequence an unprecedented enlargement of new farming land areas for grain, and especially the soybean, harvesting in South America countries. International trade of soybeans has been growing since the beginning of the 2000's. The market share of the South American conglomerate countries in the soya production took the lead in the world, both in production and trade exports, as per DAO UN data revealed. In 20 years, from 1995 to 2015, soya production grew in world, South America countries were almost doubling the increase in this period.

				Var%	Market share
	1994/1995	2007/2008	2012/2013	2013/2008	2013, %
Argentina	12,133,000	46,238,087	49,300,000	6.6	19.0
Bolivia	870,074	1,259,676	1,675,369	33.0	0.6
Brazil	25,682,636	59,242,480	82,000,000	38.4	31.7
Paraguay	2,212,109	6,311,794	8,300,000	31.5	3.2
Uruguay	15,500	880,000	968,000	10.0	0.4
South America	**40,913,319**	**113,932,037**	**142,243,369**	24.8	54.9
United States	59,174,000	80,748,700	82,560,000	2.2	31.9
China	13,510,894	15,545,141	12,600,000	−18.9	4.9
India	-	9,100,000	11,500,000	26.4	4.4
Other countries	-	8,500,000	10,000,000	17.6	3.9
Total	**113,598,213**	**227,825,878**	**258,903,369**	**13.6**	**100.0**

Sources: FAOSTAT, USDA.

Table 1 - Soybeans production tons, main countries 1995-2015, FAO

The increase in meat consumption in the past decades generated a correspondent demand on the soybean, and especially the "soybean meal", the farina taken after oil extraction of the bean. This farina has a highly protein content, typically from 42 to 48 per cent, depending of varieties. Argentina is today the leader export trader for soybean meal in the world. This meal is the basis on many feed compounds of European and Asian meat producers.

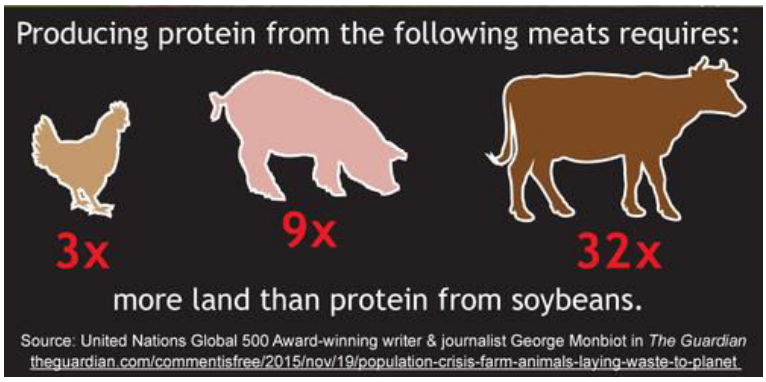
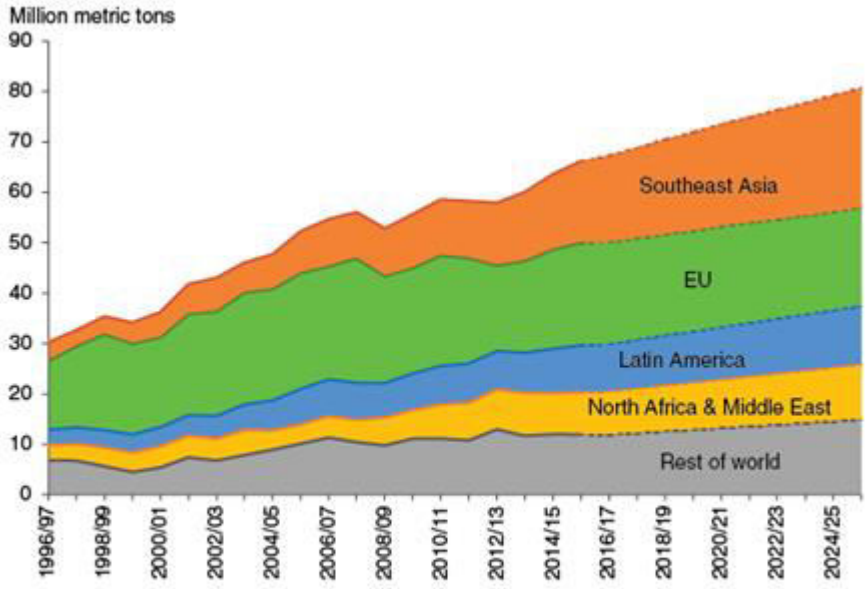


Figure 18 - Soybean land ration for the same protein

"Global soybean and products trade is projected to rise rapidly over the next 10 years according to USDA Agricultural Projections to 2025."(ODonoghue, 2018)

According to USDA and EU projections, soybean meal, the farina of soya used to convert in meat livestock, will continue to be traded in the vast majority of the world regions. Trade between world regions implies large vessels and port operations.



Note: Dashed lines represent the projection period. EU = European Union.
Source: USDA, Economic Research Service using data from USDA Agricultural Projections to 2025, February 2016.

Figure 19 - Soya meal world imports, USDA

Looking in detail to EU figures, we can observe that the European countries are in a historical path to depend on external agriculture production to sustain their consumption needs. This can be explained in many ways: the countries have different politics in agriculture promotion, their geography, orography and economical tradition dictating a different use of the land for agriculture.

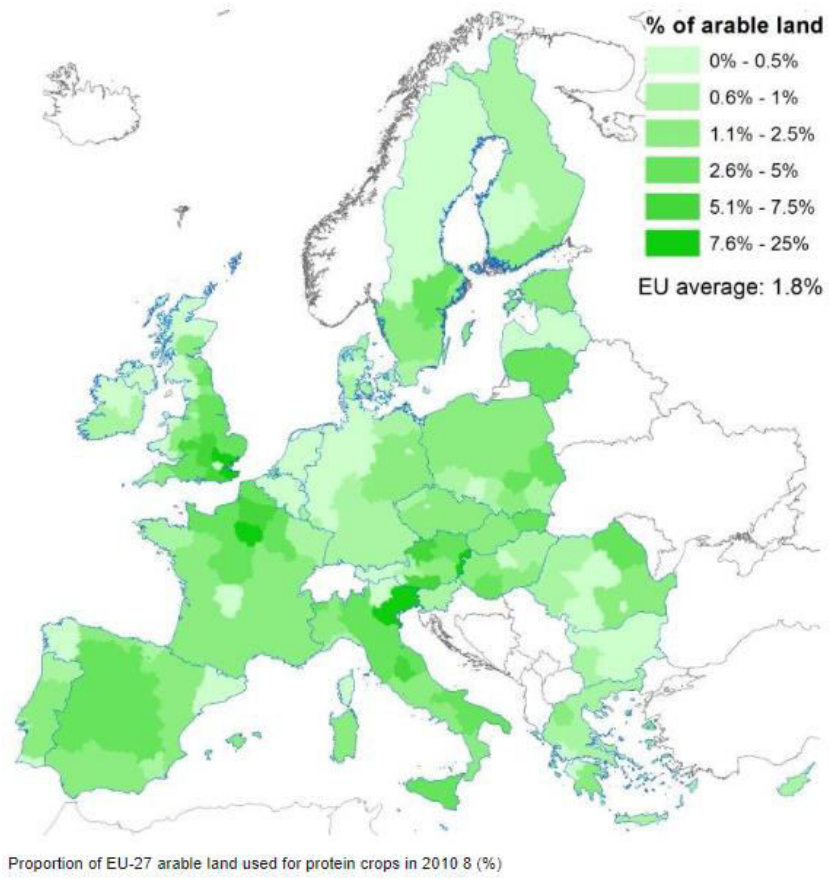
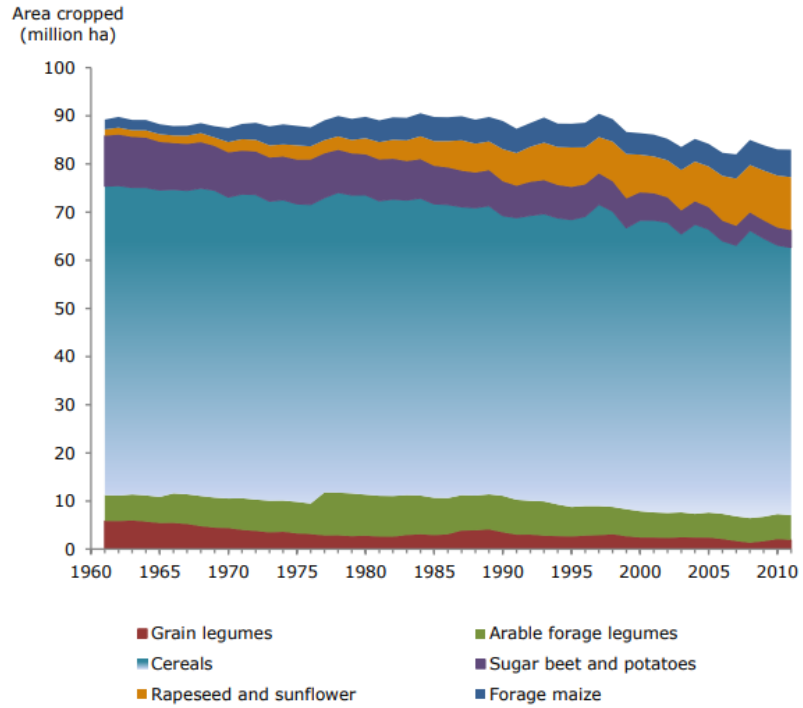


Figure 20 - EU-27 Arable land in 2010, Eurostat

At the same time, the arable land is being reduced in many countries due to the civilization urbanism pressure to conquer space from farming, despite all politics and territorial plan to preserve and sustain agriculture land.



Source: FAOstat (2013). Pre-1992 data do not include data on crops grown in the Czech Republic, Estonia, Latvia, Lithuania, Slovakia, and Slovenia.

Figure 21- Change in areas of production of key arable crops EU-27, Eurostat

Particularly when we look at the soybean production in Eur-27, since the early 1960s when the change of PAC common European Union Agriculture policy took place, continuing with successive changes in liberalizing or conservative directives and policies targeting soya crops, changing tendencies, instability of farmers and traders, pro and against GMO crops movements, we can observe the rapid decline of the soya harvest areas and the consequent dependency of imports for meat production in EU.

Soybeans and its derivative farina from oil extraction have a highly protein content, when compared with any other of its replaceable oilseeds, as the figure bellow shoes, soya taking the leading position in protein content:

Composition, yields, oil and protein yields for main crops/yields in T/ha						World (FAO)			Europe (FAO)		
Crop	%		% on product for use			Average yield 2009–2013	Aver oil yield	Aver protein yield	Average yield 2009–2013	Aver oil yield	Aver protein yield
	DM	starch	oil	protein	others	t/ha					
soya	89%	5,7%	18,9%	35,2%	29%	2,5	0,5	0,9	2,65	0,50	0,93
sunflower	93%	1,2%	44,5%	15,4%	32%	1,2	0,5	0,2	2,33	1,04	0,36
rape	92%	3,1%	42,6%	19,3%	27%	1,9	0,8	0,4	3,56	1,51	0,69
lupin	89%	0,0%	8,9%	33,8%	47%	1,3	0,1	0,4	1,63	0,15	0,55
pea	87%	44,4%	1,0%	20,7%	22%	1,6		0,3	3,82		0,79
fababean	87%	38,7%	1,2%	25,1%	22%	0,8		0,2	3,92		0,98
lentils	88%	40,4%	1,4%	23,8%	23%	1,1		0,3	1,59		0,38
maize	87%	63,7%	3,6%	7,9%	12%	5,2	0,2	0,4	9,36	0,33	0,74
wheat	86%	59,3%	0,0%	10,8%	15%	3,1		0,3	7,15		0,77
Forage and Silage alfalfa	20%	0,0%	0,0%	4,0%	16%	22,0		0,9	42,50		1,70
Forage and silage, maize	23%	3,5%	0,6%	1,9%	17%	34,6	0,2	0,7	39,60	0,24	0,75
Forage and silage, sorghum	28%	0,0%	0,5%	2,3%	25%	20,4	0,1	0,5	35,20	0,19	0,81
Forage and silage, rye grass	17%	0,0%	0,0%	2,5%	14%	10,3		0,3	9,60		0,24
Forage and silage, clover	17%	0,0%	0,5%	4,2%	12%	34,1	0,2	1,4	23,20	0,11	0,97

Table 2 - Main Vegetable protein sources for feed compounds - FAO

The soybean had a large recognition of feeding industry, due to its high protein content and its importance for the contribution of good conversion factor in feed compounds, essential in meat production efficiency.

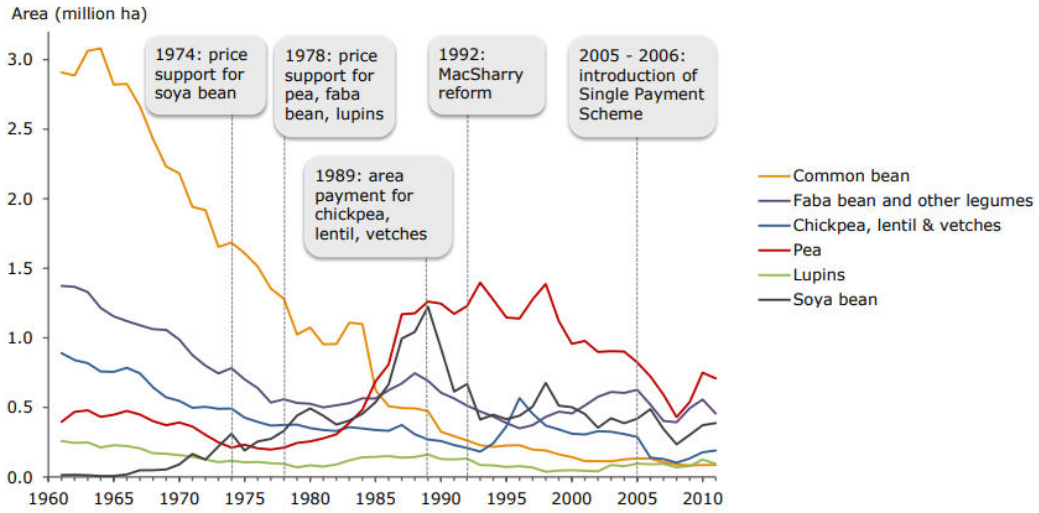
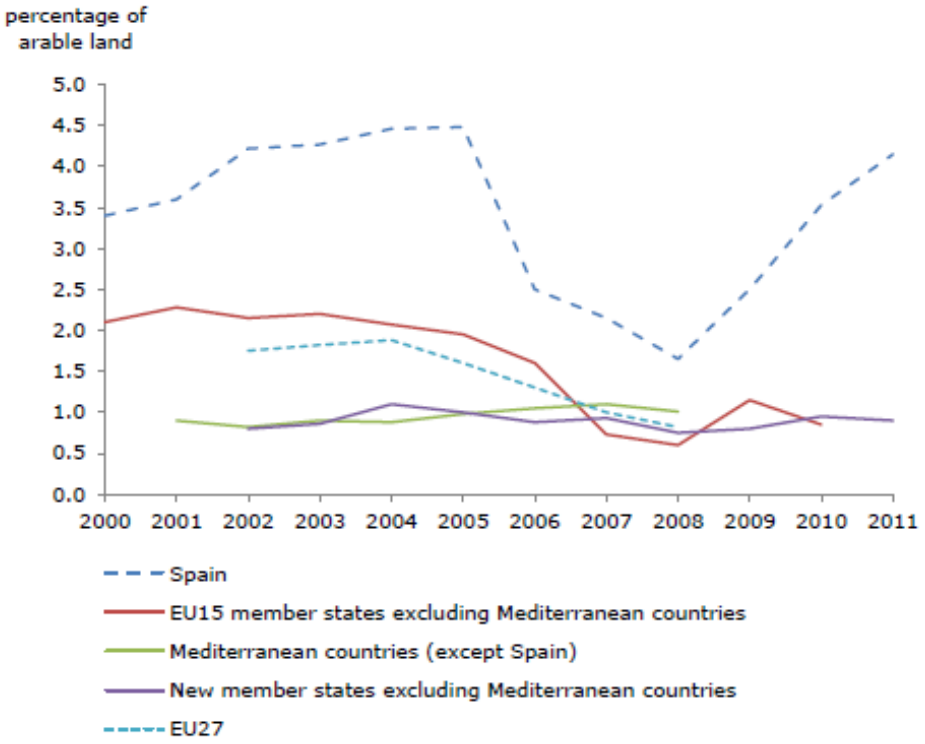


Figure 22 - Areas of protein crops in EU, and policy events

The European Union directives, taken in 2001, have progressively imposed restrictive regulations in all countries, although with some regional time derogations, that made very difficult the use of GMO seeds varieties. The impact of these regulations had special effect on the soybean production in EU. Using today land in Europe to cultivate crops or breeding seed production is considered to be unfeasible. Although possible for the farmer, the regulations

are not banning definitively the GMO, but the constrains to assure the isolation of GMO cultures are so high and risky, that in Europe 27 these crops are in practice banned. The risk of potential of GMO material contamination in other neighbor cultures is a tremendous risk to the companies, as losing a crop. If this occurs it reflects the total loss of the means of that long-term investment in the breeding, so the initial potential higher productivity and consequent profits from the corresponding business will be lost. In many countries of EU, due to the great menace of contamination with GMO material, farmers abandon growing organic maize and lose a potential income opportunity (Bernadette Oehen, Sylvain Quiédeville, 2017).

It is easier for farmers in countries with a national GMO ban. For feed producers, the most important coexistence costs are certification and testing costs, they fear that a contamination case results in quite relevant costs. The most used avoidance practices followed by feed producers is to go to the source and to buy their feed grain commodities from trustful suppliers, assuring safe origins, many times operating only with organic feed, or taking in any case spatial segregation for each specific grains. These restrictive policies in EU made considerable impact on arable land committed to oil seeds, and especially to soybeans.



Source: Calculations based on data from: EUROSTAT (2013).

Figure 23 - Percentage of Arable land for protein crops in EU-27, Eurostat

Furthermore, the tendency of feed producer to rely on soya meal is largely extended in European industry, as well as in the rest of the world commercial practice. With the growth of meat production sustained by high volume of consumption, the net import of soya products for feeding, calculated in soybean equivalent, grew from external sources.

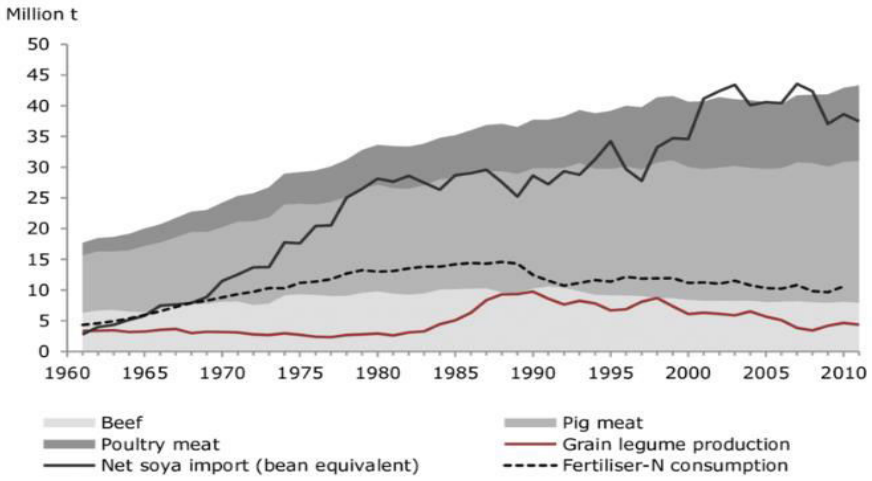


Figure 24 - EU-27 Meat productions and net soya import 1960-2011, Eurostat

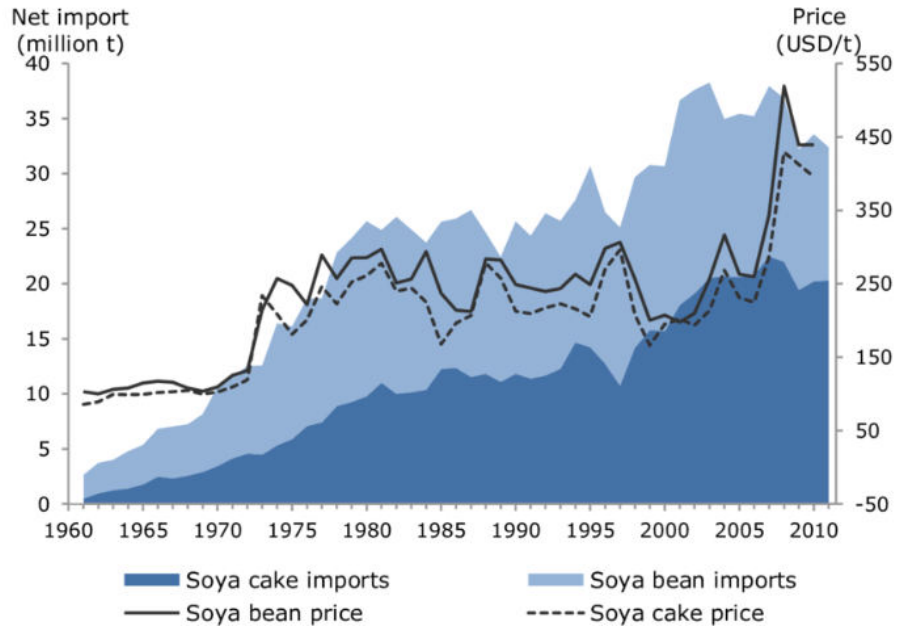


Figure 25 - Soya feed imports 1960-2011 in EU-27, Eurostat

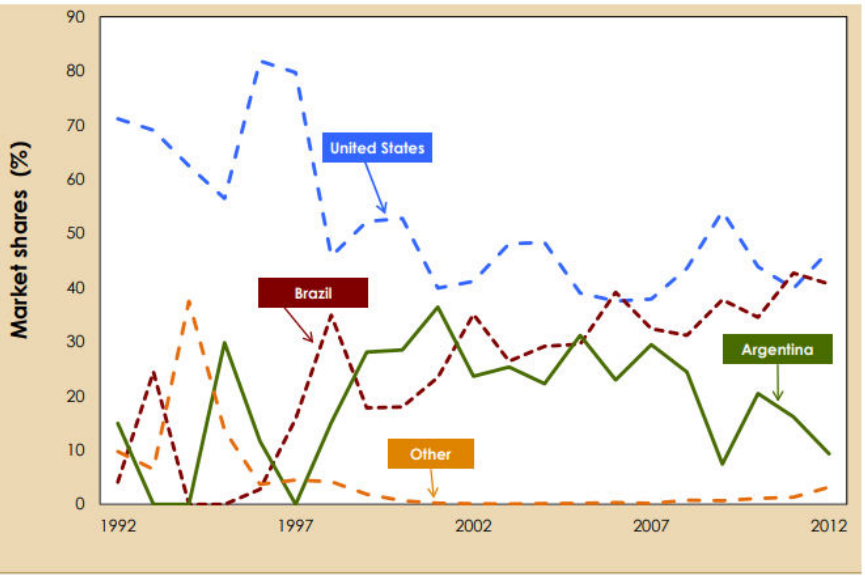
As we saw before, for several sustaining factors, being South-America region, the growing and leading producer for soybean complex vegetable protein producer, Europe like

Asia, become far largest importers of the soya from South America region, with especial focus in Brazil and Argentina, the soya export leaders.

For decades, USA was the production leader in soybeans, but recently in 2017 Brazil, due to its fast opening farming areas and introducing rapidly the technologies used by the American companies, became the world leader of soybean production and trade (Bernadette Oehen, Sylvain Quiédeville, 2017).

Actual market shares

Year	United States (%)	Brazil (%)	Argentina (%)	Other** (%)
1992	66.25	13.78	11.43	8.54
1993	71.59	13.84	7.55	7.02
1994	57.72	19.60	10.90	11.78
1995	71.34	11.13	8.05	9.48
1996	73.00	10.92	6.64	9.44
1997	66.30	23.17	2.08	8.45
1998	60.52	22.28	7.17	10.03
1999	57.74	23.55	8.07	10.64
2000	58.06	24.29	9.02	8.63
2001	50.47	28.80	13.60	7.13
2002	54.88	27.50	11.30	6.32
2003	46.48	32.10	14.10	7.33
2004	43.14	36.50	12.05	8.31
2005	46.06	31.06	14.76	8.12
2006	40.20	40.72	11.39	7.70
2007	42.85	33.12	13.48	10.55
2008	40.07	32.23	17.58	10.11
2009	45.39	39.09	7.29	8.23
2010	44.32	31.04	14.22	10.43
2011	44.73	32.71	10.05	12.51
2012	40.52	39.51	8.03	11.95
2013	36.00	41.75	7.71	14.54
2014	39.56	41.54	6.96	11.94
2015	39.73	40.10	8.38	11.79
2016	39.88	41.03	7.49	11.61
2017	40.18	42.88	4.77	12.16



Source: USDA/Foreign Agricultural Service/Circular Series

Figure 26 - Soya market shares USA, Brazil and Argentina - USDA

Market Shares in the World Soybean Market

For decades, the United States had the dominant market share of the international soybean trade. Argentina and Brazil have been smaller competitors of the United States. However, since the 1990s, Brazil has captured a growing share of the international soybean market. In 2017, these two countries accounted for about 48 percent of the world's soybean market and the United States accounted for 40 percent.[6] The United States' market shares declined from 66 percent in 1992, stabilized 8 years later at 58 percent, and stood at 40 percent in 2017 (figure 1 and table 8). While the market grew, nominal prices for soybeans in the global market increased until 2012; and declined to $401 per metric ton in 2017, as measured by CIF Rotterdam prices

Figure 27 - Leadership and market share in soybean market - USDA

In 2007, Brazil took the higher share on export market of soybean complex, continuing to open arable land and improving technology in production, and 10 years after, Brazil not

only remained leader in exports of soya, but also took the leadership in production of soya, overlapping for the first time the USA production.

Brazil had a much more recent expansion of soybean crops than USA, the big traditional producer of soya in the world. Along the Mississippi Valley well known farm fields, the maize and soya outputs were leading exports to the world by the ports of Baton Rouge and New Orleans, through the Gulf of Mexico, to the Atlantic region, or trough Panama Canal to the Asian countries. These farming capacity has been critical supporting Europe and China rising consumption and imports since many decades.

Brazil experience in soybean production began during the 1960s, initially leaded by American farmers, big companies agriculture looking for new extensive and cheap soils. Then rapidly took large areas, deforested and, as cultivation spread to the Brazil best agriculture regions, yields improved. In 2017, Brazil and the United States each produced about 120 million Tons of soybeans. USDA analysis projects that Brazil soybean agriculture production output is estimated to reach 160 million Tons (Fred Gale, 2019).

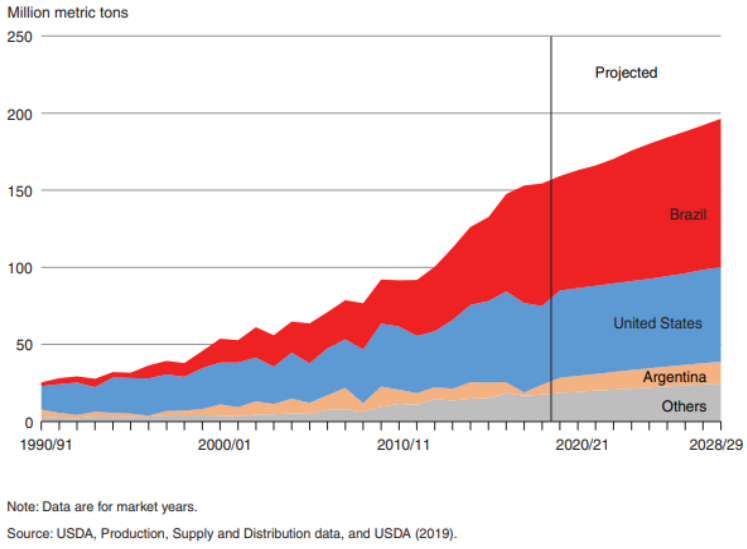


Figure 28 - Soybean exports by country – USDA

In less than one generation, Brazil took the leadership of soya production and exports, over the United States. China also became an important producer of soya in last decades, but due to internal growing demand, this production is staying inside for inner consumption.

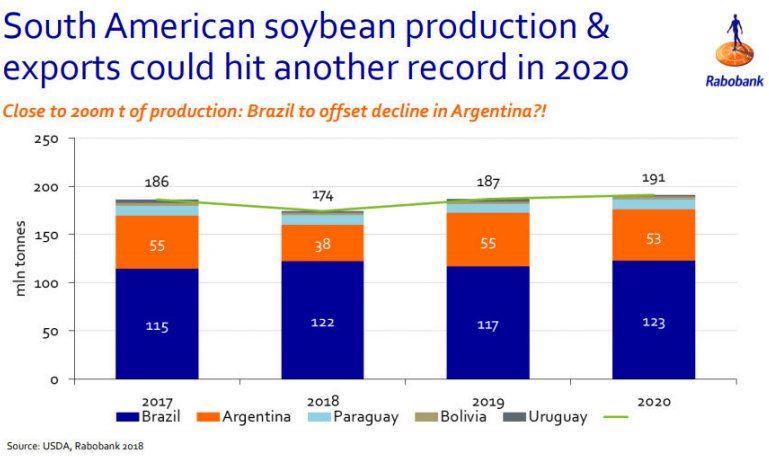


Figure 29 - South American Soybean production records, USDA Rabobank research

European Union countries are now depending on big imports of soya for breading animals for meat production. The restrictions on soybean OGM agriculture use, imposed by EU-27 regulations, oblige feed compounds producers to import large quantities of soybean meal for livestock production.

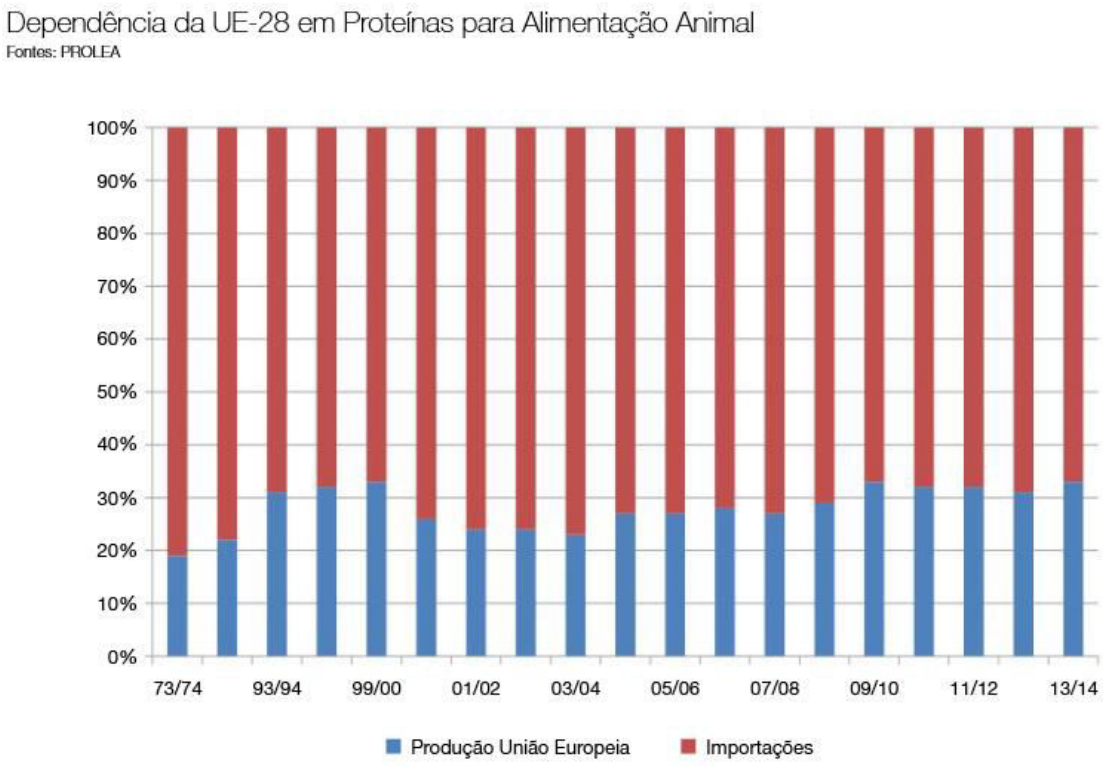


Figure 30 - UE dependency of protein imports for feeding - PROLEA

European Union countries are highly dependent on imports of protein grains for the production of feed compounds for meat industry (Schreuder & De Visser, 2014).

Animal breeders demand from an international supply chain the plant proteins to provide feed for meat and milk producing, a long supply chain of farmers with forage cereals, grass and alfalfa. Regarding protein crops in the EU a gap is being fulfilled by the feed compounding industry, directly importing or via intermediates traders. The pricing of these commodities is mostly based on the Chicago Board of Trades (CBOT) and Euronext commodity price level for future markets. Supply chains are active on local, regional or global levels. Much of the raw material for the compound feed industry is sourced from global supply chains, in particular for oilseeds, like soybeans and derived meal.

When looking to the soybean agriculture and using statistics and studies regarding the seed and their complex of products including the oil and the meal, we understand that this essential source of protein today has its leading farmed areas in North and South America continents, as well as China, and its leading traded origin in South-American countries, like Brazil for the bean, and Argentina for the meal. The EU relies on imports of commodities to meet its needs of protein-rich ingredients in feed compounds for meat. In 2014, around 13 million tons of soybeans and around 18 million tons of soybean meals were imported to the EU from different origins. USA, Brazil, Paraguay, Argentina and Canada are the key EU suppliers. These countries are also early adopters of the cultivation of GMO technology. EU cultivates important volumes of cereals, oilseeds, and also produces crops and processed feed materials that are source of proteins. Based on FEDIOL data, we can quickly observe that EU vegetable oil and protein meal industry association is today highly dependent of South America imports of protein from soya (FEDIOL, 2018).

The soymeal protein raw material feed compound is already a processed product coming from the soybean after oil extraction. In EU, it can have two main sources, the direct import of soymeal already processed, or the soya oil extraction industry that is selling the solid farines from the extraction process for the feeding industry. In any case, this industry in Europe is mainly importing the beans to make extraction, as we can see bellow:

PRODUCTION OF OILSEEDS

(x 1000 t)	2018 EU-28	2017 EU-28	2016 EU-28	2015 EU-28	2014 EU-28	2013 EU-27	2012 EU-27	2011 EU-27	2010 EU-27	2009 EU-27	2008 EU-27	2007 EU-27	2006 EU-27	2005 EU-27	2004 EU-27	2003 EU-15	2002 EU-15	2001 EU-15	2000 EU-15	1990 EU-12	1980 EU-9
Soybeans	2 737	2 643	2 410	2 044	1 692	1 171	819	1 213	1 000	911	745	851	1 258	1 098	1 030	470	790	1 205	1 068	2 135	16
Rapeseeds	19 778	21 941	20 590	21 885	24 023	20 847	19 271	19 044	20 305	21 375	18 766	17 839	15 985	15 643	15 513	9 568	9 295	8 845	9 047	6 213	1 994
Sunflowerseeds	9 603	9 529	8 269	7 631	9 046	8 697	6 700	8 187	6 866	6 881	6 649	4 852	6 362	5 717	6 296	2 552	2 702	3 035	3 196	4 289	320
Cottonseeds	535	507	439	450	326	546	271	575	385	400	482	584	595	873	837	740	785	842	840	495	1
Linseed	134	141	126	85	91	138	125	161	168	109	93	106	173	189	166	161	109	130	217	170	61
Others	0	0	0	0	0	0	0	35	9	1	1	0	1	0	1	1	0	0	0	2	3
TOTAL	32 787	34 761	31 834	32 095	35 178	31 399	27 186	29 215	28 733	29 677	26 736	24 232	24 374	23 520	23 843	13 492	13 681	14 057	14 368	13 304	2 395

IMPORTS OF OILSEEDS

(x 1000 t)	2018 EU-28	2017 EU-28	2016 EU-28	2015 EU-28	2014 EU-28	2013 EU-27	2012 EU-27	2011 EU-27	2010 EU-27	2009 EU-27	2008 EU-27	2007 EU-27	2006 EU-27	2005 EU-27	2004 EU-27	2003 EU-27	2002 EU-27	2001 EU-27	2000 EU-27	1990 EU-12	1980 EU-9
Groundnuts	76	83	76	72	73	74	61	73	70	73	253	298	276	295	302	294	315	251	223	175	321
Soyabeans	15 134	13 611	14 709	13 294	12 916	12 928	11 860	12 141	13 089	12 590	15 298	15 064	14 127	14 671	14 777	17 448	18 475	18 147	14 825	13 301	11 760
Rapeseeds	4 372	4 988	3 294	2 838	3 058	3 729	3 536	2 691	1 943	2 658	1 990	497	692	173	278	304	690	1 172	886	510	441
Sunflowerseeds	526	504	830	306	209	335	233	394	231	593	334	507	640	920	1 173	1 849	1 428	1 748	2 117	278	1 284
Cottonseeds	0	0	0	79	0	0	0	57	60	98	59	105	105	132	196	146	140	161	175	113	6
Copra	0	1	0	3	0	1	0	0	0	0	0	9	51	87	39	18	30	55	79	88	188
Palmkernel	4	1	1	29	2	29	2	0	0	0	0	0	15	49	54	10	11	16	3	57	131
Linseeds	648	591	669	627	616	516	533	446	520	412	585	756	595	522	640	642	643	628	491	135	274
Others	124	122	119	128	120	122	106	101	103	0	0	0	0	0	0	6	8	18	17	46	33
TOTAL	20 884	19 899	19 698	17 376	16 994	17 734	16 331	15 903	16 016	16 424	18 519	17 236	16 501	16 849	17 459	20 717	21 740	22 196	18 816	14 703	14 438

Table 3 - Production and imports of oilseed in EU - FEDIOL

In 2018 EU produced a very small share of the soybeans used, 2.7 million tons produced against 15.1 million tons imported. These two origins of beans are essential for supplying the crushing industry that is producing soya oils, mainly for edible products, also biodiesel and other industrial applications, and meals for feeding compounds for livestock meat production.

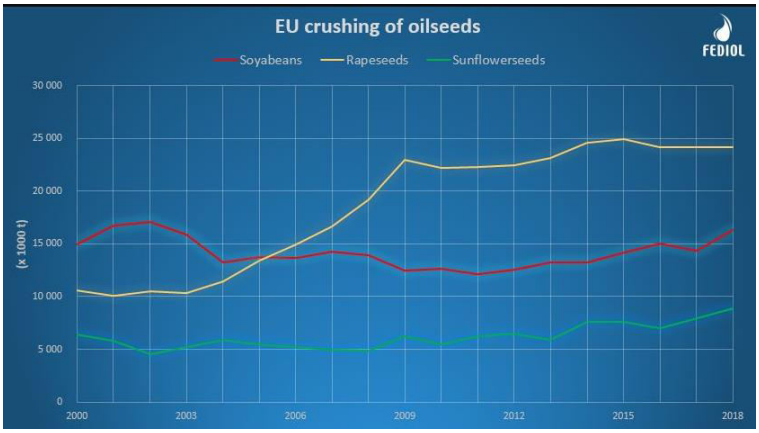


Figure 31 - EU crushing of oilseeds - Fediol

According to FEDIOL, the crushing industry is demanding this total quantity of 16.5 million tons for soya oil and soymeal production, almost the total available.

So looking in detail for the meals from soya produce in EU, in weight representing 78% of the crushed beans, we observe on the figure bellow that the 12 million tons of soymeal produced in EU are in fact the transformation on the crushing units in EU, where 90% of those are the 15 million tons of beans which were imported.

PRODUCTION OF MEALS

(x 1000 t)	2018	2017	2016	2015	2014	2013	2012	2011	2010	2009	2008	2007	2006	2005	2004	2003	2002	2001	2000	1990	1980
	EU-28	EU-28	EU-28	EU-28	EU-28	EU-27	EU-27	EU-27	EU-27	EU-27	EU-27	EU-27	EU-27	EU-27	EU-27	EU-15	EU-15	EU-15	EU-15	EU-12	EU-9
Groundnut	20	19	19	19	18	19	18	20	18	14	11	10	11	13	12	11	14	17	12	5	63
Soya	12 965	11 342	11 875	11 251	10 468	10 336	9 946	9 652	10 101	9 994	10 879	11 308	10 887	11 141	10 697	12 303	13 209	12 998	11 722	10 296	9 151
Rape	13 279	13 302	13 267	13 717	13 522	12 963	12 729	11 998	12 309	12 383	11 022	9 608	9 523	7 727	6 528	4 992	5 066	4 788	5 106	3 375	1 102
Sunflower	4 798	4 287	3 682	4 098	4 113	3 437	3 352	3 375	3 000	3 276	2 467	2 621	3 183	2 907	3 129	1 984	1 772	2 418	2 615	2 182	851
Cotton	168	162	173	188	217	197	132	157	177	107	145	173	237	275	321	330	323	333	410	265	133
Copra	0	0	0	0	0	0	0	0	0	0	0	3	7	15	13	6	6	10	26	31	65
Palmkernel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	13	62
Linseed	445	427	427	390	404	337	371	314	269	261	342	362	326	276	298	312	355	328	384	119	152
Maize (m)	557	435	405	390	372	365	338	229	320	306	342	328	346	272	266	269	284	266	257	201	
TOTAL	32 234	29 975	29 848	30 054	29 114	27 654	26 886	25 745	26 194	26 341	25 209	24 413	24 520	22 626	21 264	20 207	21 032	21 158	20 532	16 487	11 579

(m) incl. maize meal, grape and tomato pips meal, ...

IMPORTS OF MEALS

(x 1000 t)	2018	2017	2016	2015	2014	2013	2012	2011	2010	2009	2008	2007	2006	2005	2004	2003	2002	2001	2000	1990	1980
	EU-28	EU-28	EU-28	EU-28	EU-28	EU-27	EU-27	EU-27	EU-27	EU-27	EU-27	EU-27	EU-27	EU-27	EU-27	EU-15	EU-15	EU-15	EU-15	EU-12	EU-9
Groundnut	0	0	1	4	6	11	3	61	57	7	3	43	53	2	29	40	129	153	170	348	746
Soya	17 592	19 099	18 485	18 845	18 451	17 431	19 330	20 766	21 519	20 629	23 119	24 321	23 405	23 220	22 954	20 352	19 605	17 870	15 840	10 471	7 226
Rape	441	197	253	487	472	970	214	218	170	159	140	109	87	137	126	413	488	533	803	512	275
Sunflower	3 375	3 817	3 320	3 159	3 414	2 767	4 077	2 394	1 912	2 588	1 659	1 736	1 943	1 946	1 835	1 712	1 290	1 424	1 950	1 341	531
Cotton	4	1	2	3	8	12	4	96	3	8	6	7	24	37	72	100	164	207	139	569	618
Copra	3	2	13	3	3	9	14	18	30	24	16	28	49	81	142	280	408	611	495	1 086	883
Palmkernel	2 312	2 977	2 192	2 179	2 267	2 641	2 726	2 127	1 919	2 464	2 299	2 342	2 902	3 036	2 763	2 587	2 442	2 249	2 289	1 455	419
Linseed	23	28	14	6	7	6	5	9	3	8	14	16	29	38	8	16	17	35	84	507	619
Maize (m)	33	20	0	0	0	0	0	0	0	0	0	0	0	4	8	13	47	88	100	1 533	
TOTAL	23 783	26 141	24 280	24 686	24 628	23 847	26 373	25 689	25 613	25 887	27 256	28 601	28 493	28 501	27 937	25 513	24 590	23 170	21 870	17 822	11 317

Table 4 - Production and import of protein meals in EU-27 - source FEDIOL

Not enough, according Fediol, because in 2018 EU still imported 17 million tons of soymeal to supply the feed industry.

While the cereals surplus is exported to other markets, EU needs to import high volumes vegetable protein to complement its own production and to satisfy the needs of its animal production chain.

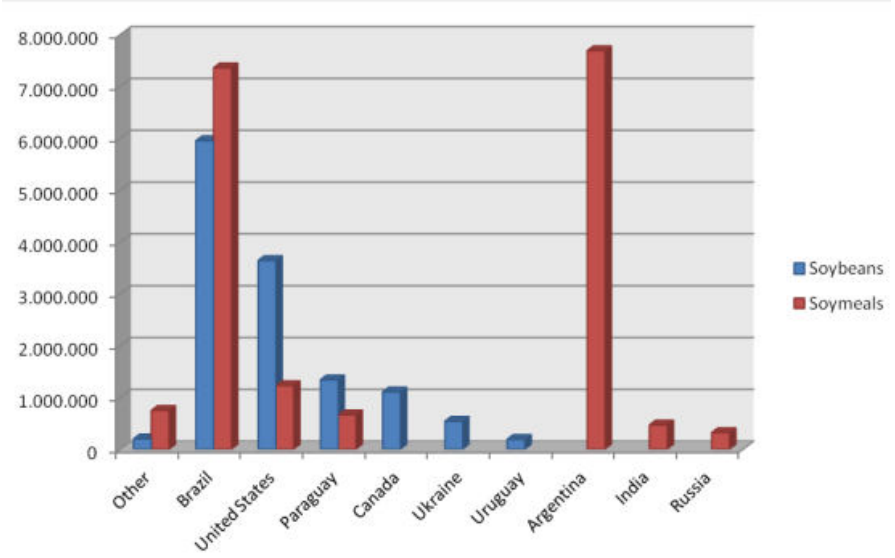


Figure 32 - Main origins of EU soybean complex imports, GTIS 2013/14

EU is highly dependent on imports of soybeans and soybean meal, some initiatives were launched by the EU Commission in an effort to assess the current yield gap in protein crops using a market value approach for protein, prospecting also alternative sources of protein for animal feed. The EIP, European Innovation Partnership, in 2014 initiative Agri, has launched a consultation process involving experts from the European countries to discuss the potential for a considerable increase in the production of vegetable proteins in Europe. The EU dependency on soya bean import for the animal feed industry is well recognized by scholars and research is being done to potential reduce this gap looking for EU produced alternatives (Visser, Schreuder, & Stoddard, 2014).

The questioning of origin of vegetable oils and protein seeds therefore brings us back to the historical fundamentals of development oil and protein crops and protein crops in a EU which remains very dependent on imports for its vegetable protein supplies. Soya remains the market leader in vegetable proteins (Pilorgé & Muel, 2016).

EU is origin of soya products is today being led by South America continent countries, Brazil and Argentina (Eurostat, 2012).

The figure shows the net trade flows of soya and meat and dairy products between EU-27 and the rest of the world in 2012, showing the specific trade flows of these commodities between the different continents.

Source: https://www.eea.europa.eu/data-and-maps/data/external/eurostat-eu27-trade-since-1995

Figure 33 - EU flows of protein Soya and Meat - Eurostat 2012

The map of the main ports for trading flows of the soya complex is well known among the food commodities trading professionals, for obvious reasons. Exporting beans from USA and Brazil, exporting meal from Argentina. Both Europe and Asia are protein buyers. Europe main port for soya are in the North, in the tradition trading ARA region, and especially the port of Hamburg, where also many of the downstream industries are located .

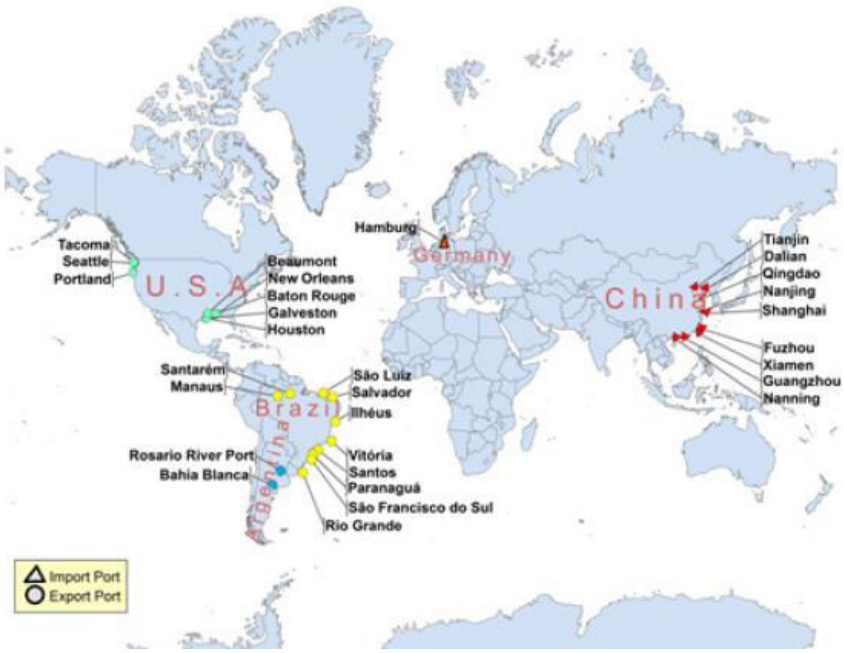


Figure 34 - Soya export-import main world ports - USDA

Figure 35 - Port of Santos (Brazil) bulk carrier loading Soya

As we saw in figure 16 - Soybeans global trade, FAO UN, soya was not an essential base grain in the feed compound before the 90's. The chicken that our mothers were buying in the local butcher meat seller was being raised with maize, wheat, barley, sunflower and others. Rapidly, after the soya becoming technological and resistant, being high protein content, the feed compounds integrated very quickly soya farina, the soymeal, in order to

achieve better conversion ratios and to produce more efficiently the meat. Today we go on the butcher and buy chicken raised with soybean meal based feed compound, most probably coming from Argentina, in South America.

2.4 Intercontinental food Logistics, trade and vessels

Maritime transport represents a key role on the import-export of goods between the European Union and the different regions of the world. In 2015, the volume of sea trade accounted for more than half of the total goods exchange between EU and the rest of the world, value 51% in the trade of goods, but for imports this figure is slightly higher, 53% more exactly (Eurostat Press Office, 2016). Other transportation means follow far behind, and represent less than half of sea cargo in volume, air, road, train and others.

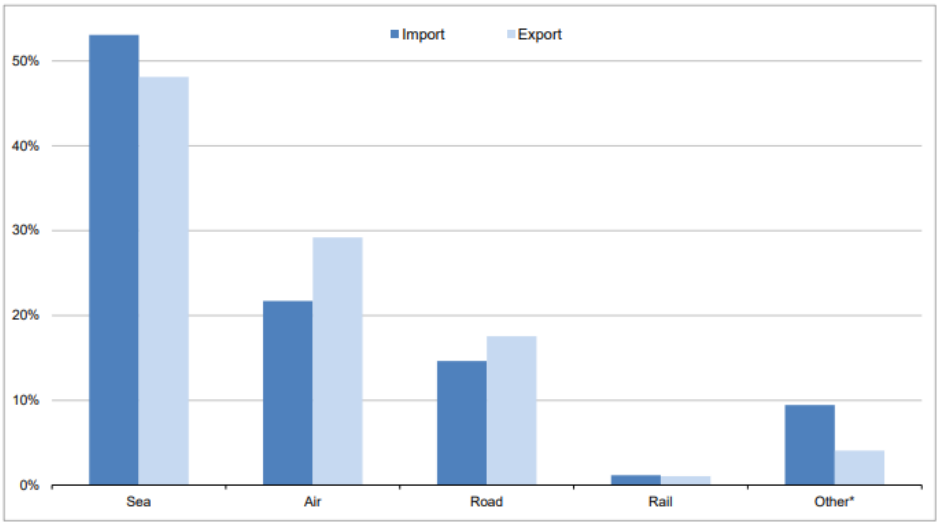
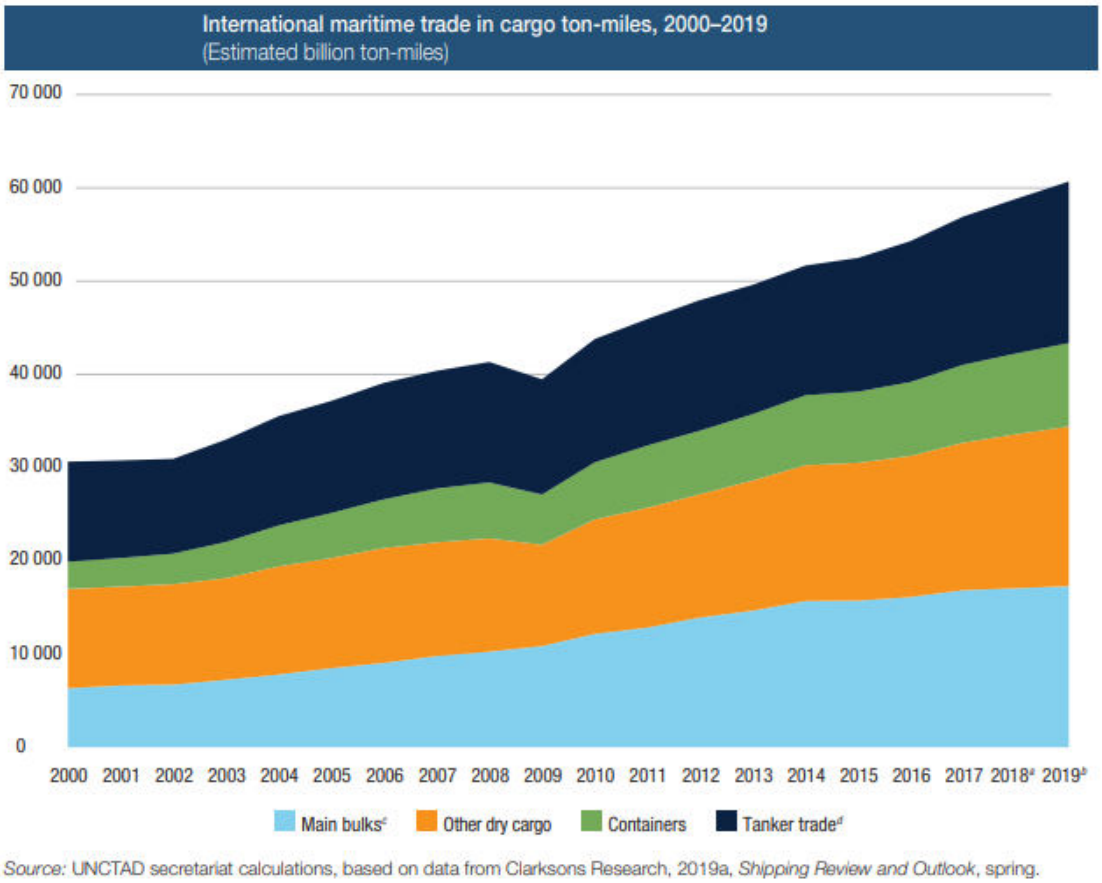


Figure 36 - EU international trade in goods, by mode of transport share, 2015

source: News realease, 184, 28 Sep 2016, Eurostat Press Office

Fairness to its traditions, if we detail the coastal countries figures, some of them with very strong maritime history, like Portugal, this figure can reach 81% of the total trade of goods.

Looking globally, seaborne trade grows worldwide (Unctad, 2019). In 2018, developing countries continued to account for most global maritime trade flows, both in terms of exports and imports. These countries loaded an estimated 58.8 per cent in 2018, and unloaded 64.5 per cent of this total. Since 2000, the contribution of developing countries to maritime trade has shifted, reflecting their growing role as major exporters of raw materials, as well as major exporters and importers of finished and semi-finished goods. Participation in containerized trade, however, has been concentrated in Asia, notably in China and neighbouring countries. Other developing regions did not contribute equally, a reflection of their varying degrees of integration into global value chains and manufacturing networks.



Source: UNCTAD secretariat calculations, based on data from Clarksons Research, 2019a, *Shipping Review and Outlook*, spring.

Figure 37 - International maritime trade in cargo type

And referring to EU, the evolution of the data in last 16 years, 2002-2018, shows that the maritime international trade transportation share keeps growing, with especial focus on the imports of goods (Eurostat Statistics, 2020).

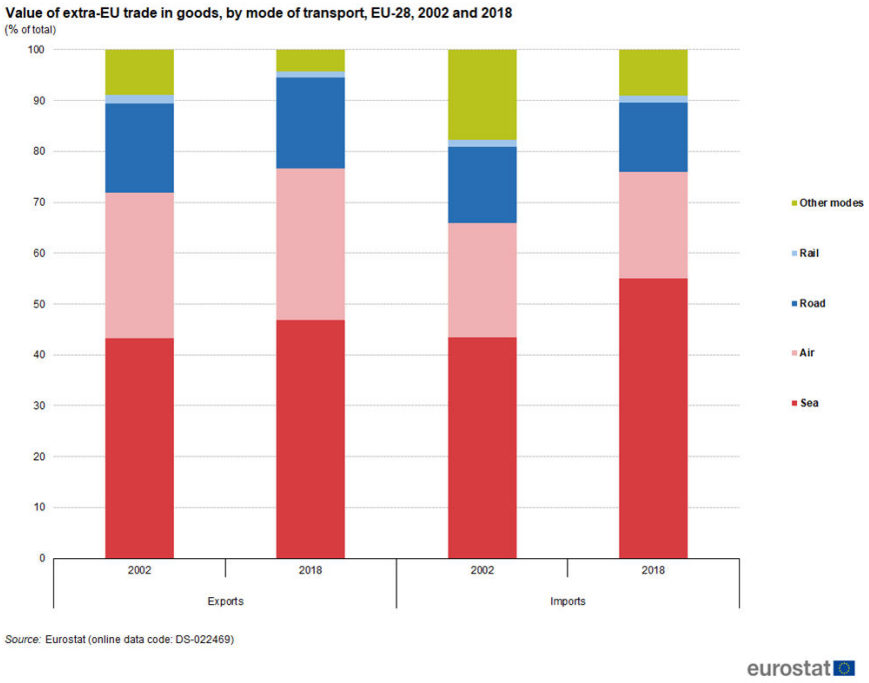


Figure 38 - EU trade in goods, by mode of transport, Eurostat

Inward movements of goods to the EU countries increased by 2.9 % to almost 2.4 billion tonnes in 2017, compared with 2016, while outwards movements increased by 2.1 % to 1.6 billion tonnes (Eurostat Statistics, 2020).

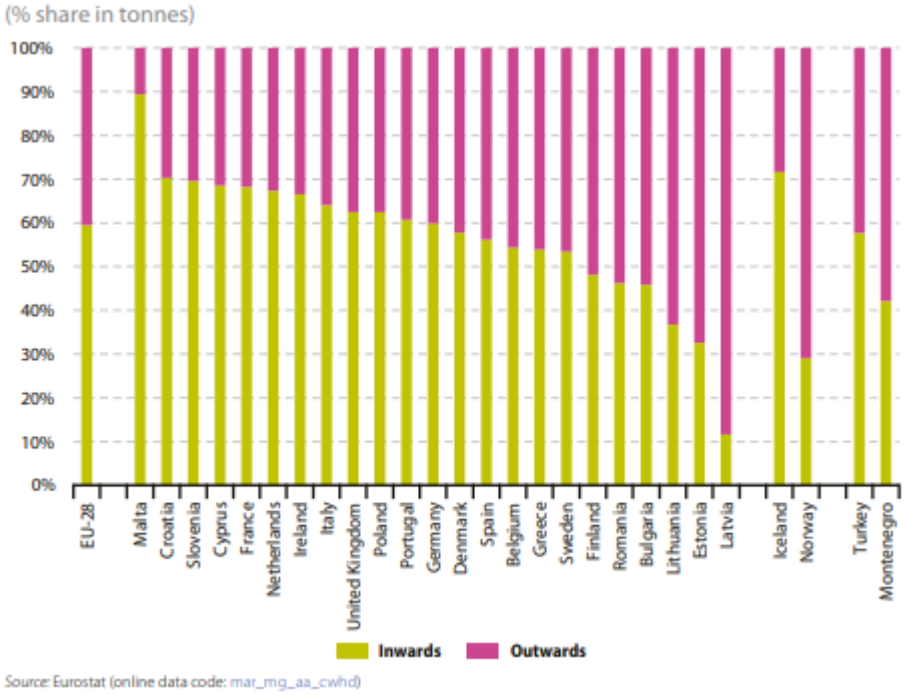


Figure 39 - Gross weight of seaborne freight handled in all ports 2017, Eurostat

By dividing these products, the petroleum has the largest share in exchanges between the European Union and most regions. Almost half of the products carried by sea between the Member States and other European countries including Russia, Africa and Asia were petroleum products. In second place come ore and metal waste with a share of 19%, and agriculture products is the third main product on seaborne trade.

The ports of north west Europe constitute a “destination zone” long time known as ARA region, in the Europe’s north-west corner, and historic ports belong to this group, **A**msterdam, **R**otterdam (Netherlands) and **A**ntwerp (Belgium), but also Hamburg (Germany). Today these ports are working in a solid assemblage of trade and related activities for Europe Economy support, being for long time the tradition ports for food commodities in Europe, next to Hamburg. The Netherlands, with a strong maritime culture and tradition, along the last centuries developed the international commerce like no other country in Europe. Infrastructures and support activities made this country the center point of the trading industry in the old continent.

By far, largest volumes port operations in Europe are today in these traditional industrialized trading countries, Netherlands, Belgium, Germany and the others. Ports infrastructures and related activities constitute a cluster on maritime economy, very strong

and important for this area. As regards seaborne freight transport, the total gross weight of goods handled in EU ports was estimated at close to 4.0 billion tons in 2017, an increase of 2.6 % from 2016. The Netherlands reported the largest volumes of seaborne freight handling in Europe in this period. At 596 million tons, the volume of seaborne goods handled in Dutch ports represented 15.0 % of the EU total in 2017 (Eurostat Statistical Books, 2019).

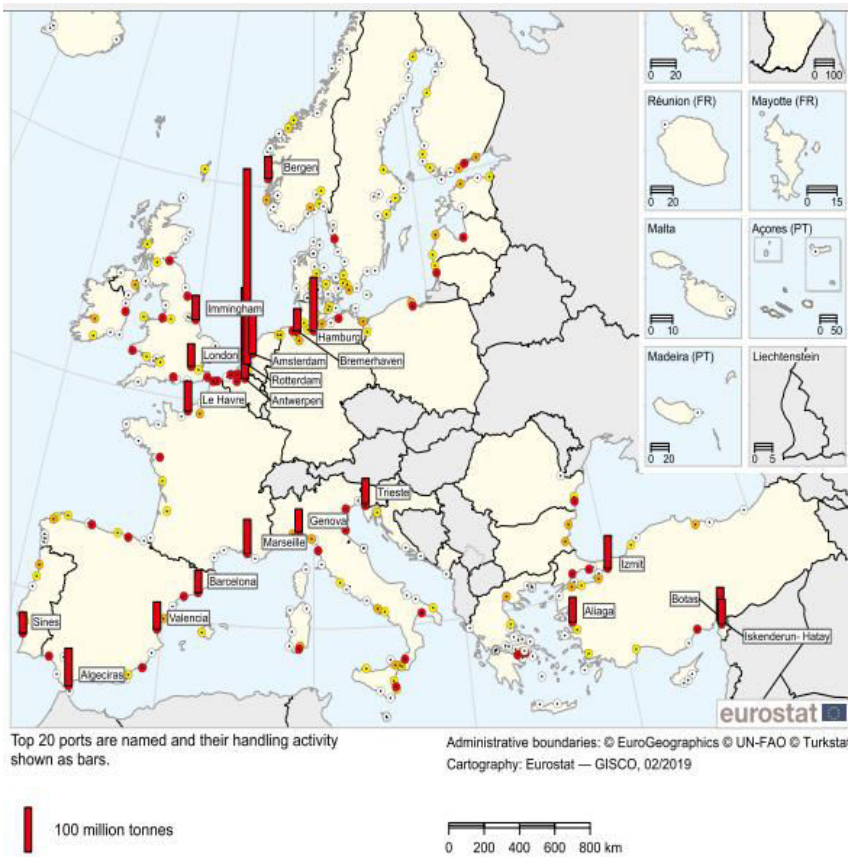


Figure 40 - Mapping the top 20 Ports in EU +Turkey

Rotterdam, the biggest port in ARA Region and in Europe, leads the tonnage of international trade commerce. Port operations and services, ship building, trading, are some of the direct sectors of the port activity, but this is also boosting a consecutive second line of activities supporting the port services, in big economical downstream collection of activities. As an example, this is the reason why Rotterdam is today the place where we can find the most experienced constellations and the top biggest lawyers companies in Europe, simply because lawyers are necessary to assist and redeem conflicts in international trade. This region has a long trading history, based in the northern countries of the European continent,

where early in the XIX and XX centuries, the main transformers of the agriculture industrial revolution that rapidly took the evolution of machinery from manufactory workshops, to enter in the countryside operations within the industrial revolution, brought agriculture commodities in high volumes of production and world trade. Europe main import/export door for food commodities is based in ARA. Often quotations of wheat, maze, barley, rapeseed, sunflower or others are referred to ARA delivery, being the main geographical reference point in European trade contracts, for food commodities.

Rank	Cargo ports		Weight of goods handled in maritime ports	
			Millions of tonnes	Share in total gross weight of goods handled
1	Netherlands	**Rotterdam**	421.6	11.1%
2	Belgium	**Antwerp**	180.4	4.8%
3	Germany	**Hamburg**	126.0	3.3%
4	Netherlands	**Amsterdam**	97.1	2.6%
5	Spain	**Algeciras**	75.7	2.0%
6	France	**Marseilles**	74.4	2.0%
7	France	**Le Havre**	61.4	1.6%
8	United Kingdom	**Immingham**	59.4	1.6%
9	Spain	**Valencia**	55.0	1.5%
10	Germany	**Bremerhaven**	53.6	1.4%

The source dataset can be found here.

ec.europa.eu/eurostat

Table 5 - EU Top 10 all cargo Maritime Ports in 2014

For all countries achieving food security requires politics regarding not only internal agriculture production, but also control and understanding of how international trade flows networks connect between countries around the globe, moving through the world import-export flows of essential food commodities. The trade and transport operators, vessel characteristics and properties on international food trade networks are poorly documented in a systematic way, being instead well known by the professionals from industry who know lines and time frames of international trade operation, especially when a multinetwork logistics perspective is needed, the few players in the world acting perhaps more agile, more quickly than governments, buyers or farmers.

Movement of goods between international ports relate between them in communities, more or less stable along time. Some scholars like Torreggiani found, looking to establish models to optimize multiple port trade operations, that the individual crop specific layers of the network have closely connected the same trading groups, a consistent

characteristic over the period analyzed in their study from 2001 to 2011. This means each year, the same traders have a high degree of repetition in the commercialization of each crop. The network is then characterized by low variability during the period in research, but with substantial heterogeneity across layers in each year, countries with more intense connections tending to import in and export to countries that are themselves more connected. Also it fits econometric models to identify social, economic and geographic factors explaining the probability that any two countries are in the same community. Torreggiani estimates that the probability of country pairs belonging to the same food trade community depends more on geopolitical and economic factors, such as physical proximity and trade agreements, than on country economic size or revenue. Understanding this community networks is especially valuable for comprehending the dynamics in the global food system, in food commodities global trade. (Torreggiani et al., 2018) . Important drivers for the establishing of Port Community links are the need to standardize methods, communication platforms, and software tools, many times using EDI information exchange, in order to improve operations in terms of efficiency and punctuality, minimum costs, looking to increase each one its competitiveness among other challenger alternative ports. Trade flows tradition, specialization in cargo types, operators and other actors of the economical upstream industry operation of the port are often driving this ports relations closer as well as the downstream operations on destination.

The development of industrial agriculture has enabled a sharp increase in food trade at the global scale. International trade strengthens food security by allocating food oversupplies to food underprovided countries, with low agriculture activity, or with climate and soil unappropriated for self-sustaining agriculture. Studying agricultural commodities and merchandize flows can deliver perceptions of the complex connections among export and import trading countries, also what are the resulting interconnection network flows. Commercial trade agreements and partnerships between specific countries could be molded by means of complex grid model approach. Dupas made an analysis very detailed based on the information of trade matrices built with the FAO data, covering a period of 28 years from 1986 to 2013, presenting an analysis of the world cereal trade in terms of weighted and directed networks (Dupas, Halloy, & Chatzimpiros, 2019) .

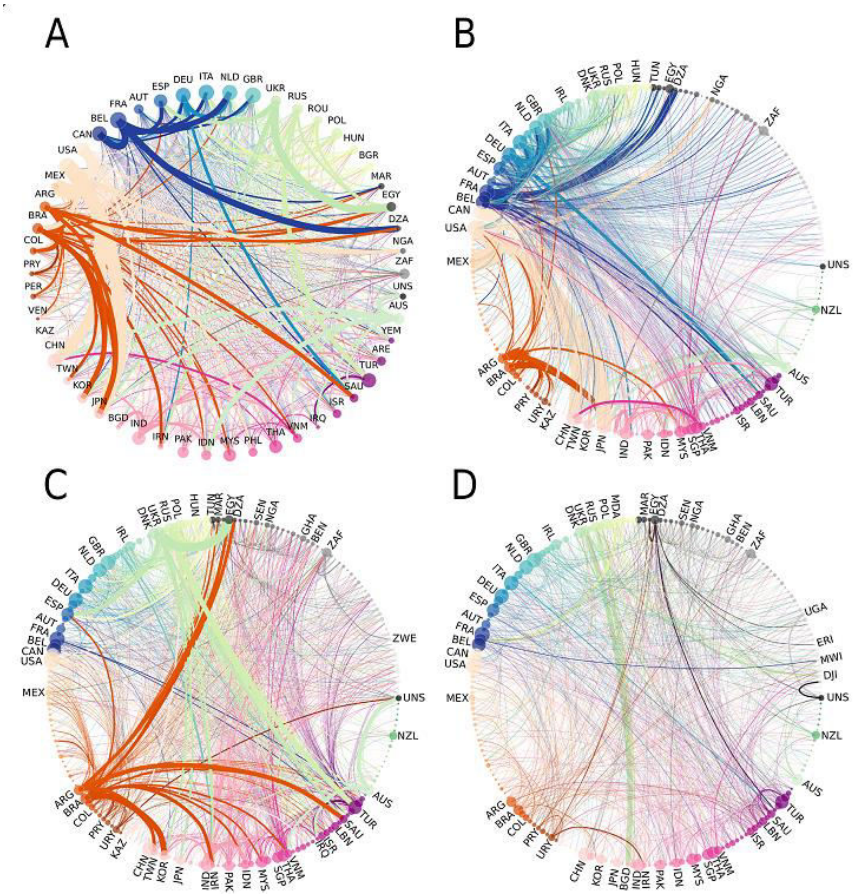


Figure 41 – Dupas cereals network, its decomposition in three subnetworks, 2013

"The countries are ranked by continent and the size of nodes is weighted by the total number of trades knot. The color code indicates the continent group: grey, Africa, green Oceania, blue to yellow Europe, orange to red America, pink Asia. The edges are weighted by the traded mass and the colour corresponds to the country of destination.

A. World cereal network. The graph is limited to the 50 most important countries and their trades. The total network counts 210 nodes and 8700 links. The total traded mass is 405.7 million tons. The degree distribution is of type exponential.

B. Backbone subnetwork. This network counts 202 nodes and 2135 links. The traded mass is 276 million tons, which represents 68% of the world trade in 2013. The degree distribution follows a power law indicating that the network is scale-free.

C. Intermediate subnetwork. This network counts 208 nodes and 4685 links. The traded mass is 121 million tons, which represents 29% of total trade in 2013. The degree distribution is of type exponential.

D. Transient subnetwork. This network counts 207 nodes and 1880 links. The traded mass is 8 million tons, which represents about 2% of total trade in 2013. The degree distribution is of type exponential."

> "The globalisation which has changed the world economy and trade has been reinforced by China, India, Brazil and Russia. As a consequence, the increasing globalisation has led to a strong increase in international shipping activity. As consequence of globalisation, the length and complexity of logistical chain have grown faster, resulting in the increase of the average distance of freight trips and their frequency. Moreover, a reduction in the costs for production and distribution caused by economies of scale, location advantages and warehouse is expected." - (CENIT, 2015)

Not easy to find much research about grains geographical production sites and especially relating it to the logistics chain and its impacts. Some of the research carried-out is related to logistics and its optimization, particularly in containers cargo (Hartmann, 2005). Some research by Kajli (Kajli & Fengting, 2013) were managerial insights on bulk grain transportation and grain supply chain governance, especially on the coordination mechanism between grain depots and grain processing companies are drawn. Another scholar. Gonzales Daniela, (Gonzales, Searcy, & Ekşioğlu, 2013) made a cost analysis by analyzing transportation costs for products like grain, identifying the main factors that impact the delivery cost of biomass, and quantifying those factors impact on transportation costs. The study provides a transportation-cost analysis that helps the design and management of biomass supply chains; many authors study the effects of disruption, although not in the sense of shortening the logistics path and time. Ouyang (Ouyang, Wang, & Yang, 2015) made a paper that proposes a compact mixed integer program, a formulation and a continuum approximation model to study the fixed charge location problem, which seeks to minimize initial setup costs and expected transportation costs in normal and failure scenarios, the program determining the optimal facility locations as well as the optimal customer assignments, solved by using a custom-designed Lagrangian relaxation (LR) algorithm; Ouyang, already cited, also develops a more traditional discrete location model in the form of a mixed-integer program, which builds

directly upon a nonlinear partial differential equation description of customer traffic equilibrium. Yang and Perakis (Yang & Perakis, 2007) use a grain transportation scenario to illustrate a model, to analyze the interactions among the shippers and the carriers, including the rail and marine shipping industry, in the bulk shipping market. Michael Miller from Cambridge (Miller & B., 2012) shows how a European maritime infrastructure made modern production and consumer societies possible, through a detailed analysis of ports, shipping, and trading companies whose networks spanned the world, arguing that the combination of overseas connections and close ties to home ports contributed to globalization.

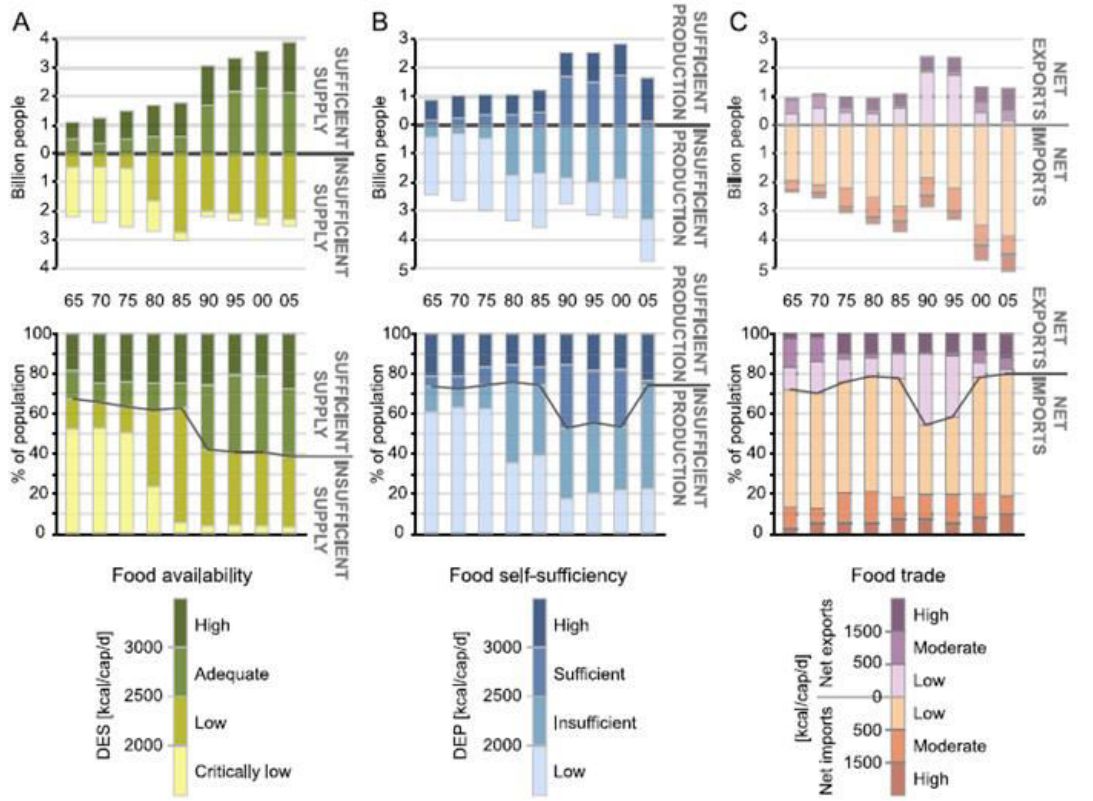
Food security, all countries look for it, is the measure of food availability for a population and also that population ability to access the same food, meeting the hunger demand in short and medium term. One of the main and primary goals for world politics, strongly declared by international organizations, is the achievement of the challenge to worldwide food security. As we saw in previous chapters, food is available on the planet enough to secure the populations needs, but the access of a part of the world population to food it is not yet a step accomplished. There are many countries with levels of food production below the necessary dietary energy supply, others exceeding this levels, that's why trade for food commodities is essential in the modern world. In the recent years, stimulated by economic growth, population's diets became richer in general, protein based, animal meat, fruits and legumes from different corners of the world. Seaborne trade, food trade supply by sea, was the answer of modern food industry to supply all countries with the necessary feed and food basic raw materials, the grains. It is true, not all countries have access to food, in close connection with low economic development, leaving a large part of the world without the minimum levels of dietary caloric levels, hunger not satisfied, although the picture is getting better. More generalized economic prosperity on the globe can be observed, considering the amount of 2.500 Kcal per capital per day as sufficient food level, doubled in the recent 40 years, from 33% in 1965 to 61% in 2005. In the same period, population areas bellow what is considered the critical low food supply, less than 2.000 Kcal per capital per day, has been reduced from 52% to 3 %, being the underdeveloped zones of MENA, LAC, South East Asia and China, where mostly the economic transformation and food supply evolution on the past decades have changed the picture. At the same time, we know

that some parts of the globe keep excessing the need of animal meat, in the same period, from 1965 to 2005, the population with oversupply of animal meat dietary overpassing more than 15% increased from one third of the world population to more than half of the population. Food supply is not a problem as long as seaborne trade makes agriculture goods flow, sustaining the increase in food demand, while local agriculture did not change much self-sufficiency caloric supply on continents. This highlights increase the significance of agriculture food commodities trade, both supplying food in importing dependent countries, and also as a source of income for export agriculture producing countries (Porkka, Kummu, Siebert, & Varis, 2013).

This figures show how important is trade in the world to sustain food availability for human populations. Agriculture soils and climate, are not in the same places as human urban cities. Moreover, in the last century, the “Green Revolution” process enlarged the necessary agriculture areas, looking for areas where they were available and at a feasible cost for farming use, and this changed the geography of world agriculture. In the beginning of the industrialization of the agribusiness, certainly it was not close to big cities on old continents that intensive farming could find places to grow, available extensive areas could not be found to seed, and neither the cost of land could be affordable for farmers. A new world of virgin territories,were captured and prepared for rural land use, as the areas in longstanding agriculture tradition regions in north continents raised their prices, far and new territories in the south hemisphere rapidly become hunted by the American and European big farming houses, especially in south America, and very soon we might watch the same spreads all around in Africa virgin territories. Trade became essential to meat production and consumption, based in the standardization of the commodities, having commercial deals in long distant stock-exchanges, supported by an international ocean fleet. After ars, the civilization put together an abundant advanced seaborne logistics activity to sustain the big commerce of food worldwide, established between intercontinental platforms.

Food security of a country population is nowadays a major issue of welfare and independence of a modern state, governments beign responsible and taking important measures to assure agriculture production, commodities stocks and trade flows, to assure the good functioning of their food security policies. Some scholars like Minna Porkka and others

(Porkka et al., 2013) made exhaustive studies about the dietary energy supply of population in the different parts of the world, their sufficiency and trade compensation. Results showed the while food supply has augmented in general, food self-sufficiency, meaning domestic production, did not change so much a long time. The deficits representing insufficient food supply to population are compensated by the means of expanding food importations. This underlines the extraordinary standing value of food trade worldwide, both in supply and in import by countries to cover their hunger.

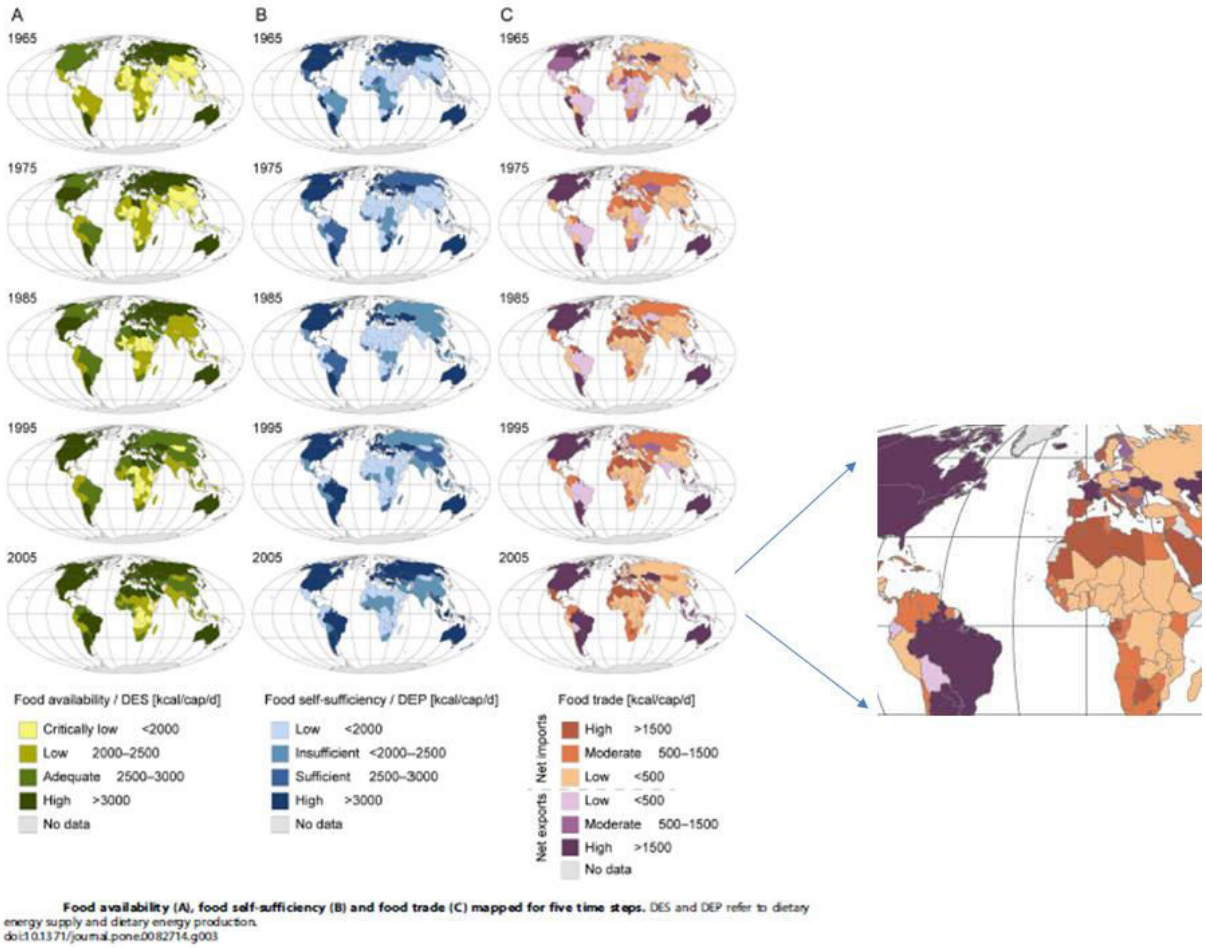


Global population in different food availability (A), food self-sufficiency (B) and food trade (C) categories. Upper figures express the population in absolute numbers and lower figures in relative numbers. DES and DEP refer to dietary energy supply and dietary energy production.
doi:10.1371/journal.pone.0082714.g002

Figure 42 - World population distribution by food availability, self-sufficiency and Trade

In the graphics of Figure 42 - World population distribution by food availability, self-sufficiency and Trade, we can see how much food trade activity is essential. Approximately 5 billion people of our population today, representing around 80% of world population, are dependent of food trade to assure their food security, being 10% high dependent. The figures also show that in 40 years, the population depending on imports of food, in a low sufficiency

or in a deeper degree of dependency, altogether doubled from 2.5 to 5 billion habitants on earth.



Food availability (A), food self-sufficiency (B) and food trade (C) mapped for five time steps. DES and DEP refer to dietary energy supply and dietary energy production.
doi:10.1371/journal.pone.0082714.g003

Figure 43 - World population food availability geographic distribution

Geographically, this analysis of Porkka show per country the evolution of food availability by quantifying each country population level of caloric energy supply and available agriculture production during 40 years. The role of food trade to achive self-sufficiency is essential for many countries as inFigure 43 - World population food availability geographic distribution .

> "Trade of food products has, thus, soared in importance in securing an adequate food supply. In many parts of the world, diets are increasingly abundant in calories and animal source foods. Within the past 50 years, the world has thus moved from food insufficiency towards an increasing dependency on food trade" (Porkka et al., 2013).

Worldwide commodity seaborne logistics today attract big international operators, modern independent private companies and many state companies to guaranteed food security worldwide, assuring the process, each one in its role in the supply chain (Ozer & Cetin, 2012).

Commodities are traded international in bulk quantities, large carries of grains are moving the food from agriculture main origins and consumer region destinations. This vessel of thousands of tons of capacity, with ships that are classified in different classes, are worldwide standardized, carrying usually from small capacities like 5.000 metric tons to large vessels 150.000 Metric tons or more. The international traffic between independent countries cannot be ruled unless by international organizations on international agreements base between the state administrations. UNCTAD is the permanent body of the intergovernmental Conference on Trade and Development of United Nations, and has a permanent secretariat established in 1964 dealing with trade, investment, and other development related to international trade and logistics. Multiple interests lead maritime lines international cooperation in transport, not being possible to rule by the means of imposed regulatory principles, which are in themselves inadequate ways to set intergovernmental standards for operational practices (Renouf, 1980).

According to data available by UNCTAD, the development of maritime trade overpassed 4% in 2017, and it was the best growth verified since 2012. In the world trade merchandize volumes reached almost 11 billion tones, representing a 2.5% increase of goods transported, being half endorsed to the tanker industry trade, liquid cargos. UNCTAD expects that sea trade volumes to increase in the following years, an estimated multifactorial yearly progress degree of 3.2% concerning 2017 to 2022. This growth might be observed in all segments of seaborne transportations, but especially in container box merchandizes and also in trade in the main solids bulk that includes grains (Sakhi, Ait Allal, Mansouri, & Qbadou, 2019).

Along the past five decades seaborne trade had a huge growth and technological development boosted by the world commerce of goods.

> "UNCTAD - World seaborne trade projections: 2018–2023
>
> Global seaborne trade is doing well, helped by the upswing in the world economy. Prospects for the short and medium term are positive overall – global GDP is expected to grow by more than 3.0 per cent over the 2018–2023 period (International Monetary Fund, 2018), and merchandise trade volumes are set to rise by 4.4 per cent in 2018 and 4 per cent in 2019 (World Trade Organization, 2018). In line with projected economic growth and based on the income elasticity of seaborne trade estimated for the 2000– 2017 period, UNCTAD expects world seaborne trade volumes to expand by 4.0 per cent in 2018. According to UNCTAD projections, world seaborne trade will expand at a compound annual growth of 3.8 per cent during that period, based on calculated elasticities and the latest figures of GDP growth forecast by the International Monetary Fund for 2018–2023. (…) and Dry bulk commodities are projected to experience a compound annual growth rate of 4.9 per cent between 2018 and 2023,"

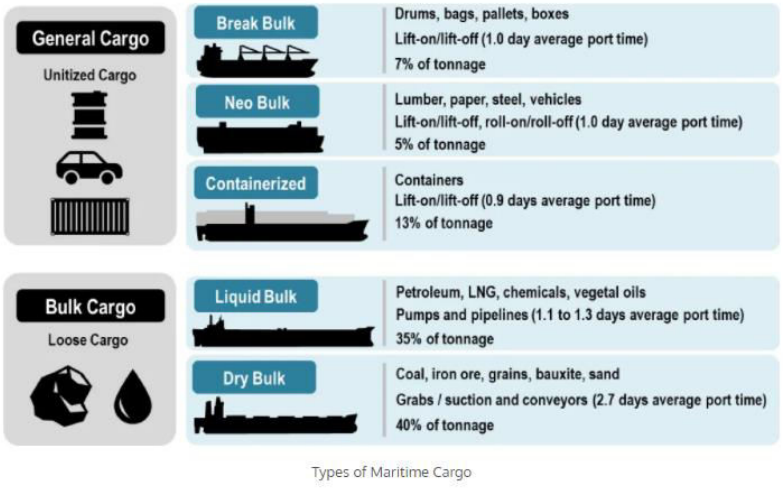
Vessels became specialized by cargo type, the containers standardized and replaced a big share of previous general cargo movements, the bulk carriers got designed for different types of cargos, the liquid and gas fleet turn very technological and specialised by cargo chemical sub-type. The same happened in other families if vessels, like passenger and cruise ships, military vessels, specialized services vessels. At the same time, to respond to transportation of goods demand, the world fleet became bigger, every year more environmentally friendly and efficient (unctad, 2018).

There is not one sole form of classification of vessel, regarding cargo type and service, we follow in this thesis the UNCTAD classification per type of vessel in four major groups: the Oil tankers (used for oil and related product are liquid tankers), Bulk carriers (vessel carrying bug dry cargo like minerals, coal, pellets, grains and others), General cargo (ships for Multi-purpose cargos, like machines, large pieces, others. In this type for UNCTAD are also project vessels, like roll-on roll-off, called ro-ro, for automotive cargo), Container ships (today fully cellular container ships, that observed a large share of the general cargo, standardizing the container box freight use transporting all kinds of dry merchandizes, like clothes or laptops, or liquid packed, example bottles of wine or cans of soda) ; Other ships (like Liquefied

petroleum, GNL tankers carriers, parcel chemical tankers, specialized tankers, reefers, offshore supply vessels, tugs, dredgers, cruise, ferries, other ships).

Figure 44 - Types of cargo ships representation,

According “Maritime Traffic”, the cargos today are classified in five main categories, determining the fundamental type of vessels. Depending of the specificity of the cargo, region, regulations, zone draft, ports operating, and other factors, vessels can have particular different adaptations in each of these types to be able to manage properly the specific cargos, having an immense specialization according the merchandize (MarineTraffic, 2018).



Source: MarineTraffic, 2018. Note: Port time is defined as the difference between the time that the ship enters the port limits (excluding anchorages) and the time that the ship exits those limits. Irrespective of whether the ship's visit is related to cargo operations or other

Figure 45 - Types of Maritime Cargo, quotas and port stay

Ship carriers take the big slice of international trade, estimating its share oscillating volumes between 80 to 90 per cent of international trade flows, and close to 100 per cent in

intercontinental trade. This evidence is even more marked in developing territories where trade network structures are much disconnected with inland intraregional trade and leave reduced development opportunity for land trade transportations. This is not the same picture when we look in value, so the cost per volume is lower in an efficient seaborne operation, the shipping share is estimated around 60 to 70 per cent of transportations global cost of trade. In recent years, air flight transport share, including express deliveries, is growing considerable, also occupying and absorbing the slice of higher valued cargoes and express dispatch merchandize, new commerce, e-commerce support and others.

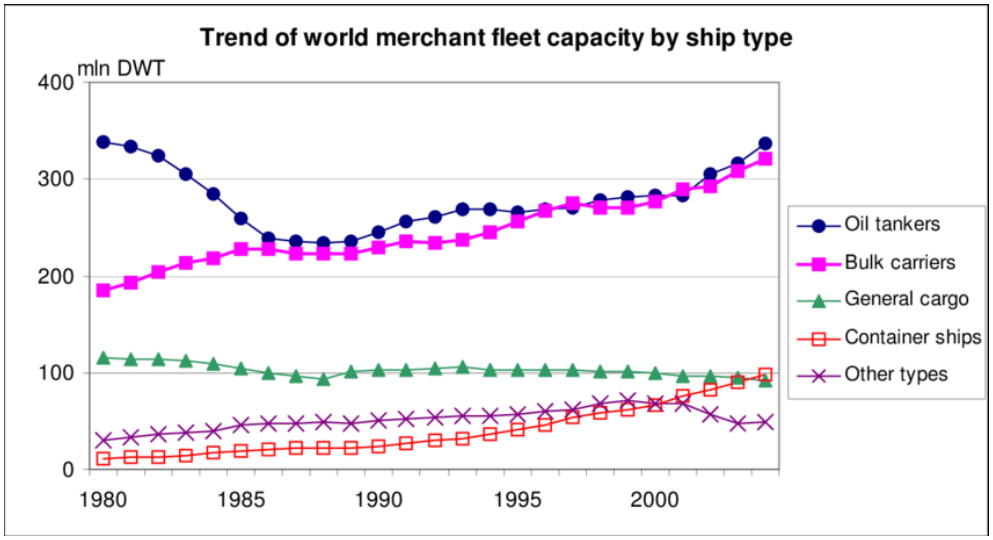


Figure 46 - Trend of World merchant fleet capacity by type, UNCTAD

Along last decades, another evolution took place, looking for reducing cost per ton displaced, the size of the vessel increased in capacity and tonnage. The capacity of the vessel measured in DWT death weight tonnage, the weight that the vessel is carrying, the total cargo, crew and other supplies.

Crude oil tankers	
Very large crude carrier	200,000 deadweight tons (dwt) and above
Suezmax crude tanker	120,000–200,000 dwt
Aframax crude tanker	80,000–119,999 dwt
Panamax crude tanker	60,000–79,999 dwt
Dry bulk and ore carriers	
Capesize bulk carrier	100,000 dwt and above
Panamax bulk carrier	65,000–99,999 dwt
Handymax bulk carrier	40,000–64,999 dwt
Handysize bulk carrier	10,000–39,999 dwt
Container ships	
Neo Panamax	Ships that can transit the expanded locks of the Panama Canal with up to a maximum 49 m beam and 366 m length overall
Panamax	Container ships above 3,000 20-foot equivalent units (TEUs) with a beam below 33.2 m, i.e. the largest size vessels that can transit the old locks of the Panama Canal

Source: Clarkson Research Services.

Table 6 - Vessel sizes groups used in shipping terminology, Clarkson Research

For food commodities, grains and seed like maize, wheat, barley, soybeans, sunflower, rape seed, sorgo and others, usually traded in large cargos of several thousands of tons, farmers, traders, transportation companies and ports are equipped to load/unload and transfer using mechanized automation means for grains and seeds, with modern conveyor lines, mechanical or pneumatic loaders/unloaders, with large debit of tons per hour.

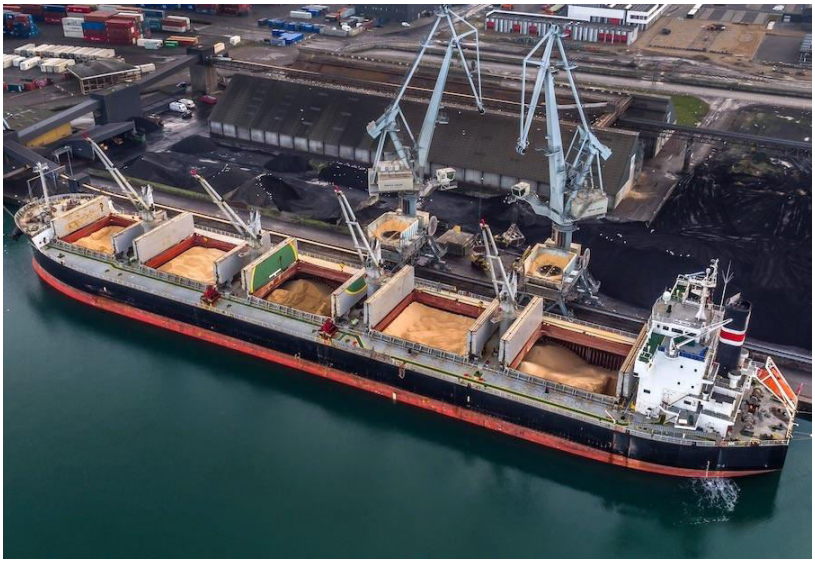


Figure 47 - Bulk Carrier in grains cargo unloading operations

Figure 48 - Global shipping routes, Stratfor

"The similarity of the shipping lanes to blood vessels is an apt metaphor for the role of shipping in global trade. According to the International Chamber of Shipping, around 90% of world trade is carried by ships. As the World Economic Forum's has highlighted, effective global trade is "crucial for reinvigorating economic growth and confronting 21st century global challenges". In a globalized world, shipping is a vital part of an effective trade network." – WEF Global agenda, International Trade and Investment

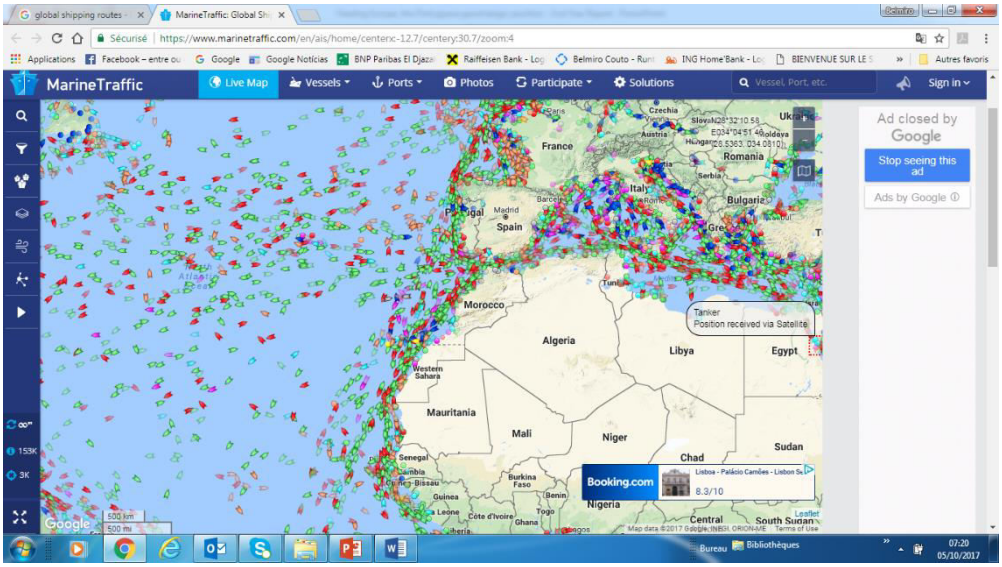


Figure 49 - Marine traffic.com, ship track panoramic view on South Europe

Oceans and Seas are populated with thousands of vessels that are cruising waters continually, attending cargo delivery, vital to sustains economic trade.

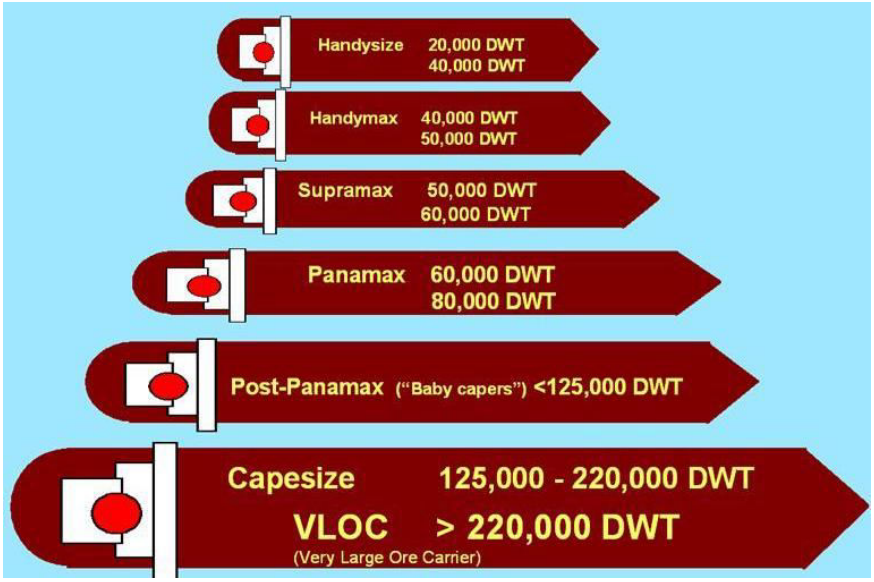


Figure 50 - General bulk carrier sizes, Unctad

Bulk dry cargo of food commodities, as well as container trade logistics, are the cargo type with higher raise in the seaborne trade, bulk commodities, that include grains, and had a

growth in 2017 of 5.1 per cent, representing almost 30 per cent of the total merchant trade in volume (Asariotis et al., 2018).

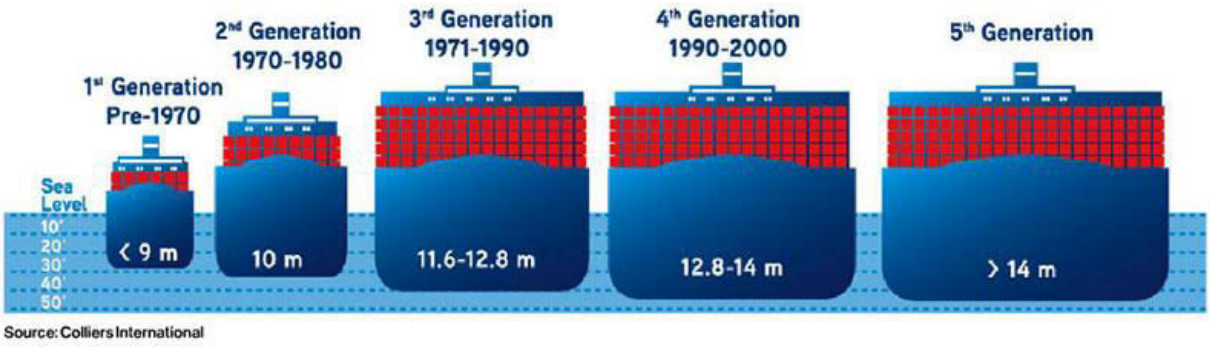


Figure 51 - Vessels sizes grow, deeper waters - Colliers

In the last 40 years, the size raised to respond the demand. Ship-owners built new bigger vessels looking for better efficiency in transportation. This change also implied port capacities to meet these new requirements, piers with longer quays for docking bigger vessels, charge and discharge systems with higher transfer rates not to have long waiting times due to big cargos, and special, bigger deep waters requirements, not easy to find in many world ports.

Operators use bulk ship carrier's transportation as the most common logistic solution for grains and seed transportation in large quantities.

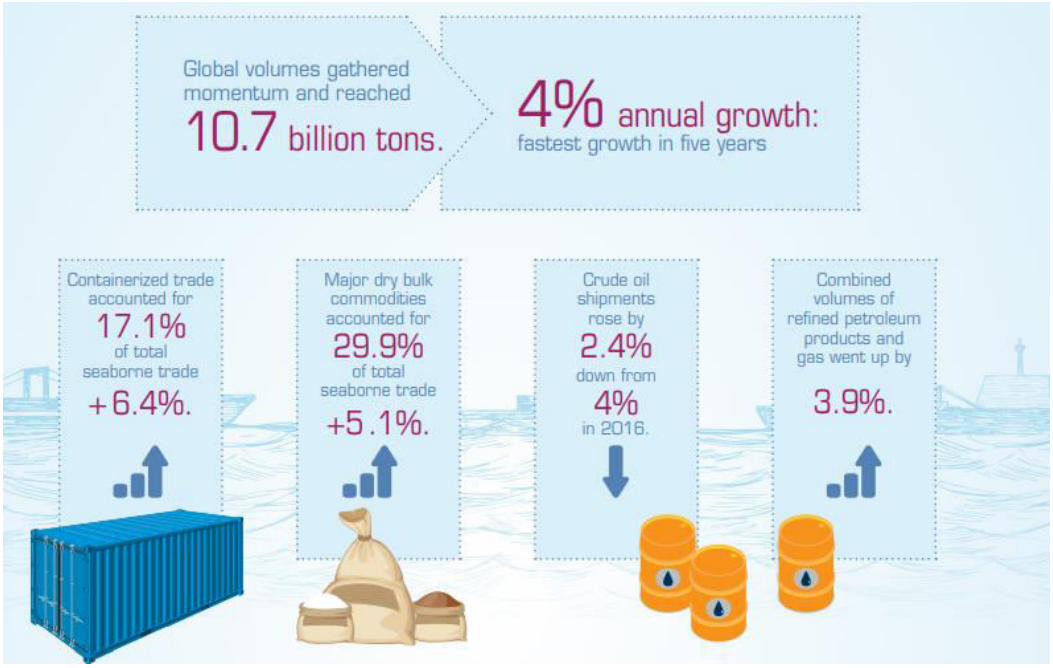


Figure 52 - World seaborne trade in 2017, Unctad

(Million tons and percentage annual change)			
	2016	**2017**	**Percentage change 2016–2017**
Main bulks	3 040.9	3 196.3	5.1
of which:			
Iron ore	1 418.1	1 472.7	3.9
Coal	1 141.9	1 208.5	5.8
Grain	480.9	515.1	7.1
Minor bulks	1 874.6	1 916.5	2.2
of which:			
Steel products	406.0	390.0	-3.9
Forest products	354.6	363.6	2.5
Total dry bulks	**4 915.5**	**5 112.8**	**4.0**

Source: UNCTAD secretariat calculations, based on Clarksons Research, 2018a.

Table 7 - Dry bulk trade 2016-17 and growth, Unctad

Figure 53 - Bulk carrier, Cape Hawk DWT 170K T, L -280m, d-18m - Loyds

Inside the dry bulk cargo, food commodities are contributing with the biggest growth on the annual trade increase for these vessels type fleet. Global trade of grains, altogether including wheat, coarse grains and soybeans, reached 515.1 million tons in 2017, a 7.1 per cent increase over 2016 (Asariotis et al., 2018).

Also infrastructures are constantly adapting for the new sizes of vessels, the Panama Canal, connecting the Antarctic to Pacific sea.

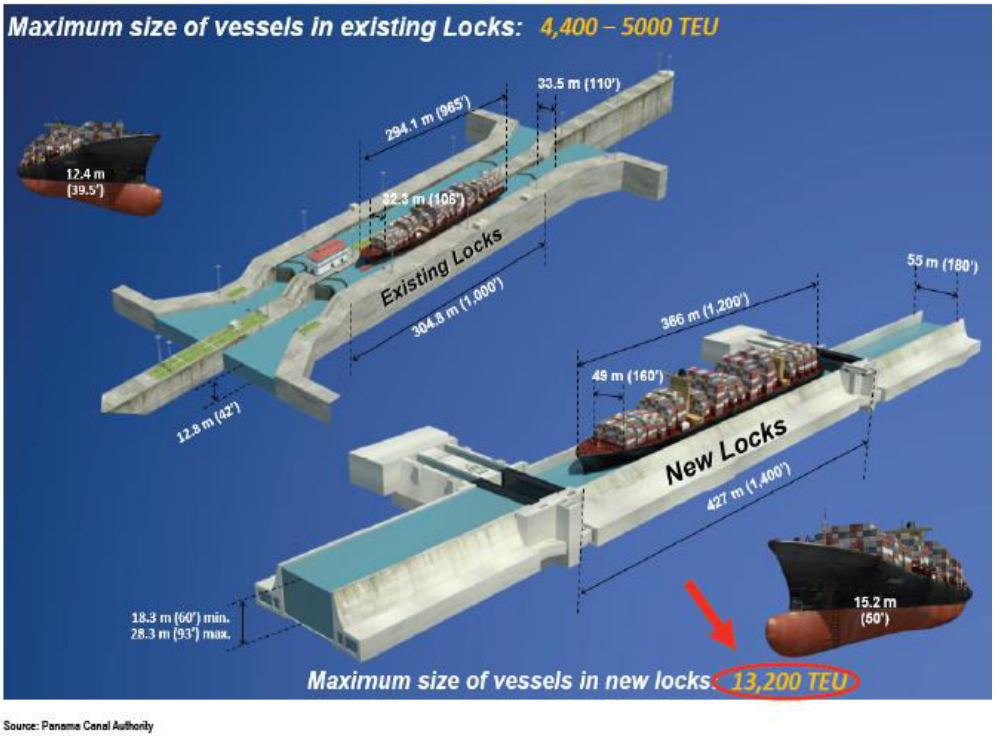


Figure 54 - Panama Canal, doubled its locks to bigger vessels

Logistics operations for grains are usually using “time charter” contracts for bulk carriers, engaging the payment of the transportation service during a certain period of time to operate the transportation of a certain merchandize from one origin port to another destination port, the basis of the contract beign pay per day fee, whatever is the performance of the operation and its time consumption. For a certain logistics job, the purchasing trader hires a “shipper” to perform all operation or takes the role, and once he purchased an amount of grains, the merchandise is usually brought to the origin port by the farmer, close to loading operation schedule on the port. The buyer will use meanwhile his shipping agent, to engage and hire a carrier between different ship owners, looking for the best offer for a period of availability of a certain ship with the characteristics required, type, size and eventually specific equipment for loading/unloading considering the ports or origin and destination. Often the best offer might come from the closes ship available for the period, to the port of loading. In fact, a chain of other players acting as agents for specific specialized tasks are involved, once many operation in different ports are to be operated, so the specialization of these professional tasks is for the better use of the capacities and an improved global efficiency of the operations. Also, other types of chartering contract might be used, the voyager charter, or the contract of affreightment. The voyager charter contract differences because the shipper specifies a maximum interval of time and pays the voyage and does not care about the vessel, or time consuming of port and navigation problems. Differently, on the contract of affreightment, the shipper engages the transfer of the merchandize, in a certain time frame, does not interfere on the choice of vessel, either in managing operations, beign usually used for small quantities cargos in combined transportation operations or lines.

In the grain business, time charter being the most effective way to perform the logistics, the buyer must maximize all parameters to make more efficient and lower cost per metric ton of merchandize and its logistic operation between ports.

It is critical the differences of day rate of a vessel, which is related to its type and category size, the bigger the vessel, more expensive per day, but also more tons can be loaded and transported, bringing the unit cost lower. To illustrate, we used the 2017 medium tariffs for a time charter operation, published according to UNCTAD data in the Review of

Maritime Transport 2018, already cited. Logically, the cost per metric ton of merchandize in a Panamax or a Cape size vessel is substantially lower than in a smaller handy vessel.

	UNCTAD 2017	MTons	daily rate	Time forward	Anchorage	Days in ports	Tot Cost
Vessel Category size	**daily Rate $**	**capacity**	**$/MT**	**Santos/Hamburg**	**days**	**loading/unloading**	**$/MT**
Cape Size	*14,227.00*	*120,000.00*	*0.12*	*24.00*	*3.00*	*12.00*	*4.62*
Panamax	*10,570.00*	*80,000.00*	*0.13*	*24.00*	*3.00*	*11.00*	*5.02*
Handy Size	*9,185.00*	*25,000.00*	*0.37*	*24.00*	*3.00*	*8.00*	*12.86*

Table 8 - Freight cost per ship type example, Unctad rates 2017

The example of the calculus of previous table, considered a full cargo of soybean, loading in the Port of Santos in Brazil, a typical soya loading port in Brazil, and later discharging at Hamburg, in Germany, a typical and most common port for soya unloading in European west coast. We used also the approximatively navigation miles and respective calculus of the trip time for estimation of the total time charter cost of the vessel, on the professional site “searates” from DPWorld, to evaluate the transit time (DP World, 2020). To have the total freight we would have to add still many other cots, the time charter for 6 days of loading and also 6 days for discharging, the cost of the operations in ports for loading and for unloading, transit dispatch services in both ports, kay docking fees, port pilotage, port taxes, VAT taxes, and others.

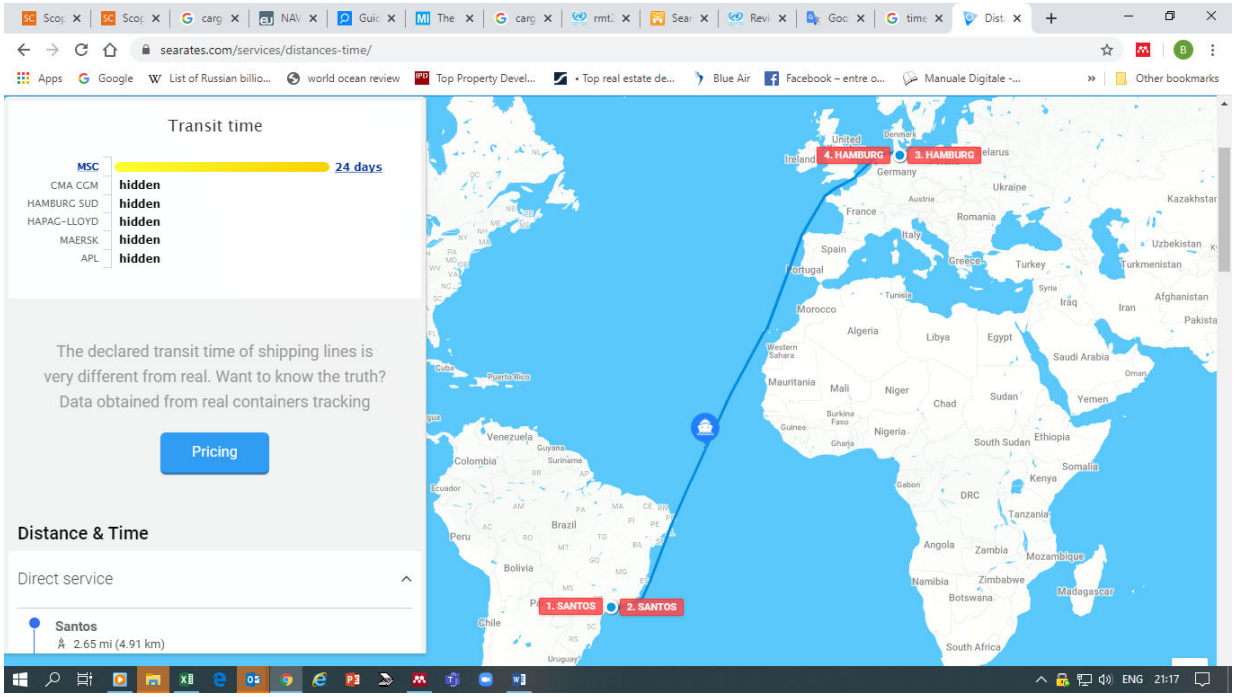


Figure 55 - Simulation of a time charter from Santos-Hamburg, Searates

In this exercise with approximate figures and values, just to identify the importance of this factors, we want to illustrate the calculus of the difference in cost impact of only the time charter contract, so we can show how important is the size of the vessel in long international cargos, once the cost per unit might be impacting the price of the commodity significantly. To explore even more this practical example, although is a virtual exercise, we used approximatively real market values, considering a price of 309 USD/MT (CBOT quotation for Soya in April 2020) for the soybean metric ton, the variation of cost 8,3 USD/MT being 2,7% of the value. In a total, loading capacity of the ship of 120.000 tons represents almost 1 million dollars in one simple cargo, sometimes, this might represent more than the margin of trade deal, being an essential difference for achievement the closing of the trade contract. In this example exercise case, this difference in the time charter tariff might influence determinately the trade lead of a total cargo of around 40 million USD in global contract value. This showing that vessel size matters.

2.5 Port Competitiveness in the world

The global logistics world ship fleet is getting bigger on size, as we saw in previous paragraph and sub-chapter, and vessels size matters impacting tremendously the commodities trading business worldwide. This is why in the past few decades vessels are transporting more and more tons of merchandize looking for lower cost of transportation per unit. Also it is trying to reduce time to market with all the commercial and financial impacts when companies could close deals sooner, vessels getting more speed and a modern design and powerful propeller engine machines; also vessels got specialized by type of merchandize, to get more efficiency in transport and port operations, being bigger for higher quantity of merchandize. Port operations became more time consuming, especially procedures for loading-unloading both in vessel and port terminals, turn into specialized terminals and equipment according merchandize type, vessels and equipment's for operations further fluent is the main concern of respond to the competitiveness of its clients operations and efficiency of the port (J.-P. et al. Rodrigue, 2017).

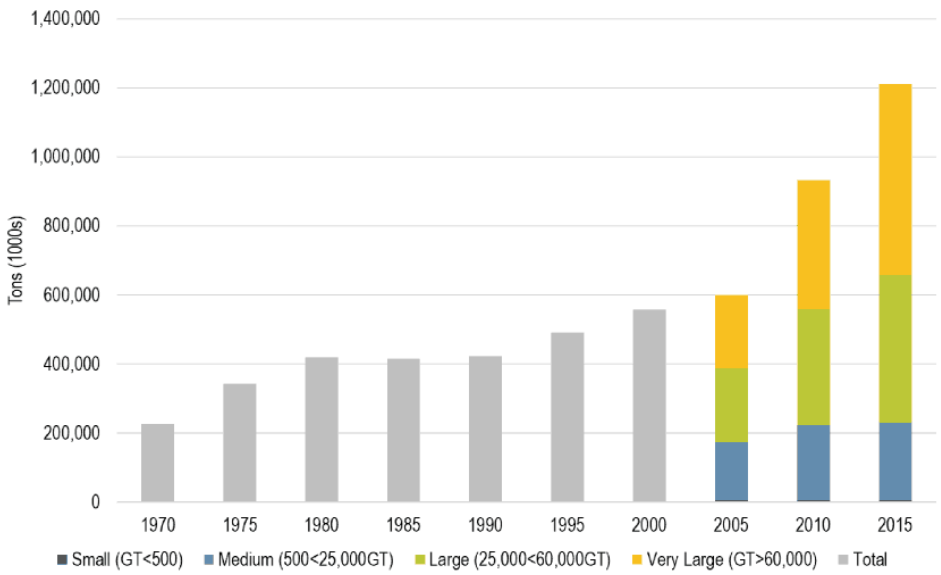


Figure 56 - World Merchant Fleet, Tonnage Registered per Ship Size, 1985-2015
Source: Lloyd's Register of Shipping. Statistical Tables, World fleet statistics and Equasis.

Global demand of agricultural products is projected to continue rising through 2029/30, and trade is the response to this demand. Ports are the front-end terminals for the

transfers of food commodities between world regions. The past and continuing expected increase in global agricultural imports is propelled in general from emerging countries and low to middle income populations. On the next decade, an increasing food and feed demand in developing economies is expected to account for large the growth in world consumption of agriculture commodities, as we saw, depending from imports of agricultural commodities during next years. Developing countries account for more than 80 per cent of the projected growth in the global demand for grains, feed seeds, meet and oilseeds. Income growth of the population, moving life style to urbanized areas are projected to remain strong and increasing figures, this will give strong stimulus for a sustained progress in demand and also in trade of agricultural commodities. Population figures growth is very strong in general on emerging economies, and this fact is contributing for the important rise and importance of agricultural products trade. The market is today every day more global, any disruption in one corner of the globe impacting the opposite corner of the planer. The recent “African swine fever” spread in a number of countries in Europe, and had strong consequence in several other countries, especially in China, where a large impact on production and consumption projections (ODonoghue, 2018).

The analysis of port competition is often based on the individual characteristics of ports rather than on port connections. Network analysis of traffic between ports reveals their relative position and the results confirm the rise of secondary ports compared to their main competitors, thereby reflecting the importance local port policies, the overall structure of the regional network of ports by a few major hubs that manage to prevail (César Ducruet, 2011).

The seaport is a place of contact between two modes of transport, land and sea, the ports have progressed with the pull of vessel technological advances, with their major functions, and their construction cannot be abstracted from the geographical environment. The sedentary and maritime professional environment shows the influence of port activity on the urban economy of a port region, highlighting the relationships between port growth and urban morphology (Vigarié & impr. Hemmerlé, 1979), Vigarié also established a steady consensus of the concepts of maritime range and port system, initially illustrated a set of neighbouring ports in a near range and their interdependency whether in land and trough sea trade operation connections. Ports being considered the front-end of inland territorial

corridors, it have been ranked in a continental perspective placing in hierarchies their capacities of attracting seaborne traffic, while always trying to spread their hinterland stimulus and positive impacts. Some scholars deeply worked to provided spatial models (Monios & Wilmsmeier, 2013) suggesting a trend towards an increasing level of cargo concentration in port systems. A port region notion developed other spatial models for the port zone expansion making the focus on the governing institutional interactions, leading the complex inland multiple connections in a port. The concept accounts for the fact that modern ports operate in an increasingly complex and sophisticated transport and logistics environment, embedded within multiples planning activities from different and sectors.

Another scholar have continued focusing primarily on hinterlands, the rise of intermodals platforms and multiple logistic chains all over the place around ports. Economy actors are changing their place and also their behaviours, as a consequence of many progresses in economy, technology, and society. The old limits no longer stand, and seaports are probably facing this phenomenon more than other territorial units. Port-related downstream activities are rushing to be located in other territories in secondary centres at more or less detachment away from the port zone, this is making the so called 'port network'. The growth of port networks is an innovative chapter in the advance history of ports hinterland geography and as actor influencer in economic development (van Klink, 1998).

Modern operators look for value in supply chain management, an integrated perspective of the whole chain transaction cost. They come with new approaches, using integrated digital tools for developing integrated services for the best achievement in cost, of the all included operations and services, in end-to-end transaction maneuver. This integrated vision, using modern technology for combining the multiple elements of an entire supply chain management fold of operations, is the aim of modern high tech tools intended for the best proficiency applied to trade and logistics operations. "… A port can be conceived as a logistics platform, where a group of enterprises interact and work together in order to increase the operational efficiency of each one and of the system as a whole, allowing competitive advantages that translate into gains to the community, such as consumers. As organizations, ports are local communities grouping several actors belonging to competing and complementary networks, who come together for both individual (e.g., own profitability)

and collective (e.g., making the supply chain feasible) purposes" (Cacho, Marques, & Nascimento, 2020).

The fast and persistent rearrangement of the multiple world supply chains and also of the logistics paths where specific ports are part integrating make existing paradigms no longer suitable to give comprehensions about the duties of port administrations and their responsibilities. Today the port with all its infrastructures, terminals and capabilities, grouping also their operators, must be seen as components in a long value-added supply-chain system, which is often integrated in constellations of many other players. These conjunction of services must give value to the shippers and ship owners, serving the vessel and the cargo forwarding, operating in the port space, all service providers together, interconnected and complementing their services offer, covering a complete pallet of services from the large group of companies operating activities in the port. Also many port authorities are focusing in customer segmentation, and operations specialization, with technical terminals and support infrastructures focus to target a unique solution value proposition, also capturing value for itself and for all the members of the services which are embedded in its dominium. The large responsibilities of the port authorities imply they shall consider decision in long-term strategic planning, understanding and defining the best role of the ports, the way they position and rank themselves in the new international port business environments, defining their role and place, in the new paradigm of ports systems, being an essential component in a complex value-chain, and no longer a infrastructure with simply more or less individual systems and functions (Robinson, 2002).

Today the competitiveness of a port seen in longer on its capacities and infrastructures to operate its main obligations of cargo handling for which it must be well equipped, or related to its inland interconnections, for which it must be well integrated with other cargo solutions and systems of supply chain interconnecting inland functions. Although the port is equipped and has the know-how of the technology to provide services to its clients, the customer might well escape to other competitor ports due to its hub-related relations with the supply-chain integrations that connect a certain port system. Outing in different words, port competitiveness implies nowadays the engagement of many other actors that might be engaged with the supply chains that can be attracted to operate in the port system. Today the

port is a piece of a complex supply chain of players, continuously looking for added value in the choice of the hubs for the stream of the merchandises flow, valuing from origins to destinations. In its strategy, it must be interpreted as a cluster of multiple other organizations inside and outside the port zone, integrating all interconnecting transportations that together build the value for its final customer. This value is observed when always a port operator, as well as any logistics supplier connected to the port, can go far beyond the simple basic transport of merchandise, beign able to offer a package of differentiated services in the logistics chain of integrated operations, to respond each specific customer to its unique requirements, this beign the high value which the customer is willing to pay for (Carbone & Martino, 2003).

The analysis of any merchandize or commodity flows is inseparable of their productive origin as well as their spatial destination, the overall supply-chain value again. Transposed to the seaport, the problem remains the same: the port refers to a maritime space in on one hand, and land on the other hand, but also to a place where transport occurs and particularly coordination of the different stages of a supply-chain are to be observed. The “triptych concept” of many authors, the hinterland, is defined as "the land space in which the port sells its services and, consequently, recruits its clientele", the maritime horizon is "an oceanic concept", it refers to "maritime routes", therefore to trade flows, but also to types of exploitation, "the determinism of the ship", because the nature of maritime navigation imposes consequences on the human environment of ports, this also including ship-owners and traders, their professional organizations, customs administrations, the port own structure, by the orientation of its development policy within the framework of maritime competition, also by the role of the management authorities.

The space “maritime, port, land” trilogy has been widely used since in the specialized literature, models on the spatial and functional evolution of ports and its port systems only partially fit into the new freight distribution paradigm (T. E. Notteboom & Rodrigue, 2005). Because the figure of the triptych manages to simply, synthesize, the devices or the existing transport systems in the port and their spatial projection. The figure of the triptych places the port, confused with the maritime city, in the center of the scheme and assemblies on both sides the foreland and the hinterland. The port is the physical interface between the

terrestrial and ocean dimensions but also an interface in the system, the equal weighting of the three elements, maritime, land and port and their equal importance in port dynamics (Dubreuil, 2005).

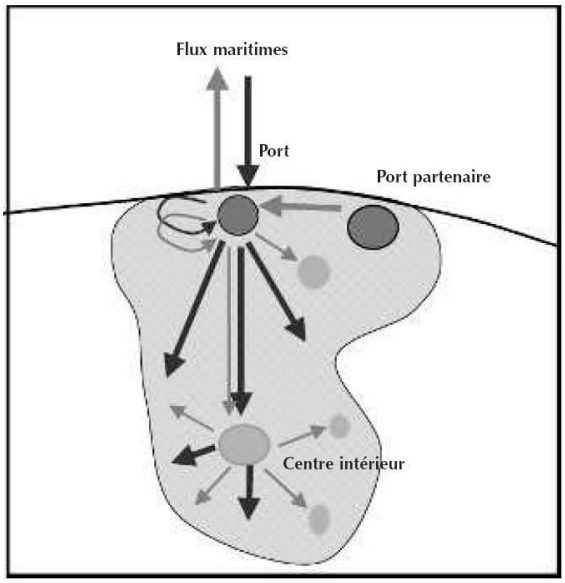


Figure 57 - The port trilogy, according Dubreuil

Although the development of peripheral ports and offshore hubs has a maritime purpose for cargo distribution towards secondary ports (Slack & Wang, 2002), their emergence has been interpreted from the hinterland perspective of a port regionalization process leading to the formation of a 'regional load centre network' (T. E. Notteboom & Rodrigue, 2005), there remain important local deviations from general models of port system development, due to local contingencies that provides a review.

The definition of port systems has often been limited to coastal morphology, like oceans, seas, basins, gulfs, straits, deltas and to geographic proximity between ports situated within administrative borders on various levels (Ducruet, Lee, Roussin, & Lee, 2009). These authors made a synthesis about a number of case studies of port systems. Port systems have not been defined and delineated from the maritime perspective of inter-port linkages, this raising the question whether physical factors and geographic proximity still play an important role in the current spatial patterns of shipping circulations. The concepts of maritime region and port region, which remain rather descriptive and vague in the literature, may benefit

from the application of similar frameworks than in other studies of global networks (Derudder & Taylor, 2005), allowing for the definition of coherent groups of ports as well as the identification of leading ports.

Maritime networks are basically defined by the see trails of vessels displacement between ports, while other transport land networks are deeply studied and analyses by scholars, there beign a scarcity in studies about maritime networks empirical studies, although no motivation might be found for justifying this fact. Although maritime transportation takes a shares pf around 90% of the global trade merchandize volumes, the industry did not attract yet many scholars to devote their studies to analyse maritime transport systems as other transport did (Ducruet, Rozenblat, & Zaidi, 2010). The maritime specificity is that vessels move in a free space in what convers the spatial territory, not using roads or iron tracks like in terrestrial transports, or corridors in the atmosphere like in air transportation (White & Senior, 1983). The constraints of maritime networks are the continental platforms served by existing canals in coastal geography of the territories, ships having to contour the continental platforms. Unless there is a canal (like Panama, Suez, others), in ocean navigation, vessels can flow freely, leading the captain to take advantage of flows of oceanic water currents and favourable winds predominance. Depth is often the most conspicuous limitation when approaching the entrance of ports or even in the terminal pier. Political barriers might also be obstruction interdictions for the navigation in certain close to shore waters, ruled by countries without circulation agreements, but in general for the rest, oceans are free to use and navigate in international waters, without physical factors unless weather conditions, these might be the only traps for free navigation, storms, strong winds, icebergs that are not impeditive factors for modern big vessels cruising oceans today. This inconsistency given by volatility and spatial complexity on the ocean paths definition might be one major fundament why maritime networks form a vaguely defined distribution when likened with terrestrial networks (J. Rodrigue, 2020).

Extensive empirical research has been made in the South East Asia region (Liu & Park, 2011), to study and analyze why some ports are developing higher growth rates than others, revealing and concluding that in fact, much more than the services, infrastructures and

capabilities of the port it-self, the maturity of the industrial activity in the hinterland economy is the major pulling factor to merchandize throughput high performance.

Maritime routes are structured according to the type of commercial service they support, which comes in three main categories:

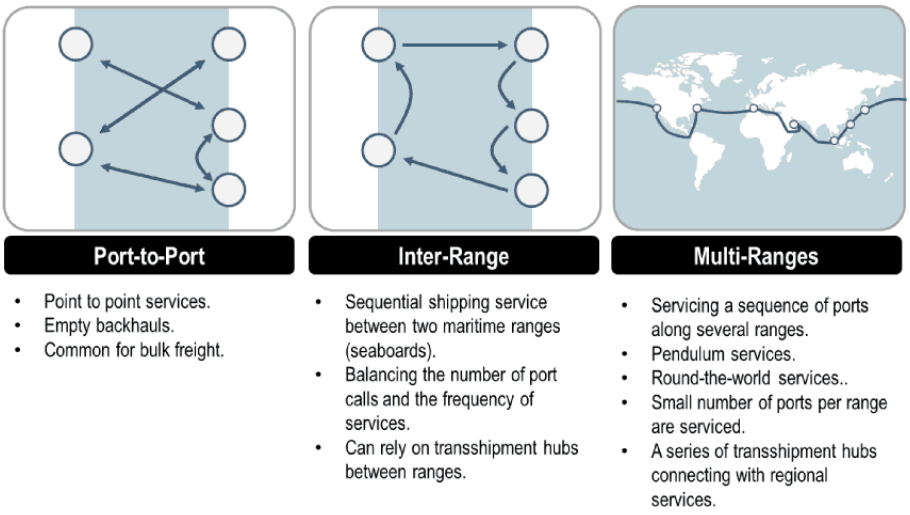


Figure 58 - Types of Maritime routes, Rodrigue

Port to port – many time the vessels movements back and forth, dedicated to the trade stream of the same type of cargo, repeated seller and client, picking in a fixed origin and unloading in the unchanged destination, moving the merchandize in an unidirectional flow, which causes the return of an empty and useless backhaul. Raw materials like minerals, oils and grains are many times subjected to this king of cargos, linking production origin port with the consumption destinations ports as market imposes. These are most common time charter contracts with the ship-owners loading in one port and unloading the cargo in one to three ports in proximity at the destination.

Tramp ships (for hire) do not have a specific network structure and service ports. Inter Range – usually called liner, the vessel makes a regular path between a chain of a sequence of ports, shipping agents and traders are contracting partial cargo capacity of the liner, in one slot of the regular course of the vessel, sometimes a group of vessels making the same line in carrousel, depending of the market demand. Many inter range liners are operating permanently in East Asia to North America, North America to South America, or Europe Atlantic Coast and Mediterranean, or Africa coast. These carousels in the main

economical tradition trading regions are then interconnected with world cargos by multi ranges lines.

Multi Ranges – are long large distance maritime paths calling hub ports along more than two ranges. Frequently the sequence of ports implies a circumnavigation around the globe, defining a path, usually served in two ways, to interconnect the world hubs and then distributing regionally in inter range systems from these transshipment hubs (J. Rodrigue, 2020).

Some scholars analyzed the important competitiveness factors for a port, chosen by the ship owner to integrate its line, allow the port to grow, attend more cargo, increase and maximize its services (G. T. Yeo, Roe, & Dinwoodie, 2008). The services capabilities and performance of a port, also prolonged to the attractiveness of businesses in the hinterland of the port, are of major interest of port administrations to increase the competitiveness of their services towards the exporters needs, to increase the performance of the logistics networks dropping whole cost of the commercial operations and transfer of the goods, this counting also the multiple indirect costs produced by delays of port operations and other unreliable factors (Dappe & Suarez-Aleman, 2016). Also cluster factor analysis has been performed to improve some port operations, based on the same competitiveness criteria, including issues like the berth for docking, regarding depth, length and availability, terminal tariffs applied to services, load/unload rates of typical cargos, average waiting time for mooring, among other factors, classified using cluster analysis methodology to evaluate port attractiveness grounded on the skilled verdicts of logisticians (Cabral & Ramos, 2014).

The typical and common factors that are influencing the competitiveness of a port, focusing in tis intrinsically internal services and capabilities, have being described by Yeo, Roe and Dinwoodie in a construct, upgraded and later used by this thesis to also evaluate the importance factors considered by the participants in the panel of in-depth interviews made on the chapter “6 - Industry leader’s discussions about logistics efficiency gains, a new South West European Grains transshipment Hub”of this research, as later described in the methodology.

Many other inquiries of scholars used the same Yeo pioneer construct for empirically evaluation of the port services in several research papers (Shuwen, 2017), the empirical

construct organization dividing the port competiveness in 7 majors factors (Port service, Hinterland condition, Availability, Convenience, Logistics cost, Regional center, Connectivity) each one sub-divided in 2 or 3 variable in a total of 18 variables. The research performed intended to define the components for an assessing and valuation construct of port competitiveness. It was a good contribution for the research on this field, once there is not so much literature and research work in the industry. The results concluded in what extent each of the services are more valuable for the ship owners and might influence the port choice for operations, giving relevant lessons for the port strategy and its development policies.

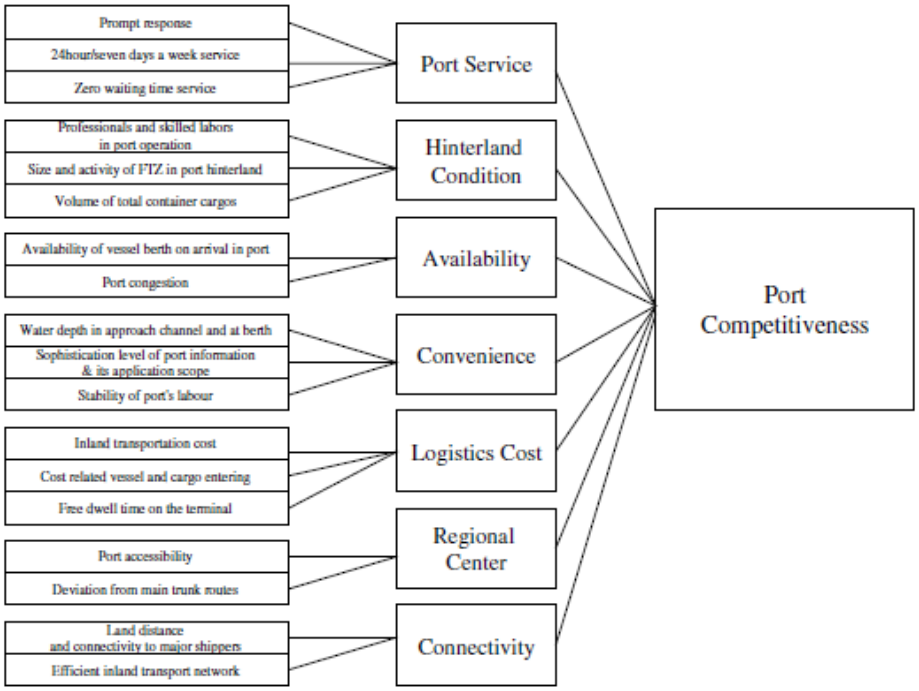


Figure 59 - Evaluating structure for port competitiveness, Yeo and Roe

2.6 Time to market, financial and supply-chain management impacts

In international trade and logistics, operations time consumption is a precious element for the management responsible. Time to market, meaning bringing the merchandize more quickly to industry consumption is critical in the business, as we will see further down. Although the subject is involving very serious considerations and impacts, we cannot find many literature or research related to this important subject area. Some authors are focused in production and supply chain inventory management, where some lessons might anyway be

taken, considering that the food commodities flow is in any case an inventory of stock material being hold for a certain period before delivery to market. As we will see later in this thesis research, time to market factor is a main issue for the conclusions of the document.

Enns studied the incorporation of value in two perspective, the holding cost along time with the leading objective of cost reduction based in stock decrease in quantities, also the value added to the final product by incorporation of material purchase and incorporation of transformation phases of the process (Enns, 2011). Another perspective from Leonardo Riviera, also followed by several scholars in the calculus of the cost of a product, is the obligation of integration the resources used costs accumulation along the manufacturing chain, in an accountability traditional perspective, but also by the construction of a VSM value stream mapping approache showing the incorporation of value in the product construction along the chain (Rivera & Frank Chen, 2007). The volatility of the agriculture food commodities quotations is investigated by Ahmadi in the correlation with the oil energy market, using a model of the structural vector autoregressive SVAR studied for several periods including the 2008 global crises period, of high volatility of the prices of the commodities, concluded for the high correlation between the food commodities and the energy market commodities, in the different episodes analyzed (Ahmadi, Bashiri Behmiri, & Manera, 2016).

Identifying the impact of the inputs, this is the feeding components of the dietary of the poultry industry. Cinar & Keskin showed how the stock of food commodities and its volatility on prices are impacting the meat production in Turkey, finding the measures of impact of the cost of commodities in the price of the meat, leading to the conclusion how important is to integrate both food commodities and energy market variables, on the business strategy of meat production (Cinar & Keskin, 2018). Being an important highly cited reference on the studies on volatility of food commodities, Abbot, resuming many other scholar studies, analyses the interaction of several factors along past recent experiences considering recent world crises, also the recent periods of world economic growth and consequent food demand, discussing around how food commodities are subjected to various factors influencing their prices in international trade, condensing in three main envelops all other factors: the global changes in production and consumption changing the offer demand

equilibrium, the USD volatility in which commodities are linked, and the biofuels completion on the food market. These envelops are gathering many multiple factors that are influencing the trade of food commodities in global markets. Essentially the growing food demand in developing countries, leaded by China and India population growth, although struggling to improve agriculture for self-sufficiency levels, are very far from covering the internal demand (Abbott, Hurt, & Tyner, 2008).

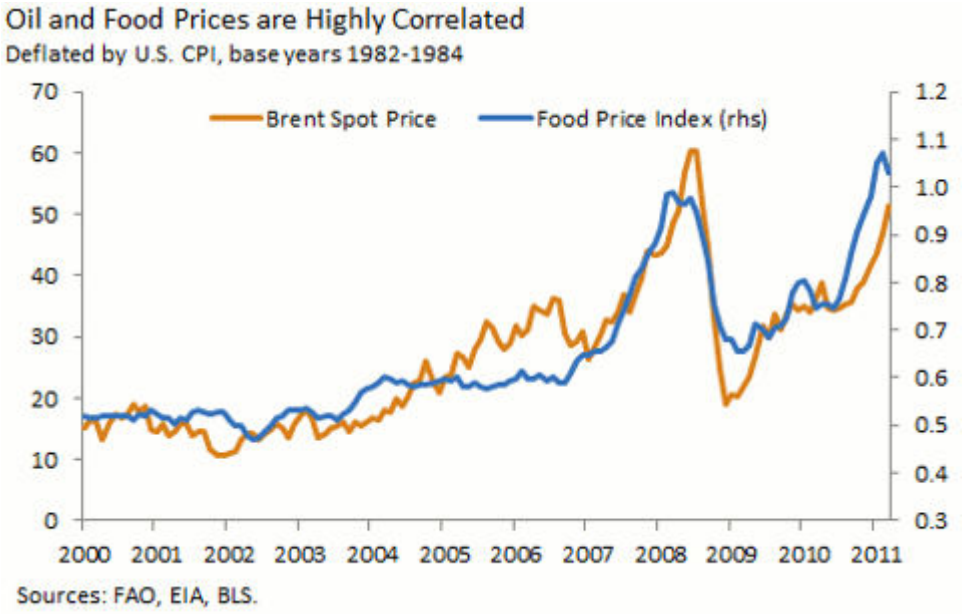


Figure 60 - Food commodities and Oil, prices correlations

Food commodities and Brent have strong correlations (Ali, 2011). The economical crises and the economic growth periods correlations between a food commodity price index give us obvious graphical interpretation.

Hedging food commodities grains imports is a common operation in the big trading houses of food commodities in world, introducing financial costs on the value of the merchandize, but reducing risk exposure, essential to compensate price fluctuation on the market during the hold time of the merchandize. Making a back-to-back operation, you do not need to do this safekeeping financial stock operation, once your business is not exposed to the risk of the price fluctuations. But not always is possible to back the purchase of food commodities with an immediate sell to the client. So risks exist and extend a long time. Using the futures market of the exchange bourse for that commodities, of correlated products that

minimize differences in price fluctuations, traders make the opposite operation of the futures market and get the compensation difference in the end of the period, whether there is a loss or a gain, important is to secure the margin and not take risk in the beginning of the operation. This is the essential for the use of hedging instruments that cost a margin the trade operation, not get caught by the risk, especial of falling quotations. This phenomenon and instruments are studied by different authors (Sarris, 2010).

Also come controversial analysts consider that the future market of food commodities turned this products into speculative trading items like raw materials, metals and energy (Lehecka, 2015).

Figure 61 - The facts behind the food prices, CME

"Effective markets are part of the solution to managing grain price volatility as a result of these factors behind food prices. Farmers use our futures markets to manage their price risk, and speculators play an important role in these markets. They take on that price risk in exchange for the opportunity to make a profit. In doing so, speculators are providing much-needed liquidity to hedgers and helping to discourage the swings in

price volatility that might otherwise be much more severe without them" (CME Group, 2012).

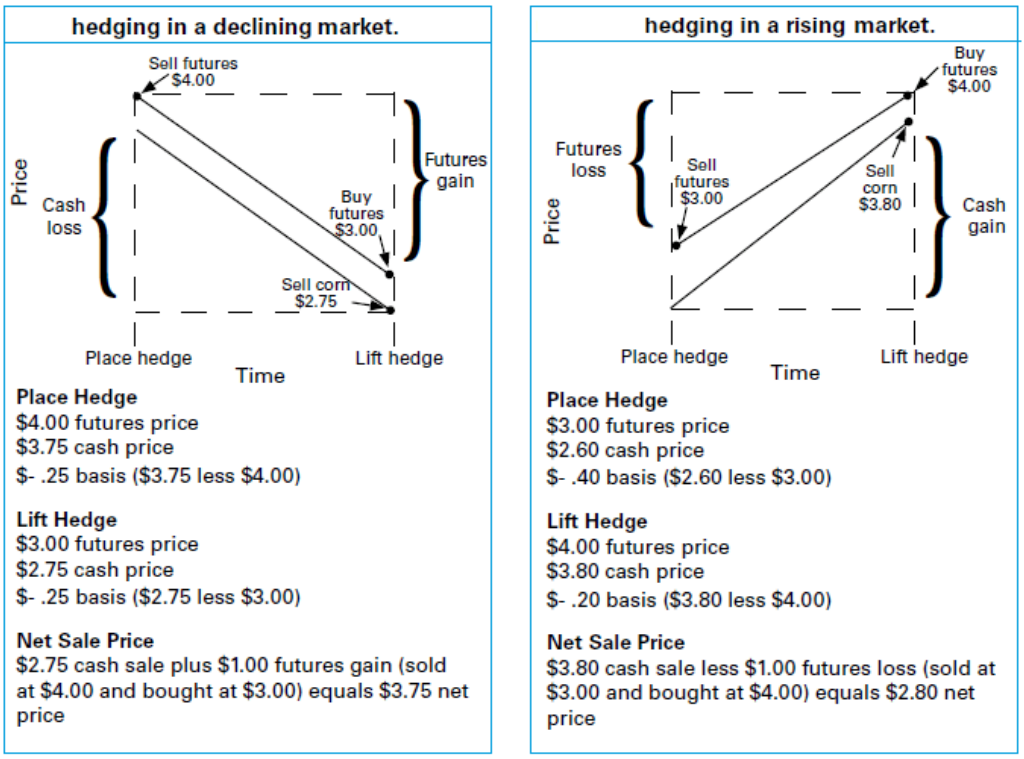


Figure 62 - Hedging operation example illustration, Wisner

Hedging is the operation of securing a cash stock, by taking opposite and equal positions in the cash market and in the futures stock market for the same product or a strongly correlated product (Bob Wisner; Don Hofstrand, 2015).

If hedging the operations can take out, or deeply reduce the food commodities price fluctuations, reducing risk, impacting tremendous in the value of the merchandize, endangering the profit or the loses in all the complete value chain, we may require then to oblige the trader for doing so. For the big world trading houses this is an easy recommendation. But here resides the problem of the accessibility of these complex and expensive financial instruments of the stock exchange future market, not accessible for small companies and/or developing economies players. In small companies, especially in developing countries, cultural knowledge of hedging is scarce, but even moreover the institutional environment, banks and stock exchange access, is not prepared or available.

Time – to – market is a critical variable in food commodities trade. The value of the stock can very easily change: for speculative market factors, word rising food demand growing faster than production, bio fuels competition in the oil seeds markets, depreciation on world currencies especially the USD and the EUR, the oil energy price fluctuations as important impact on commodities production and logistics, beign very related to international politics stability and peace, the oil price fluctuations also affects the fertilizers market volatility having in food commodities direct value change; but also because food commodities are biological products being subjected for many possible adverse conditions that are likely to change productivity like the climate factor impacts on the harvest, phytosanitary events in crop diseases and consequent losses, also the biology of the product might deteriorate and loose consequent value during stock hold time due to plagues, fungus, contaminations, excess humidity or others.

Above all, food commodities are quoted in exchange bourses worldwide and, as any other stock product, have cash and future products like gold and oil, though subjected to value speculation influenced by major investors and market movements of the capital invested in stock products. It is true that the adverse consequences of food commodities price fluctuations impacts in the end human consumption food products, what is especially critical for poor and developing countries, their food security representing a major concern for international organization like FAO, World Bank or IMF.

Concluding that very important costs and risks are attached to the time to market of commodities today, it is critical to reduce and control this factor. Time to market impacts, whether it is long or shorter is changing relevantly financial hold costs. Exposer risk on market price, deterioration of merchandize, these might all be calculated and taken in consideration, but also business opportunity, in which a certain trade is limiting the capacity of the trader to make other opportunity business, better or worse we never know at start, so each trading house has not and endless investment capacity of financial resources, or managerial teams attention for endless trading leads.

Exposer to price fluctuation, cost of capital in the allocation of cash for a transaction, or deteriorations of the merchandize risk are examples of costs that can only grow with the time-to-market factor, that is, as much time the logistics trading operation takes, more costs

and risks are involved in the operation, also potentially losing business opportunities blocking other operations at the same time, for limitation of the various resources implied.

Figure 63 - Soya trade, seaborne bulk cargo operation

Let's take a hypothetical example to understand the size of the value of this issues appointed. Soybean meal is the solid remaining part of the soya after oil liquid extraction, very precious for mixing in feed compound for animal meat production, due to its high value of protein content. Consider a trade lead closed in 18 march 2020, the same day of start loading the ship, a typical supramax vessel loaded with 150.000 Metric Tons of soybean meal, navigating between South America and Europe, traveling between the port of Itaqui (Sao Luis do Maranhao, Brazil), port of loading, and evaluating two different destination ports with difference "time to market" due to distance, Hamburg (Germany) and Sine (Portugal), unloading, a complete cargo of "soybean meal". We always refer values in the CBOT CME quotations price, on the departure, in 18 march as 304,0 USD per short ton. Choosing as destination Hamburg (in Germany) versus Sines (in Portugal), navigating at 13 knots per hour, this vessel would take the merchandize cargo to Hamburg in 14 days of navigation, in opposition with 10 days of navigation to Sines. Let's consider as exercise a time charter contract for the vessel, at 15 thousand USD per day, also adding plus 5 days for loading the

cargo at the origin in Itaqui port, in Brazil. Supposing the trader is able to sell the total cargo on the day of arrival to the destination port, this means we will consider the navigation time + loading to Sines (10 +5 days) and to Hamburg (14 + 5 days) and according to CBOT CME quotations for soya meal on the day of arrival, the value is changed showing the risk of exposure to market real prices fluctuations. Considering as example the quotations given by CME Group (CME Group, 2020), the CBOT market exchange operator, on the last 6 months, we can observe the following fluctuations:

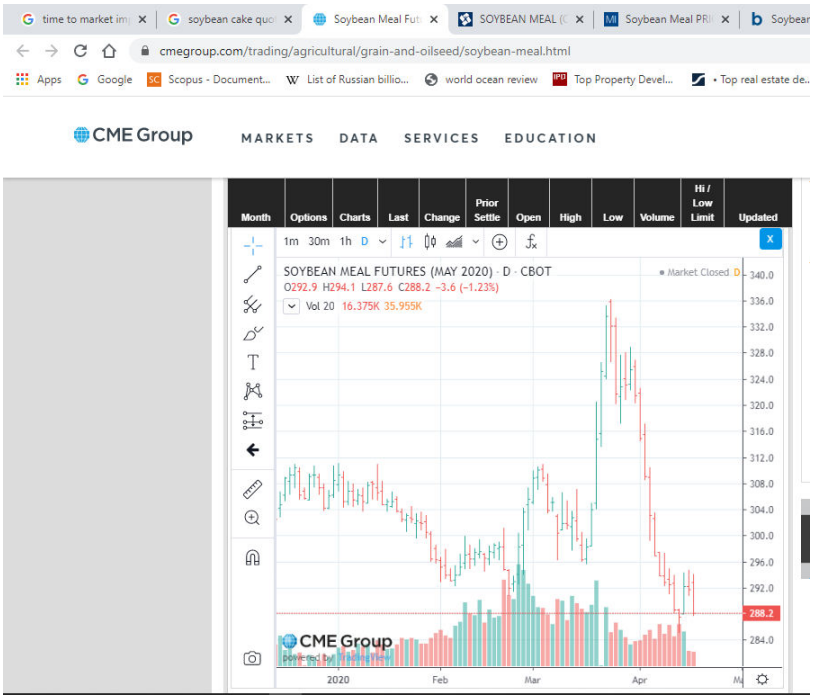


Figure 64 - CME Group quotation for Soya Meal , CBOT CME

So we can rapidly calculate the table below, the exposure cots due the fluctuation of the market price from 18march to 2nd April in Sines, we got a quote of 309,10 USD per short ton, and for 7 April in Hamburg a quote of 293,80 USD per short ton. A short ton is corrected to metric tons by a factor of 0,907. For the simplicity of the exercise, we will not correct the quotation in origin and destination, so we keep all values referred to the CBOT market place or origin which is delivered at Golf of México, on the historical agriculture trade port of Baton Rouge (Louisiana), in the very end of the Mississippi, river near New Orleans. The standard logistics corrections for each port quotation could be introduced, but for the purpose of evaluation the “time to market” difference cost is nor relevant.

Also, we have to consider the financial cost of holding the 150.000 metric tons soya meal stock during the cargo displacement, so assuming the financial cost at a rate of 7% per year, calculating 15 days to Sines, this is 225 thousand USD, and 19 days to Hamburg represents 285 thousand dollars.

Usually a big grain cargo uses a time-charter operation between two ports. Like booking a taxi, you book a vessel, you pay de vessel at a tariff per day "all included", unless ports tariffs and services. This daily tariff of the vessels includes a complex group of operational and capital costs, that can be detailed, as in many scholars papers in the specialized literature, we take the example of a clear and well-designed model proposed by Milojka Pocuca from the Faculty of Maritime Studies, of the University of Ljubljana, Slovenia (Počuča, 2006). Pocuca builds the overall costs calculation for the daily tariff in three main blocks of expenditures, the operational costs, the fuel consumption cost and the depreciation costs.

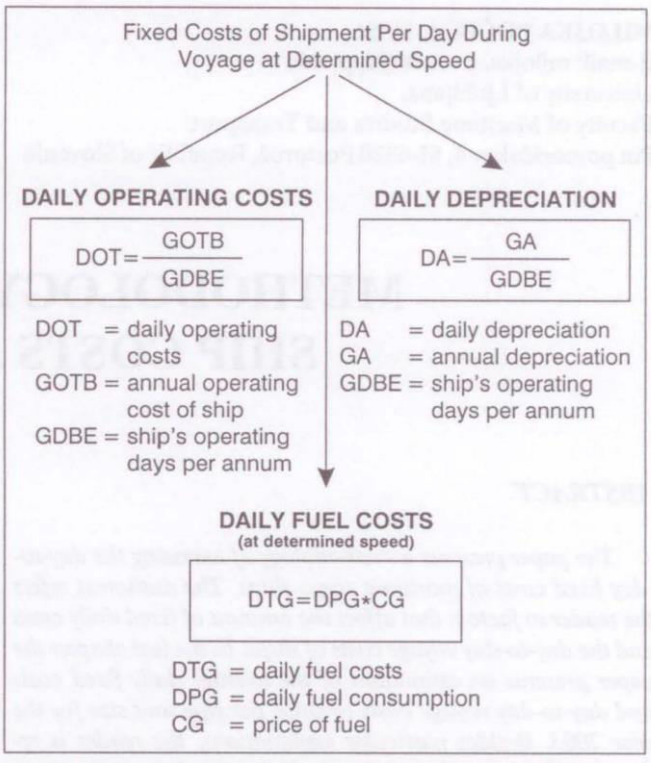


Figure 65 - Fixed costs of Shipment per day, sailing – source Pocuca

Ship prices, today internationally quoted, can be obtained from different sources, easily on-line. One of the most currently used source is the "Review of Maritime Transport",

issued by UNCTAD, that releases each year, among other information's of the world ship fleet, the average daily cost of a vessel per type and size.

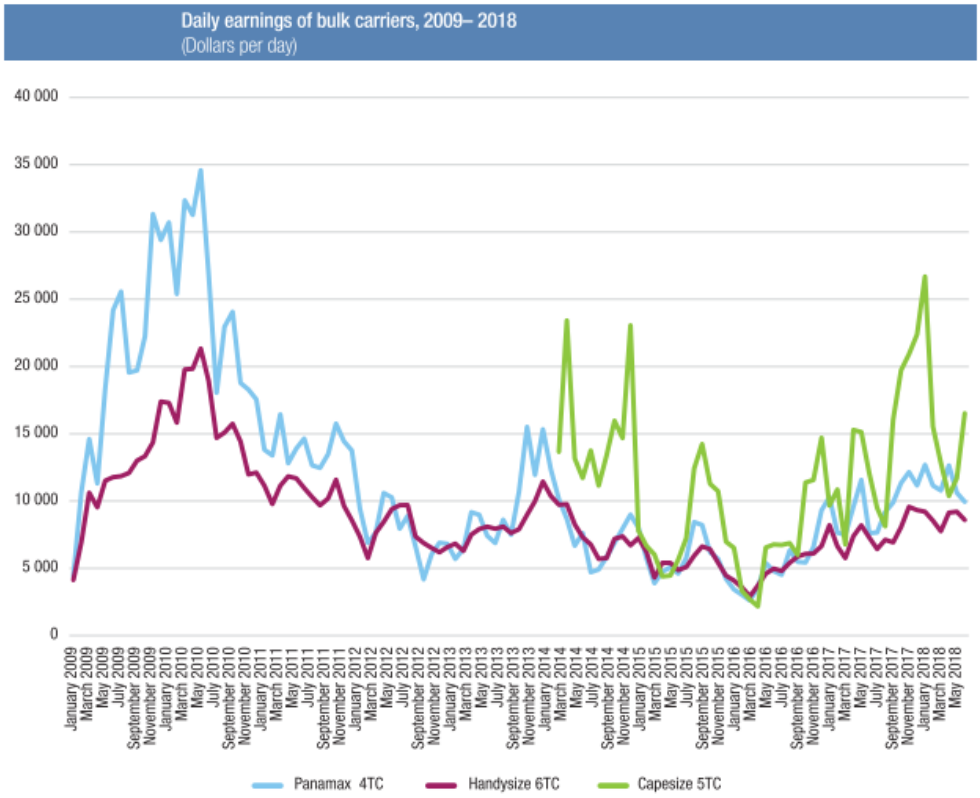


Figure 66 - Freight rates of bulk carriers, source UNCTAD

We considered for this exercise, the actual value of 15K USD per day, for a bulk carrier Panamax size, used in international grains logistics, extracted from the Review of Maritime Transportation, UNCTAD 2018 (Asariotis et al., 2018).

	Itaqui (Bz)	Sines (P)	Hamburg (D)		
Soybean Meal (ZM)	**daily quote**	**daily quote**	**daily quote**	**difference**	**unit**
	18-Mar	**02-Apr**	**07-Apr**		
days load + navig		**15**	**19**		
price	*304.00*	*309.10*	*293.80*		
Short T to Metric T	*335.17*	*340.79*	*323.93*		
Vessel cargo value	*50.28*	*51.12*	*48.59*	*2.53*	*million USD*
days navigation		*10.00*	*14.00*	*4.00*	*days*
days loading	*5.00*				
stock hold cost 7%Y		*144.64*	*183.32*	*38.68*	*thousand USD*
time charter, 15k USD		*225.00*	*285.00*	*60.00*	*thousand USD*
			total dif	2,629.00	*million USD*

Table 9 - Example of calculation time to market cost difference

The final result, just for the “time to market” factor including the difference between the two destinations, because of 4 days difference, risk exposure + financial cost + vessel time cost, a total of 2,6 million USD, is in this case favourable to Sines. The holding stock costs and vessel sailing time costs are always smaller, when comparing to a more favourable trip to a shorter port distance. The loss or gain in the exposer to market fluctuations risk is always question mark.

We can rapidly conclude “Time to market” matters.

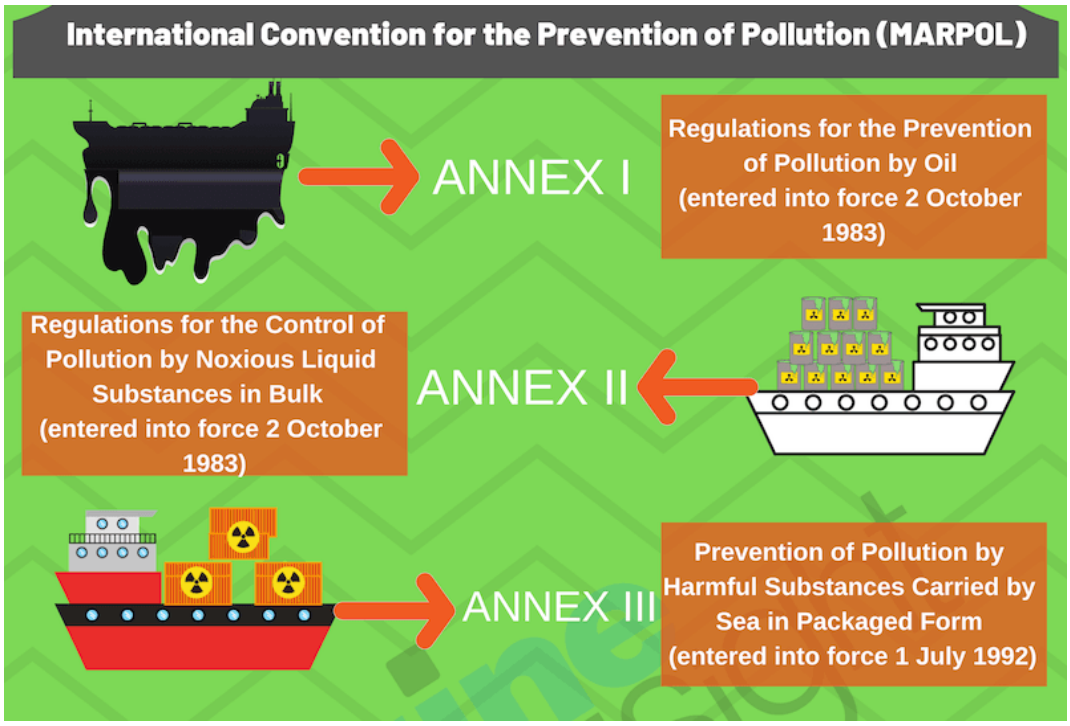
2.7 Seaborne environmental impacts, energy, CO2, Sulphur, energy

Seaborne trade, the world transportation of goods through the oceans and maritime paths, linking all sea ports, combined in interconnected network structure, is mainly based on big vessels movements around the globe, being today essential for modern life, as representing a strong contribution for the logistics of goods, supporting 80% of global trade as we saw before in chapter 2.4 Intercontinental food Logistics, trade and vessels.

Regarding ahead in the forthcoming age, implications of autonomous vessels, sailing together with human drive ships, have to be taken in considerations, already in trial experiments. Experts are considering that autonomous vessels might involve separate reserved paths, although, some other follow the arguments that automatic shipping will be more safe and require less constrains, being navigation technology systems more reliable that human operations in the conduction of the ship. This futuristic vision is yet difficult to unveil (Ivana Lukic, Angela Schultz-Zehden, Javier Fernandez, & Daniel Nigohosyan, 2018).

Seaborne trade is essential to modern world, as we saw previously, moving an exceptional cargo volume around 10 billion tons per year, of cargo worldwide this including all bulk commodities, minerals and liquids, merchandize in containers and general cargo. Since long time, particularly when power boats became mechanized port authorities start behaving with environmental concerns, in particular liquid spills on the ocean. The XX century brought some world known big oil spills, some accidental, others neglected, criminal or terrorist attacks causes, causing the contamination of maritime wild life, the dead of many fishery

resources, sometimes causing unpopular widespread of coastal pollution sea life high mortality. The international organizations concerned to protect the oceans, rapidly intervene to establish the International Convention for the Prevention of Pollution from Ships, named MARPOL, a convention to avoid maritime pollution by seaborne traffic, whether from operation mistakes, mishandles abuses, or accidental events, any of these causing water contamination and endangering sea life equilibrium, many times also threatening littoral environments, costal sea life and connected populations welfare. MARPOL late revision of November 2019 established VI annexes, chronologically referring each to a specific field in the beginning of prevention against pollution, since in the sea protection first convention in 1973 and constantly upgrade integrating all recent recommendation and procedures in numerous fields (IMO, 2020).



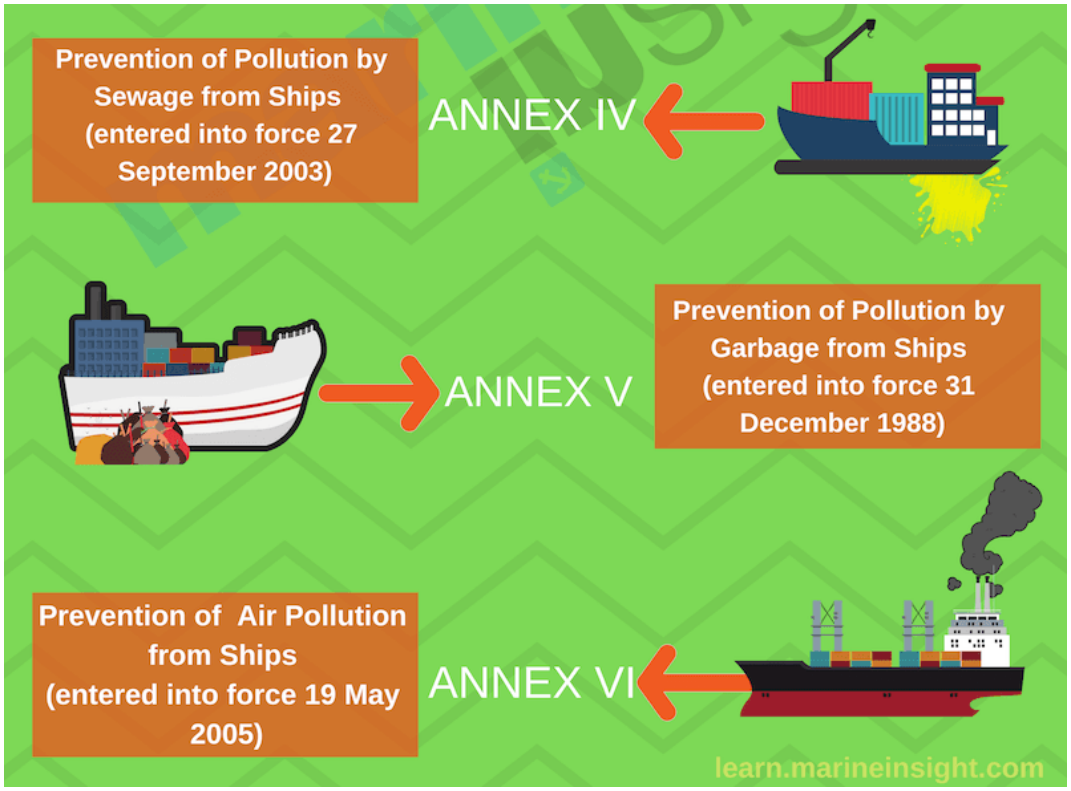


Figure 67 - MARPOL resume of the Annexes, IMO

Also strengthening the IMO role on the marine environment protection apprehensions, having a relevant international regulation in all Maritime affairs, the International Maritime Organization launched numerous instruments to protect the maritime environment in regard seaborne operations (Endresen, Eide, & Norske Veritas, 2018).

Nonetheless, seaborne trade is inevitability generating negative impacts in environment, vessels are today very big powerful machines, highly energy consuming built to move large cargos at long distances, displacing enormous volumes of tons of merchandizes, and impacts are not only oil and carburant spills over water, but also greenhouse gas effect emissions especially CO2, NOx and SOx, aggressive antifoulants paintings to prevent algae, the use of sea water and all mini and micro life organisms be pumped in the ballast ocean waters of the vessel and later released in other ports containing invasive species for that sea life destination region, garbage and domestic used waters releases, noise pollution on the sea, accidental cargo releases on the sea, also the occurring risks of ship sinking being accidental our grounding for abandonment. Also in the port operations many transfers of cargo might cause water contamination when sediments and liquids are spreading during

loading and unloading harbors operations due to ineptitude or miscarried maneuvers. A number of international organization on maritime affairs and sea life, try to create rules, norms and procedures, measures of mitigate this risks and preserve environment safe for a better world (Walker et al., 2018). Essential guidelines constituting a Codes of Practice have being issued by several maritime organizations at international level, as examples we have ICS International Chamber of Shipping, the Shipping and Environment Code of Practice (ICS, 2008), also ESPO European Sea Ports Organization issued as well its Environmental Code of Practice (ESPO, 2013)

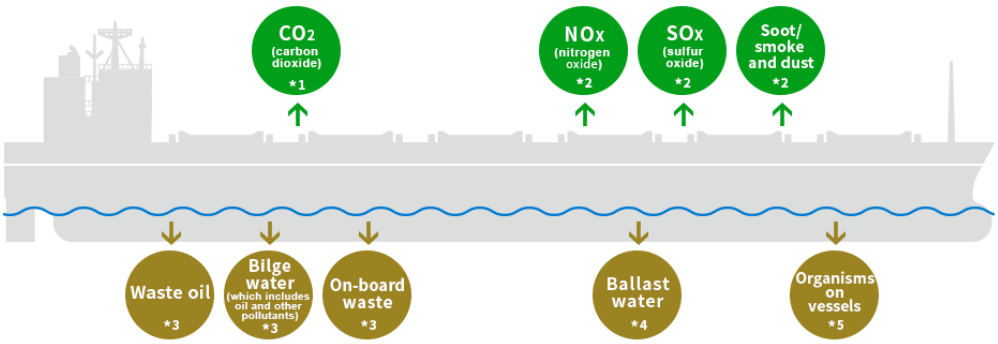


Figure 68 - Seaborne logistics major impacts, ICS

Although when compared to other transport modes, seaborne logistics are far more efficient in cargo big loads, only not convenient when compared with very short timing deliveries to destination. In a ratio of cargo load per ton of merchandize displaced in the same distance, seaborne transportation can have the best ratio of CO2 and other emissions per unit load.

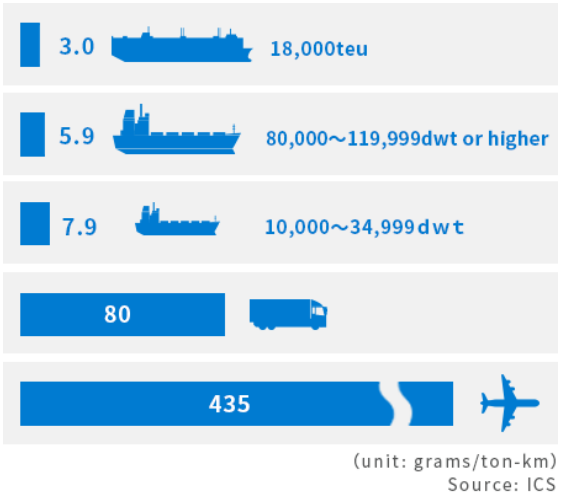


Figure 69 - Cargo modes, grams of CO2 emission per ton of cargo, ICS

Nevertheless, the world economy growth severely impelled by the development of emerging economies, generally we can anticipate that the world marine logistics will remain high and will keep rising. As saw, sea trade is overpassing 10 billion tons, representing 90% of all volume cargo in the world, and prospects are consensually conferred to keep rising in the upcoming days. CO2 gas emissions due to seaborne traffic in the seas, in fact account for nearby 2% of the total planet emanations.

The IMO International Maritime Organization made a recent evaluation of the contribution of the global shipping industry fleet to the anthropogenic CO2 emission, accounting like 2,2% of the total, on the other hand this figure would grow as the projected growing rate of the maritime shipping is expected to double by 2050 powered by world trade evolution. In 2018 convention IMO states agreed to reduce greenhouse efect gases at least 50% by 5050 to overcome these impacts, implementing a strategic agreement for the transition to full decarburization. The IMO strategy for the international ships fleet follows the transnational agenda to tackle the greenhouse gas effect emissions, following also the Paris Agreement of ONU goals for sustainable development 2030, setting out a vision to reduce gas and CO2 in particular, emissions acting in the international vessel ship fleet.

An ambitious objective was settled between all countries and the private sector ships-owners associations “Getting to Zero coalition” targeting new vessels, commercial viable “zero emission” to be introduced by 2030 the most (Jan Hoffmann, 2020).

The ICS, International Chamber of Shipping, is the private ship-owners association, that proposed to the states an investment plan to developed the technologies and convert the fleet, to the necessary arrangements for the targets of decarburization 2030. The world fleet renovation is scraping the vessel in a medium age of 30 years. Meaning to match this objective technological upgrades on the existing fleet are to be done, representing large investments by ship-owners, influencing the transports costs, and the merchandizes prices (IMO Grennvoyage2050, 2021).

The world fleet keeps growing, vessels sizes are growing. Looking to the medium world ship size, all type confounded, we may observe that in 20 years its size multiplied around 8 times bigger (UNCTAD, 2020).

Vessel Types		0-4 years	5-9 years	10-14 years	15-19 years	20 + years	Average Age years
Bulk Carriers	Ships	22.84%	44.09%	14.64%	8.70%	9.74%	9.72
	DWT	25.12%	46.28%	14.15%	7.53%	6.92%	8.88
	Average Vessel Size (DWT)	81 482	77 757	71 592	64 156	52 622	
Container Ships	Ships	16.68%	21.77%	31.32%	13.95%	16.28%	12.34
	DWT	27.58%	28.52%	27.06%	10.52%	6.3%2	9.44
	Average Vessel Size (DWT)	83 362	66 050	43 565	38 031	19 579	
General Cargo	Ships	4.71%	14.60%	14.38%	7.11%	59.20%	26.39
	DWT	9.34%	25.85%	17.23%	9.57	38.01	18.95
	Average Vessel Size (DWT)	8 770	7 507	5 255	6 360	2 725	
Oil Tankers	Ships	14.67%	21.73%	18.22%	9.40%	35.98%	18.87
	DWT	22.54%	31.41%	24.97%	15.74%	5.35%	10.11
	Average Vessel Size (DWT)	82 577	78 314	73 092	90 578	8 241	
Others	Ships	12.62%	19.01%	13.45%	8.27%	46.65%	22.85
	DWT	22.00%	19.32%	19.57%	10.92%	28.19%	15.44
	Average Vessel Size (DWT)	10 461	6 548	8 839	8 136	4 214	
All Ships	Ships	12.72%	21.56%	15.29%	8.53%	41.91%	20.98
	DWT	23.76%	35.76%	19.73%	10.76%	9.99%	10.44
	Average Vessel Size (DWT)	44 370	39 985	30 696	30 946	6 342	

Table 10 - Age distribution of world merchant fleet by vessel type in 2019

Source: UNCTAD, Review of Maritime Transport 2019, data by Clarksons Researc

Regulation of the world vessel fleet is not an easy task. States and ship-owners struggle between a frame of regulations and taxes. Greece is leading the list on the ship-owners registrations origins, but Panama is leading the vessel flag registration, showing how the regulations are changing from the country origin of the ship-owner.

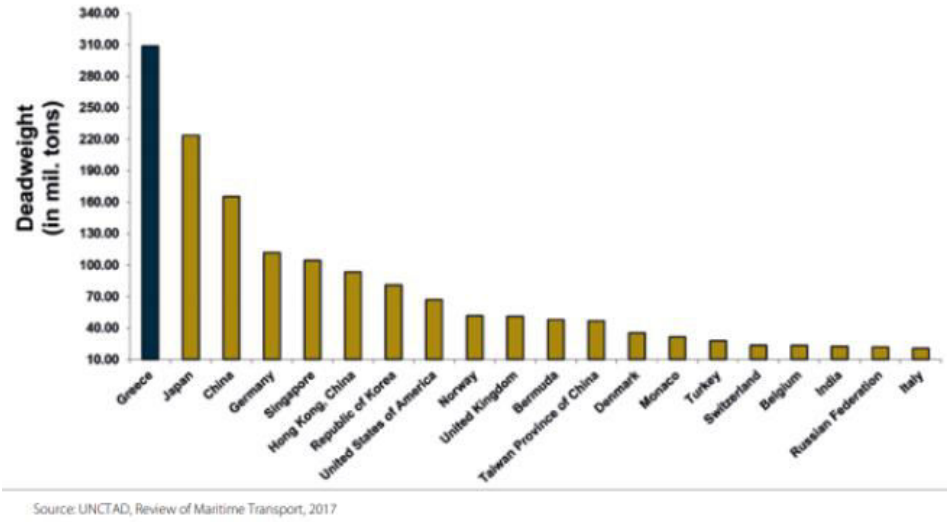


Figure 70 - Ownership of the world fleet (dwt over 1kTons)

However, the flag registration country allows changing the geography of the ship operational references, giving different frameworks for taxes and regulations of the ship-owner country of origin. The flag registration country determines where the vessel is checking the compliance for the operations. Thus, we may observe a different distribution of the world fleet registrations (UNCTAD, 2020)

Flag of registration	Number of Vessels, January 2020	GT, January 2020	Estimated share of Global Maritime CO2 Emissions, 2019
Panama	7 041	222.8	13.52%
Liberia	3 824	132.2	10.64%
Marshall Islands	3 700	125.4	8.80%
Hong Kong, China	2 423	94.8	7.87%
Singapore	2 652	87.6	6.29%
Malta	2 090	70.9	5.40%
Bahamas	1 380	43.6	4.27%
China, People's Republic	4 265	62.7	3.67%
Japan	2 550	52.0	3.57%
Italy	903	13.5	3.12%
Top 10 Economies	30 828	905.5	67.15%
Rest of world	32 708	472.1	32.85%
World	**63 536**	**1 377.6**	**100.00%**

Table 11 - Nationally flagged fleet by vessel numbers, their gross tonnage

Source: Marine Benchmark and IHS Markit data. Vessels more than 1KT dwt

Recently came to effect the so called “Sulphur” regulation imposing the vessels limits to SOx emissions, which are now in force since 1st January 2020, although announced in MARPOL the regulations was published in 2005 in its Annex VI, forcing the new constructions of new vessels to follow this limits, also imposing the existing fleet a period of 15 years to adapt to this emission limits. This has created strong constrains to vessels which are not adapted, becoming blocked to enter in many ports in world adhering with strict outcomes to the conduct of IMO and MARPOL regulations. Freight prices are already reflecting this constrains, as many completion on the fleet is suddenly not operation or disappearing to scrap. So, since the 1st January 2020, the regulation limit in Sulphur content in the combustible, fuel oil, most commonly utilized in vessels shall be reduced at levels of 0.5% mass by mass, this directive shall decrease the levels of SOx Sulphur Oxide exhausted by vessels and improve environment, in particularly in close areas to the ports and improving life quality of coastal population communities. In a recent conference of Rabobank, a Dutch bank specialized and focused in agriculture business and food commodities, in the 2018 conference “Outside Influences on the Grains & Oilseeds Industry“ focused in commodities business analysis insight, the estimation of cost to solve this emission could be based on three solutions, the easiest is to change the use of combustibles to low-sulphur content diesel or other combustibles, this is very expensive, so ship owners are looking for technological changes to economize, depending of the vessel age; replacing the vessel engine or converting to Dual Fuel engines and installing the necessary LNG tankage on the vessel, to use an LNG propeller, or many times not easy to tackle this change technically, the alternative is to introduce exhausted gases cleaning technologies, a so called “scrubbing” unit, different technologies are available with the same principle, that make a significate separation of the SOx from the emissions, reducing levels. Any of this solutions is very expensive, the replacement of the engine much more, and would be viable in investment analysis only for vessels still with long life perspective, considering 30 years as the long life of a merchant vessel. Those built before 15 years are already complying with these requirements, so the second solution of installing scrubbing units are the most applied technology, representing

investments around 5 to 7 million USD, which Rabobank estimates to impact like 4 to 5 USD per ton in the transport of cargos in seaborne trade. In the end, the feasibility will be contingent by the type of ship, newly build or retrofit and its economical trade-off. The request for these methods will encompass a price increase owed to higher working costs.

This MARPOL Convention, aiming the reduction in SOx emissions from ships, is having a negative impact on prices of the maritime freight and already higher carriage rates are known especially losing the competitiveness of SSS, Short See Shipping, when in competition with terrestrial transports, train or trucking.

Alternatively, many ship owners scraped their not compliant vessels for the occasion of this regulation enforced moment. Both phenomenons causing the rise of prices in the seaborne trade, consequently impacting the food price downstream.

2.8 Discussion résumé of the chapter

Food and feed world changed in the last two generations. From the readings and findings, we can systematize some essential ideas for the next chapters, central to the context of the discussion of results in the chapter “7.2 Main conclusions and findings“, transcribing results and findings from many researches that were made by authors and institutions, although in the specific field of this thesis we may sustain that still a lot of gaps are observed in the fields of the good design of seaborne trade route efficiency, once the lines exploited by the big vessels in the globe are not designed for the best outlay in merchandize flows, likewise these ocean routes are moreover consequences of existing infrastructures and trade relations. In the recent four decades, we assisted a remarkable shift to the south hemisphere of different factors in the food and feed commodities world that could impel new strategies for global logistics of agriculture food raw materials.

Figure 71 – Protein for meat in Europe, Soymeal seaborne trade from Argentina

In the table of the figure bellow, we are sketching a synthesis table of the relevant facts and its implications, of all this chapter and sub-sections subjects, we can résumé the main facts evidence in this chapter, gathered from other scholar's previous research jobs and also from literature revision findings from credible sources of information:

Fact or finding from literature revision and discussion	Insight in the last 4 decades	Implications and findings for the research
Grains, food commodities, are the basis of 2/3 of human diet	Green Revolution made agriculture production an industrialized activity.	Agriculture technology is improving the yields.
World Agriculture production strongly increased	In two generations, population doubled, but grains production tripled, not in common territories.	Trade and logistics are the answer to meet supply and demand.
South hemisphere, particular LAC Latin America Countries lead this growth	Brazil and Argentina became leaders in oil seeds and some grains exports.	Longer distance origins might need alternative logistics for Europe.
Agriculture Technology access is driving yields escalation	While an European harvest doubled, Brazil multiplied by 10 factor in the same period, departing from a lower basis.	South America agriculture is in strong progress, soon Africa countries expected to follow.

Meat consumption per capita progression	Economic development offered more meat protein to population.	Feeding raw materials for meat production increase.
Feed for meat changed from cereals base staples for Soybean basis	Soya OGM varieties took the main source of vegetable protein for feed compounds. EU is importing around 40 M T per year.	Europe imports of soya complex products augmented strongly.
Soya origin new leaders are in South America, Brazil and Argentina	Specialized ports and soya cake large factories were built in South America to meet demand.	Southern long distance sea routes are bringing soya to Europe.
Food Trade is covering the gap demand and sufficiency	Many countries, even in developed regions, depend from trade to cover needs. Food commodities trade represent today around 600 m tons in world. Around 1/3 is soya trade.	Trading of food commodities grains soared in the last 40 years. Seaborne trade from south America increased strongly.
International commerce developed	90% of volume of international trade is made by shipping.	Ports and ship-owners strongly developed the seaborne industry.
Vessel size grows	To be more efficient, ship-owners made vessels bigger in the last 40 years from 10/15 K Tons to 100/400K tons.	Deep water ports, long quays are required and critical in ports.
Europe seaborne trade is dominated by ARA region ports	Food commodities are entering EU mainly by traditional ports and infrastructures in the north.	Food commodities are travelling to north Europe, diverting then to south.
Hamburg is the biggest Soya receiver in Europe	Trading is discharging soya in Hamburg, to feed industry and transshipment to other ports.	Hamburg is a costal port of Germany, in north sea, connecting north Atlantic.
Time to market is critical in food commodities	Depreciation of merchandize, financial cost, and exposure to price risk of quoted commodities.	To mitigate risks, time to market is critical, hedging is not covering all commodities. Financial costs and deterioration to minimalize.
Vessels environmental impacts subject to severer regulations	Regulations demand more environmental friendly transports. Especially in CO2 and SOx, among others, demanding huge technological reconversion investments.	Vessels more green, investments, more expensive operation. Freight costs rise, becoming more critical its impact on food cost.

Table 12 - Review resumé of the main facts and findings

The relevance of the findings sustain the research question pertinence, as it will be discussed further down. One important document came out in 2017 “Estratégia para o aumento da competividade Portuária 2017-2016”, presented by Ana Paula Vitorino, Ministry of the Sea of Portugal, at 10th February 2017. This document emphasis the vision of Sines as an Iberian and south Europe distributor port and one main gate for the hinterland of Iberia and south Europe. The new investment plan for the Portuguese’s ports, and especially for Sines, foresees huge investments in infrastructures, to increase, modernize and diversify the capacities of the Portuguese terminals. According to this plan, targets are to invest 2.5 mllion euros in ports infrastructures and double the operations capacity from 90 to 180 m tons.

This document does not orient any response to the research question of the thesis, also does not reject its inclusion in the Sines strategy. However, the thesis question, being positive, is fitting perfectly in this strategy, looking for diversification, attract more investment, and develop complementary activities, jobs and local economies. One of the advantages of Sines, is its ZAL/ZIL (Zona de Actividade Logistica e Industrial), an opened contiguous area devoted to complementary economic activities. Contrary to the majority of other world ports, it is not closed and surrounded by a large city constraining space and surface extension, using this advantage to diversify the port use, these are clear objectives of the port administration for the next years. The pertinence of this thesis document might be the core of a new prospective analysis for the port of Sines strategy, so, for its economic role in the hinterland of Iberian region and South Europe coast.

Sines is the closest continental European port to Panama Canal. The opening of the new-sized Panama Canal, inaugurated in June 2016, the Panama Canal expansion project, also called the Third Set of Locks Project, doubled the capacity of the Panama Canal by adding a new lane of traffic allowing for a larger number of ships, and increasing the width and depth of the lanes and locks allowing larger ships to pass. The new larger size of ships, called New Panamax, are about one and a half times the previous Panamax size and can carry over twice as much cargo. The expanded canal began commercial operation on 26 June 2016. This fact is generating a lot of new papers and is impacting studies on the world logistics operations, especially in the Atlantic area, one of the most crowded maritime space, full of vessels corridors, between America-Europe continents. The Panama Canal Authority predicts that the

volume of cargo transiting the canal will grow by an average of 3% per year, doubling the 2005 tonnage by 2025. Allowing larger vessels to transit, the canal will move more cargo per transit and volume of water used. Historically, the dry and liquid bulk segments have generated most of the Panama Canal operations revenues. Bulk cargo includes dry goods, such as grains (corn, soy, and wheat, among others), minerals, fertilizers, coal, and liquid goods, such as chemical products, propane gas, crude oil, and oil derivatives. Recently, containerized cargo has replaced dry bulk as the canal main income generator, moving it to second place. Shipping industry indicate that the canal expansion will be beneficial to both the canal and its users because of the demand that will be served by allowing the transit of more tonnage.

3 The research questions

3.1 Is the agriculture production southern trend a reality?

In 2014, Brazil soybean production volumes overpassed the USA crops, more recently in 2018, Brazil also reached USA on the corn (maize) harvest, always the traditional world champion of this protein excellent source and cereals, longtime the prime supplier of soya and maize for many world countries. Brazil is not alone in the agriculture production growth in the southern countries of the globe. In fact, the technology of the “Green Revolution”, together with deforestation for new farming areas and “the knowledge” spread by new modern Universities focused in Agriculture education all over developing countries (Tarlau, 2015), made the southern countries of the globe, with good weather conditions, progressed agriculture producers, some of them rapidly overpassing the tradition champions in the main commodities production and trading. Changing the geographical origins of the commodities may cause important impacts on the international trading and logistics operations.

Figure 72 - Agribusiness scaled in southern countries with the "green revolution"

In the recent decades, the food commodities production has been industrialized all around the globe, so agriculture technology and economies of scale in farming production led the farmers to increase their yields per hectare, at the same increase the harvest acreage to

enormous culture plane fields. This was also a market reply for the world population demand growth and starvation stoppage, international trade of grains was the answer, economical and vital for human kind.

Figure 73 – Federal University of Minas Gerais, school of Agribusiness, Brazil

More technological and industrialized countries led the industrial farms revolution in XX century. Large scale agriculture for long decades is well known in countries like Russia, Ukraine, EUA, Canada, France, Poland, among others. In the southern hemisphere geographies are a lot of recent new farmers, as technology in parallel with social economic development and policies, are phasing in, like Brazil, Argentina, South-Africa, Namibia, Australia, New Zeeland, Malaysia, and many others will come in the chain. This new geographical farming scenario poses questions that undisputable impact some of the world economies, for sure, at a higher level, the regional economies of some globe regions.

Is food production Latitude moving to south ?

That is, can we assess whether the farming countries, their location weight and importance in the world food production? Are being deploying the food agriculture production mass center of the world to southern geographies? And it is unquestionable, will be impacting this in the world trade logistics of food commodities, extending or generating a lot of transport lines from southern ports, and recently increasing the volumes, possibly challenging other ways of food distribution in the hinterland of the world regions?

Today, the country and continent logistics is organized by natural and historical factors like natural transport river flow channels, sea port locations using natural coast orographic

conditions, also the traditional of trading ports and commercial zones. But other factors might influence the efficiency of international logistics and could persuade the international trade to deviate or change its routes, for better efficiency of the transport system, economy of logistics, environment gains, reduce time to market and achieve an overall cost reduction.

3.2 Europe should look for efficiency for this geographical southern movement of agriculture origins?

During the last two centuries, the entry door of Europe for the food commodities was naturally more close to the origin main countries of the agriculture production of grains and seeds, USA, Canada, and former URSS. Also historically, the trade organizations and commerce operators were based in the European North West region, historically very strong in maritime culture and trading from long distance origins and past-colonial countries.

The North West region on Europe, today called the ports of ARA region, grouping the cities of Amsterdam, Rotterdam and Antwerp, also extending to Hamburg port in Germany, is by far the biggest gate of Europe maritime trade region. Its historic geneses is based on long historical maritime culture of those populations, and might have been pulled by the industry development of German lower-Rhin industrialization economy process still in the XIX and XX centuries, a coal rich area that demanded its exploitation as the main source of energy for all applications, and by than importing iron ore for steel and wood to sustain the industrial development phase. The Ruhr coal area and the Rhin communication river valley established an ongoing growing exchange trade between these countries and the world origins and destinations. The industrialization quickly developed trade in search of raw materials and exporting its products and machines. Many world strategy scholars like Michael Porter, Paul Krugman, and others, in various studies like “The Competitive Advantage of Nations”, still find today the importance of these capacities of the region to leader the trade and ports in Europe (Boon, Wubs, & Klemann, 2011).

Notwithstanding the quick development of global seaborne trade in the recent decade, many world regions did not developed international trade, due to the lack of

infrastructures and to its costs and tariffs, other formal and regulation barriers between countries, leading to the reduced or strong deficiency of trade amongst some world countries (Linders, Burger, & Van Oort, 2008).

Should Europe look for alternative ports in the southern continental countries?

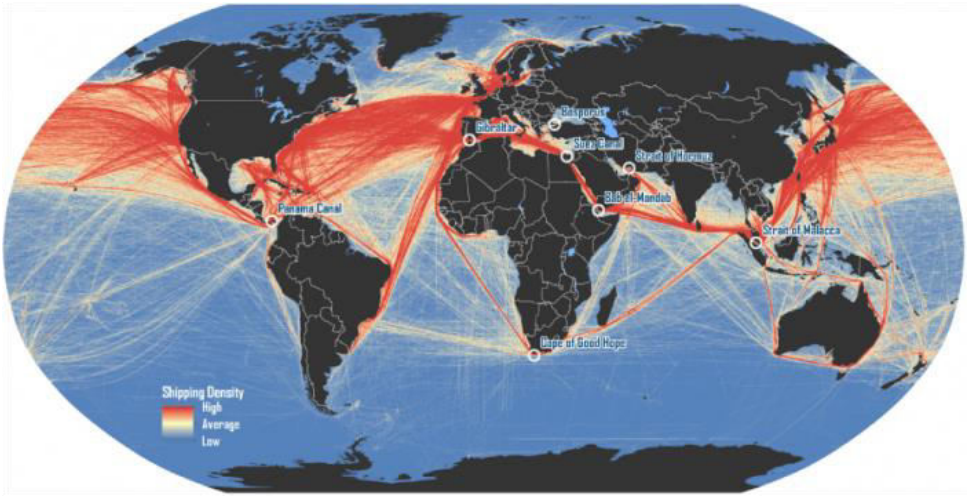


Figure 74 - Maritime visual shipping routes, The Geography of Transport Systems

The answer might be yes, if the efficiency of the markets accessed by traditional ports is increased by other new locations. Abundant maritime traffic crosses the West European Atlantic coast up to ARA region destiny, not being able to discharge or brake the load in southern ports putting efficiency and economical gains in the overall logistics operations.

Changing the geography of the production of Grains might be sensible to adapt/change the logistic channels of the commodities to the hinterland of Europe.

3.3 Is Portugal an Atlantic more efficient alternative reception for food commodities?

Portugal, due to its geographical condition, is a pivot territory between continents, this made its history, remaining for the international strategies a country unique in the European framework. A geostrategic vision of Portugal substantiate its old recognized maritime tradition and prevalent conquer and trade activities along its historical existence. Portugal throughout its history has experienced moments of pronounced leading role worldwide, far exceeding what would be expected for a country of its physical size and population count. By the prominent Treaty of Tordesillas established in this city, signed by the king D. João II, in 1494, on the XV century, Portugal shared the world with Spain, making a convention dividing the new territories in the glorious period of maritime discoveries.

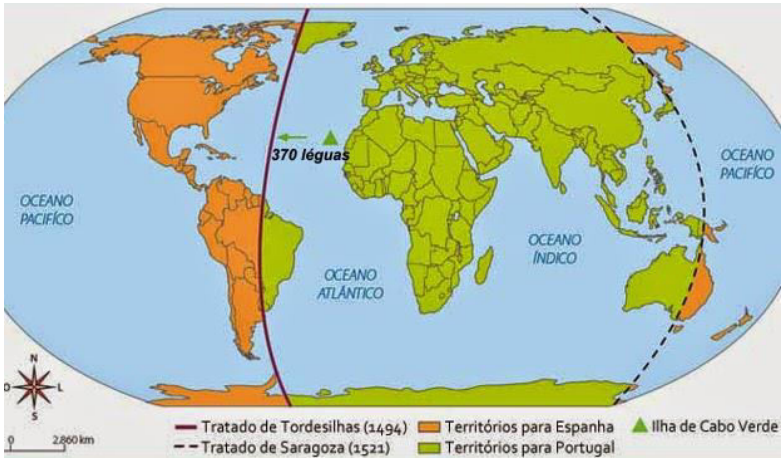


Figure 75 - Tordesilhas Treaty, Portugal shared the world in the XV century

It was a treaty between the kingdom of Portugal and the newly formed Kingdom of Spain, through the marriage of Isabel de Castela and Fernando de Aragão, to divide the lands "discovered and undiscovered" by both Crowns outside Europe. This treaty arose as a result of the Portuguese challenge to the pretensions of the Spanish Crown, resulting from the trip of Christopher Columbus, who a year and a half earlier had arrived at the so-called New World, claiming it officially for Isabel, the Catholic. The treaty defined the meridian 370 leguas west of the island of Santo Antão, in the archipelago of Cape Verde. This line was located halfway between these islands, by then Portuguese territory, and the Caribbean islands

discovered by Colombo. The territories to the east of this meridian would belong to Portugal, and the territories to the west, to Spain. The treaty was ratified by Spain on 2 July and by Portugal on 5 September 1494.

The end of the Middle Age and the beginning of the Modern Age in XV Century was on the rise, opening up to great discoveries, it was when mercantilism took the place of feudalism, and the Renaissance period was established, and new ideas and new perspectives arose. There was an expectation of exploring new horizons and new continents to accumulate capital, readjusting the losses brought about by the previous era. Portugal and Spain, in this period had prominence, had common interests in the maritime discovery of new lands not only for the extraction of fortune, but also for colonization and the territorial expansion and religious spread, being both countries controlled by the Catholic Church.

Training maritime knowledge was primary for a country such devoted to the sea affaires, the sea is for Portugal of great importance in the domains of security, war, geo political, commercial and other domains. So the Portuguese political deciders took, very early, strong serious decisions in relation to training and education of the professional staff of the navy, the creation of modern serious institutions going back to the political Regime of Marques de Pombal, in order to create a body of special educated Navy Guardsmen, however, not contemplating a picture of permanent studies for their education. But, in the following year of 1762, it was created the school of sea guards and sea lieutenants in Porto. Soon later, in the reign of D. Maria I, in 1779, it was established the creation of the Portuguese Royal Navy Academy, by Minister Martinho de Melo e Castro, beign the first step towards a specific theoretical preparation of captains for the merchant navy and military. Late in 1837, the foundation of the Polytechnic School was a relevant step for the creation of the Maritime Academy were all elementary mathematics, mechanics related to navigation, sailing and nautical, completed a set of scientific and technical subjects that would constitute one of the singularities of the professional training of naval officers, predominance of a scientific culture. In 1782, also Melo e Casto established the Companhia dos Guardas da Marinha, separated from the Royal Navy Academy. Turned to the instruction of nautical officers, it covered theoretical subjects and practices. With the withdrawal from the court to Brazil in 1807, and even before the departure of royal family, there was also the transfer of the

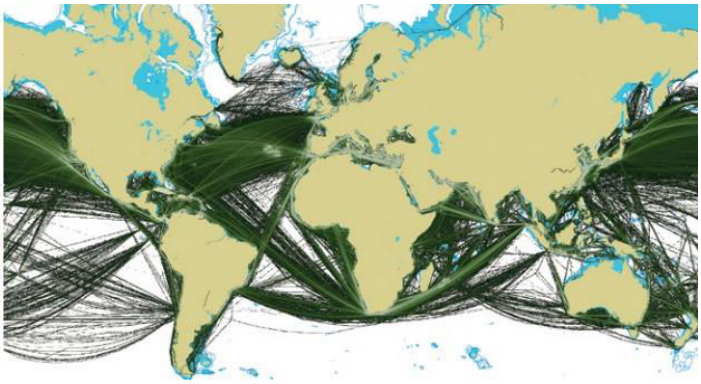
Academy and its library to Rio de Janeiro. The Polytechnic School, created in 1837 in Lisbon, would play a relevant role function in the preparation of the military of the different branches of the armed. In 1845, Costa Cabral founded the Escola Naval, designation which replaced that of the Royal Academy of Marine Guards. It was therefore an elite school, of higher level, which provided its students with extensive technical and scientific training, in a country where the educated population, at all levels of education, was extremely little (S. Campos & Aguiar, 2008).

Figure 76 - Portuguese geostrategic relevance, APS

The careful analysis of "Figure 76 - Portuguese geostrategic relevance" also clearly expresses the importance, which we already underline several times, of the position of Portugal in the globe, pivot of American, Africa and Eurasia platforms, superintending the Atlantic Ocean and Mediterranean entrance. In fact, it is in this region that some of the main world routes intersect, namely those connecting Europe to North America, and those to the Mediterranean, also soon, to the Persian Gulf. These are the routes where most of the world trade, hydrocarbons, food, and merchandize are flowing worldwide, a significant number of global economic exports and imports.

Today more than ever before, the world economy revolves around trade and the interconnections for mobility. The transference of goods, and the mobility of the populations

that the transports means allowed, making distances shorter, shifting forms of trade and business strategies, modified and globalizing organizations, all these enabled the development of international exchanges like trade and tourism in scale as never before. These also generated a set of new opportunities and challenges for the countries, contributing to the progressive higher level of globalization and interconnection of world economies. Portugal, due to its geographical alignment with the Atlantic Ocean, Mediterranean Sea and the main continental platforms, is a hinge in the one of the most important poles of the world, its history and peaceful international political relations remain inimitable, making this country unique in the European framework.



Source: Prepared for UNCTAD by Marine Traffic.
Note: Data depict container ship movements in 2016.

Figure 77 – Marine roads of Global Shipping, UNCTAD

The control of the European West Atlantic routes presented here in “Figure 77 – Marine roads of Global Shipping, UNCTAD ” (Unctad, 2017) shows the enormous strategic geolocation importance to Portugal, which over the years has been able to take advantage of this added value position. Portugal is in the corridor of the South European Atlantic west coast, where traffic interconnections are crossing lines from large assortment of origins and destinations. In a time when the increasing size and autonomy of ships, and greater security of naval transit operations are a reality, we should not underestimate the strategic importance and negotiating power that Portugal's position confers. Also the relatively peripheral position of Portugal in relation to the economic space in European economy in which it operates, especially in relation to rail and road transport, allow to Portugal to state that the maritime transport is a benefits to overcome and counterbalance its peripheral

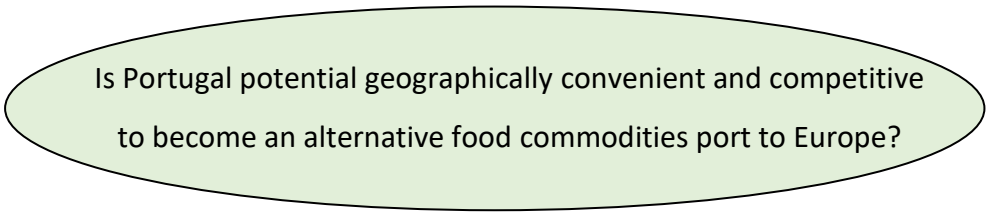
situation referred to central Europe, recognizing the role and making Portugal the fulcrum of a central position for all the Atlantic zone englobing Europe, Africa and America.

Figure 78 - The new Silk Road, china to Atlantic - Expresso

China economic strategy express interest, and in an increasingly insistent way, for Portuguese centrality in the Atlantic at the intersection of global maritime routes, namely Sines, says Ana Paula Vitorino, former Minister of the Sea, in an interview with Expresso May 2018, by Jorge Nascimento Rodrigues. The Portuguese ministry came up with a memorandum with the counterpart in Beijing to develop what they called a "blue partnership", symbolically using the color of the oceans. The goal will be to create a “blue” extension of the new silk routes initiative, known as One Belt and One Road, which puts Portugal on the map of Chinese globalization. The parallel visit to Portugal by Wang Yi, the Minister of Foreign Affairs, and the meeting with the Portuguese counterpart, Augusto Santos Silva, reinforced this opportunity as Expresso news covered (Rodrigues, 2018). Five hundred years after the Portuguese arrived in Canton and after having created the first global career that connected Lisbon, Goa and Macau, Portugal and China are now found in the Atlantic.

Attesting the trends in the geographical agriculture productions movement going south, and in particularly in what refers to the protein vegetable source today, also considering the rising trade and logistic support by seaborne cargos, in what concerns to the

vessel sizes looking for deep water port terminals, the discussion is raised and launched to evaluate whether Portugal, and Sines, would be an alternative solution for Europe food commodities entrance door in the South West Atlantic geostrategic position.



Sines is one of the further southwest and at the same time, naturally deep-water European port, allowing what is today the tendency for the use of super-carriers of bulk-commodities vessels taking 80 to 150 thousands of tons of grains to the destination port. These vessels require deep-water harbours. They cruise at low speed, so looking to shortening the trip, meaning less days in a time charter contract, being a substantial gain in time to market, crucial for commodities preservation and low losses, due to food protection reasons and also financial costs.

Sines is in the main corridors of the European Commission infrastructure transport projects plan. Through the General Direction of Mobility and Transports, the Commission published several documents nourishing the development requirements for the TEN-T project proposal, establishing the primary network corridors for Europe infrastructure of sustainable transportation (EU DG Mobility and Transport, 2015). The reports identified the infrastructure improvement requirements representing nearly 700 billion euros of assets investment plan up to 2030. The goal is to introduce the optimisations of the infrastructure used in the corridors using transports with intelligent assisted systems, for achieving, efficient, and environmental friendly transport infrastructure system. In the TEN-T pioneering approach, Commission consider all transport means generating a complete integration for the best efficiency and profit of the operations, all factors being considered, all infrastructure combined highways, roads, railways, waterways, ports and airports, in an all-inclusive and combined approach.

In a preliminary analysis, we can see the port of Sines is the Atlantic southwest port in the termination of the Trans-European Transport corridor. The current infrastructure status of Sines and its interconnections, traffic flows for passengers and freight, have identified an upgrading action plan to be undertaken from now to 2030. The commission includes the preliminary lists of projects, which aim at completing cross-border and other missing links, removing bottlenecks, inter-connecting transport modes and enhancing interoperability, notably the rail transport.

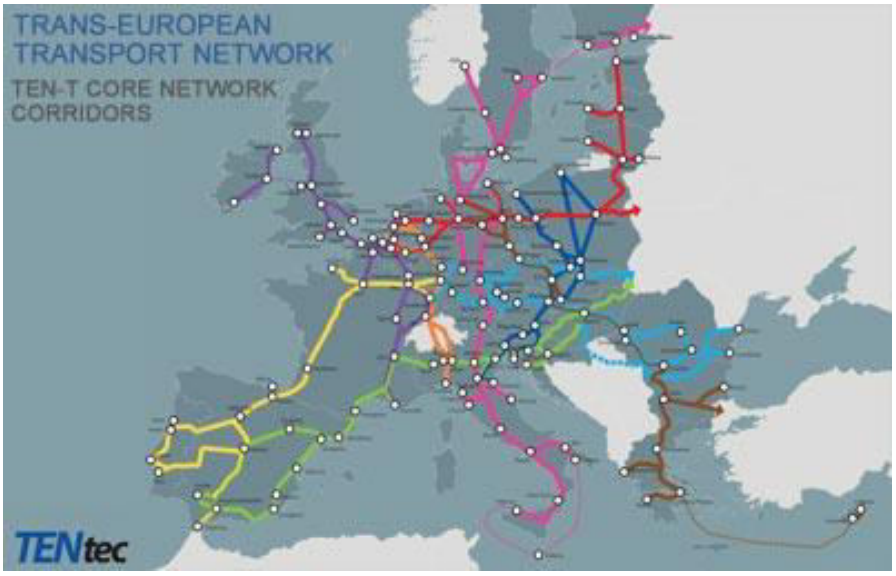


Figure 79 - The TEN-T integrated network, EU DG mobility & transports

The Figure 79 - The TEN-T integrated network, EU DG mobility & transports exposes in a very explicit way the South West position of Sines, surrounded east by the European geographical context being the extreme South Atlantic favourable touching point and entrance. This level of integration of port of Sines in the trans-European logistics network reveals its strategic importance, beign considered in the Commission level.

3.4 What other research questions may follow this investigation

To evaluate this question, a theoretical assumption of “Grains Terminal in the port of Sines” is designed to allow the interviewees to evaluate the assumption. This terminal should follow the modern characteristics of a Grains, flours, meals and oils terminal, with proper infrastructures for this purpose of evaluating the functionality. The serious of subsequent other questions are arising.

What is the impact of a food terminal to the regional hinterland of the port?

Preparing the infrastructures of a port for food commodities, grains and oils logistics is an investment plan, mobilizing considerable resources. These capabilities may generate the traffic of cargo, the pure transhipment of cargo, very likely to happen to divert trough short see shipping, in particularly to other Atlantic and Mediterranean ports. This is that kind of development opportunities that may lead to a flow sequence of several other investments in logistics and food industry chain, downstream activities.

Figure 80 - Maquete of tipical Grain Terminal, exemple Comvex Constanta 2020

Having a grain terminal, other primary food transformation industries will be attracted to install in the contiguous ZAL/ZIL or other regional nearby locations. The proximity of the raw materials is an attraction factor for the installation of the transformation activities. As

well factories like Vegetable Oil extraction and meal production, from oils seeds and especially for the soybeans coming from south countries; the milling grains activities producing farinas, flours and related feed compounds; the feed compound industry combining cereals, meals and vegetable oils for animal meat production. A second level of transformation industry will come on the downstream chain, the edible oils, the sources and mayonnaises, pasta and spaghetti factories, milling for special bakeries and cakes, all the food products in general, even the meat producing complexes for chicken, pork, fish, and others. A grain terminal will flow for an integrated chain of activities supplying directly and indirectly the human hunger demand.

To decide for an ambitious grain terminal to Sines, to look for south Europe grains logistics, it is crucial for local decision making process, to evaluate the local impact of the hypothetical new port terminal, or the opportunity of a potential reconversion of existing terminal closing operation, as might be the present case of one of the existing terminals.

Being a deep water port with excellent natural characteristics, opportunities not blocked by big urban constraints, with and appreciable expansion capacity in its terminals, Sines is a paperless port which has been achieving a high increasing rate. Being part of the Trans-European Transport Network as a priority project, the improvement of the rail connection Sines – Elvas – Madrid is due to be completed in the following near future and will highly contribute to the enhancement of the hinterland market.

After the energy specialization, the hydrocarbons and its refining oil products, gasolines and others rapidly attracted other downstream chemical activities, the LNG terminal, and recently the port's main challenges lie in containerized cargo Terminal XXI, that already increase capacity, operating transhipment of containers and the rail connection to the hinterland.

The role of Portugal will become very relevant if the proper strategy is followed in the political infrastructures of the ports and its inland connections. In each globe region there are sea Ports systems, from where and to which merchandize is delivered, creating nodal points to assist a regional area of the world. In Europe, ARA region, the system made with the ports of Amsterdam, Rotterdam and Antwerp is by far the biggest supplier of food commodities for Europe in our days. In a context where the tendency of food commodities production is

coming down in latitude, southern countries in the European coast may have clear advantage in converging the exchange of merchandize, with clear advantage, among others:

- Reducing sea freight cost;
- Reducing time to market;
- Reducing financial cost and volumes of working capital in food trading;
- Bringing less price risk due to floatation of the food markets volatile exchange;
- Reducing perishable risk of food commodities, especially in grains and seeds products;
- Reducing fuel consumptions and CO2 and SOx emissions;

Consequently, in the end, bringing food products more efficient and cheaper to the European industry and its consumers.

If we consider the Atlantic coast of Europe as the main entrance of food commodities coming from America continent, also from Africa and Pacific region trough Panama channel, Portugal may be strategically offering the best location in the European Southern west coast, with deep water ports like Sines, allowing big Panamax and Super-Panamax vessel drafts to dock and transfer bulk food commodities to other transport node systems, like ports, inland storage facilities, other feed and food industrial activities.

Of course, still a political and economic strategy is to be developed from the simple analysis of data that shows this evidence: food production is coming down in the globe.

Laulajainen sustained the economic efficiency of the dry bulk seaborne operations, once the dry bulk cargo often is repetitive and keeps the route along the yearlong operation, the first cargo is then determinant to take a price level determined by real world data historical collected, given a price level that can make the route profitable or financially unsuccessful path, the price differences between regions might be caused by availability of tonnage in the region, balanced with the sailing distances between loading and unloading destination ports (Laulajainen, 2007).

3.5 Résumé of the Chapter, the research questions

The Thesis resumes the research questions around the opportunity to evaluate a new maritime terminal for Grains and Seed in Europe, making the international logistics more efficient, reducing environmental risks and impacts, in the end reducing the overall costs of food in benefic of the population. All in line with the two main objectives postulated for the Thesis: Validate if it is true that the agriculture is moving South along the past decades, and Europe has its grains distribution organized in the North Sea. Being so, does it make sense to further study, technically and economically, a hypothetical new terminal for Grains in the European Atlantic South West region.

From these objectives, fall in 3+1 research questions that are proposed:

- Is food production Latitude coming down?
- Should Europe look for alternative ports in the southern continental countries?
- Is Portugal potential geographically convenient and competitive to become an alternative food commodities port to Europe?

A fourth research question, requiring deeper studies and evaluation is still discussed:

- What are the impacts of a food terminal to the regional hinterland of the port?

4 Research Methodology presentation

Research is methodological work, a sequence of rational and systematic tasks, gathered to respond to the research questions (Aberdeen, 2013) . The first step in the research is the definition of the problem in presence, what are the research questions to be answered, from here the definition of the research program, the path, methods, procedures, time frame and resources, might be established, although during time, in practice suffering corrections and adjustments along the research way. The researcher should start the work having already in mind the final objectives of the work, planning consistently all tasks and milestones along the research job (Hollweck, 2016).

To answer the research questions formulated in this thesis, the research design proposes a serious of steps and tools to search the results on a methodical and systematic procedures aiming to optimize the available information in order to understand, explain and predict the phenomenon.

The research is proposed in 3 phases, followed by exploratory work discussion.

1st Phase – Data analysis – quantitative data treatment of food commodities world production statistics of one past generation, for all countries. Followed by data analysis and exploratory discussion;

2nd phase – In-depth interview with industry leaders – followed by the phenomenological exploratory, content analysis of the materials produced, the research made the analysis of the significance of the classified relevant topics came from the respondents;

3rd phase – Short Case Study discussion, the Terminal XXI and its similarities and effects to a grains dedicated terminal, the transhipment business based sustainable model;

4.1 The Research design, Epistemological and Methodological considerations, review of literature

The primary purpose of this thesis is to determine the relevance and at what extent it is important to study and evaluate the consequences of the change in the geography of the production of food geography in the world, focused in food commodities grains that represent around two thirds of human food basis, and in addition, its logistics impact to Western Europe continent.

Paradigm of the research is the way, the path, of options taken by the research agent, along the investigation process, with a collection of principles engaged, conducted to achieve its objectives and reply the questions and problems formulated previously, is the complete framework of the research, its collection of beliefs that are common ground between the research actors, how and what way they observe the world, their realities. The choice of a research paradigm is intrinsically connected and dependent to the human research agent in presence, his experience, culture and convictions (Yin, 2015).

In the research scientific world two extreme main perspectives enclosed the opposite paradigms, followed by several different intermediate and mixed propositions. The paradigm of the investigation work focuses on the philosophy of the research in social sciences, a set of base assumptions and beliefs formatting the way of thinking of the researcher and determining how the researcher is going to act and develop the work. The quantitative research, positivist and post-positivist, those using the scientific method, experimental and empirical, we can count, as the primary tool to discover the reality. Positivism and Post-Positivism intend to measure the reality, this research current states that the reality is steady, being a universal existence, it is independent of the actors and observers in that reality. It is like it is, facts are facts. Positivism is accountable, numeric translated, yes or no, true or false, it serves the quantitative approaches and methods.

Opposed to the Quantitative, positivist research paradigm, constructivism, also called interpretative paradigm, expresses subjective views and different perspectives, based on people personal experiences in the world they live in and its own interpretation of the reality

and its subjects. Recently several different mixed approaches tackle in between this two extremes, called a Pragmatic approach (Rahi, 2017).

The mathematics, the “queen of science,” as well as physics or chemistry, are hard numerical, the essence for quantitative research, in these exact sciences floors, as states Guba (Guba Yvonn As, 1994), the numerical impartiality of other sciences like Biology, or social sciences, signalling some imprecisions, subjectivity, developed the Qualitative research paradigm approach, including the contextual information, the human actors, the behaviours and beliefs, their activities. Qualitative data provide much richer insights in general, in the human behaviour phenomenon, the reason why it enriches research in social sciences.

It is quite important that researcher expresses and stays coherent to its paradigm of research, it is not the choice of methodologies that matter in the end. The methodology are the techniques that will help the researcher to analyse and discuss the problems, composes one of the elements of the research path followed, the ontological position of the researcher towards the focused problems, the way to observe and tackle the reality, defines then the epistemological course, the relations between the reality and the researcher (Belcher, 2009) (Monforte & Smith, 2020). The epistemology relates the researcher with the reality, how the researcher is involved and participating in the reality of the observed problem. The ontological position states the vision of the researcher towards the reality. Confronted by main flows, how the researcher understands the reality, the Ontological positions of the research framework can be characterized by the Representationalism, were reality is overserved and measured, does not depend of the observer context, interpretation, is objective, or realist (Catterall, 2000).

On the other hand, we have the Relativism and the Nominalism, reality can have different interpretations and depends of the observer, place and time. The sociological scientific research became effective in early seventies, opening new research methodologies in the social sciences comparable and as well as reliable, with those in exact sciences. Although, opposing positivism, the social studies granted their solid backup on “relativism” principles as it does not take “fixed points” in the physical world, either “fixed reality”, in a logic that could bring researchers from different backgrounds and cultures in dispute. Natural or rational thinking are not based in one sole universal true, the understandings of reality and

formal mathematical world are configured within the cultural bias of the society where it is observed, differing in space, time, culture, so called the “social construction” of the scientific knowledge (Collins, Joseph, & Bielaczyc, 2004).

The Epistemology is the way and the options how to conduct the research work, beign framed by the ontological position of the researcher and diverts between different positions of leading the research work. These research paradigms, their routes, guiding the options and choices of the research, are necessarily moulded by the ontological position of the observer, and its epistemological path, framed by the global research paradigm chosen.

The Relativists research jobs are related with the also relativist ontology position, where translating reality depends of those performing so, where and when, context, culture and personal beliefs are influencing the perception of reality. Relativism as an epistemological format of the research leads the works towards a more subjective meaning of the reality, the researcher is an actor on the investigation job and his interference is indicted on the results, so they are in a certain way subjective, intrinsically connected to the profile of the players of the research. Social Constructionism is linked to a Nominalist ontology and aims to understand the meaning of happenings in the world.

The social research, for some authors, can be divided in four main Paradigms. Dana and Perry made their aggregation with the respective Ontological position, they called the “reality” the Epistemological researcher track and how the researcher relates inserted as part of the research job, and the Methodologies furthermost frequently used in each research Paradigm construction (Sobh & Perry, 2006).

	Positivism	Constructivism	Critical Theory	Realism
Ontology	Reality as it is, no matter who is watching.	Depends who is watching, where, when, “Constructed reality”.	“Virtual” reality shaped by society.	Reality is difficult to catch, only by different sources may be apprehended.
Epistemology	Findings are objective and true, as reality is quantified.	Researcher is a player within the research context .	The researcher is a “transformative intellectual” changing the context.	Findings need validation, Triangulation of sources to validate findings.

Usual Methodologies	Quantitative methods. Surveys, experiments, verifications.	In-depth interviews, participants observation, grounded theory.	Action research, participant observation.	Many qualitative methods, converging to validate.

Table 13 - Essential four Paradigms in Social Sciences, Sobh & Perry, 2006

Other academics, studying the paradigms and its hermeneutics, also in the earlier application to the social sciences research context, considered different elements in a résumé table, classifying and defining the important research paradigms different way, but essentially they come with the same type of structure, descriptions and considerations (Guba Yvonn As, 1994).

Fundamental Beliefs	*Positivism (Naïve realism)*	*Postpositivism (Critical Realism)*	*Interpretivism (Constructivism)*	*Pragmatism*
Ontology: the position on the nature of reality	External, objective and independent of social actors	Objective. Exist independently of human thoughts and beliefs or knowledge of their existence, but is interpreted through social conditioning	Socially constructed, subjective, may change, multiple	External, multiple, view chosen to best achieve an answer to the research question
Epistemology: the view on what constitutes acceptable knowledge	Only observable phenomena can provide credible data, facts. Focus on causality and law-like generalisations, reducing phenomena to simplest elements	Only observable phenomena can provide credible data, facts. Focus on explaining within a context or contexts	Subjective meanings and social phenomena. Focus upon the details of situation, the reality behind these details, subjective meanings and motivating actions	Either or both observable phenomena and subjective meanings can provide acceptable knowledge dependent upon the research question. Focus on practical applied research, integrating different perspectives to help interpret the data.

Axiology: the role of values in research and the researcher's stance	Value-free and etic Research is undertaken in a value-free way, the researcher is independent of the data and maintains an objective stance.	Value-laden and etic Research is value laden; the researcher is biased by world views, cultural experiences and upbringing	Value-bond and emic Research is value bond, the researcher is part of what is being researched, cannot be separated and so will be subjective.	Value-bond and etic-emic Values play a large role in interpreting the results, the researcher adopting both objective and subjective points of view.
Research Methodology: the model behind the research process	Quantitative	Quantitative or qualitative	Qualitative	Quantitative and qualitative (mixed or multimethod design)
Based on (Guba Yvonn As, 1994)				

Table 14 - Research paradigms reume, as per Guba

In this thesis, a mix of both main paradigms, Quantitative research in the first stage, pure positivist, where practices of data mining, clearing and treating data elements and series, numeric possessing and statistical calculations were performed to find out about the evolution of a physical variable, although complex and composed of several sources of elements, it was used exclusive numerical and strings data processing, to reach out the results; also it was used Qualitative research in a second phase, a Constructivist, following phenomenological and narrative analyses, a series of in-depth interviews, and the analysis of a short case study, to conclude in a analysis discussion chapter. An ontological position and perspective, relativist towards the phenomena, ensures that different views points, in space and time, may interpret different perspectives of the same reality.

Both quantitative and qualitative paradigms are used to observe the reality and interpret it in this research, however we do not consider this case is an application of the Pragmatism paradigm, where a mix of the quantitative and qualitative methods, qualitative empirical data might triangulate with other research methods building a complex construction of crossed methods to find the conclusions (Patton, 2014). Although numerical and statistics treatment is made in the first phase of the research, it is not about the same question that is handled further by a qualitative paradigm, using a phenomenological and

interpretative epistemological path, where a relativist position was assumed in qualitative in-depth interviews phase.

The Methodology selection and justification follows the epistemological views and ontological positions of the researcher, reaching and gathering fundaments that justified the choices, also by the specificity of the reality, the samples, the appropriate methods to extract data for the subsequent analysis.

The proposal methodology is to use both Quantitative and Qualitative techniques to search the answers for the research questions:

Question 1	Question 2	Question 3	Question 4
Is food production Latitude moving to South?	Should Europe look for alternative ports in the southern continental countries?	Is Portugal potential geographically competitive to become an alternative food port to Europe?	Possible impacts of a food terminal to the regional hinterland of the port?
Quantitative, data analysis, positivist	Qualitative		
FAOSTAT and IMO Geographical data bases	In depth Interviews, open questions		
SPSS and Excel data treatment	Inductive, Phenomenological and Narrative		

Table 15 - The research question and its paradigms

The analysis of the results allowed the research to reach fundamental conclusions required to answer the research question proposed.

The research design for this project is based in a mixture of methodologies considered adequate for the purpose of the thesis mission, where epistemological and methodological considerations were previously taken to track the path of the research work. In the social sciences, several epistemological problems requiring the attention of researchers wishing to carry out qualitative and critical studies, particular in this field, there is always a complex

problem on the relationship between a qualitative analysis, on the one hand, and the reality to which it refers, on the other. Against pure realism and radical relativism, some authors defend the idea that the results of research should be plausible. This leads to the question of what are the standards against which we can judge the acceptability of a qualitative study. Researchers are always revisiting the opportunity of coming back to the criteria of validity and relevance of the works done (Rueff & Julien, 2012).

Research design is far from being consensual, have a unique form or solution, varying substantially along time, school's context of the researcher, the resources available, results depth required on the investigation work. Designing the research work is a critical topic on the preliminary plans of study work of the scholars, often is reshaped and overturned along the path of the job. The current understandings about research design are an enormous colourful pallet collection of the ideas, methods, different criteria's, stamped in scientific literature all around the scientific community resources, leading the researchers that may have a cause of confusion, having lack of clarity and uniqueness in the literature about the different approaches of the research design, its methodologies, particularly on the social sciences common space (Abutabenjeh & Jaradat, 2018).

Many scholars and authors had profound discussions about the methodology for social sciences, its validity and acceptance by the scientific community. The succession of methodological discussions are abundant in literature, on the whole in social sciences where research is borrowing the reliability and validity of the positivism, of physics and natural sciences (Cho & Trent, 2006), (Rose & Johnson, 2020).

Social research is taking the path towards a more empirical and relevant than many humanitie,s trying to approach to the relevance of natural sciences or mathematics, using more epistemological methodologies to trying to perceive more accurate, searching for legitimation of results. This approach might also be taken the risk of legitimate the research work because is making use, sometimes extensive use, of empirical studies and complex mathematic analysis approaching a scenario of positivist research, searching an apparent relevance for a better acceptance of results.

Often the Epistemologists do not want to progress without the need of understanding and the discussion of all foundations of the knowledge, servants of the Science of Knowledge,

they feel blocked by this obstacle, their search having more or less success, offering without limits a varied and diverse spectrum of solutions, by discussing or disputing the new status of their methods. However, "it is enough to write or pronounce a sentence deemed to be a piece of knowledge to adopt ipso facto epistemological positions "(Rueff & Julien, 2012).

Qualitative Data Analysis, used to reach meanings and communicate findings from the research, is always a form of interpretation of data collected whatever is the style, codes or strategies of the investigation. Using qualitative data, usually requires a lot of time and effort for processing and interpreting the collected information.

The literature review showed that research methodology design approaches are convergent and sometimes divergent between many scholars in social sciences, in the end, it's the research option that have to be sustained on the base fundaments that led to the choices made in the current research methodology steps proposed.

The In-depth interview methodology is often employed by Research when surveying business owners, high-level executives, community and business leaders, key opinion influencers, technicians, specialists, and other professionals about complex or highly sensitive topics. This research methodology is also used as a technique for learning more about an industry's specific characteristics and practices directly from those individuals who specialize in, and often who are leaders of that industry. The point of in-depth interviews is to allow for a semi-structured discussion in which the respondents are treated with great respect as "experts" in whatever field or situation they happen to represent.

The questionnaire used guides the respondents to reveal their point of view regarding the topics of analysis, processing the transcription after, content analysis is the method in which the qualitative data is somehow diverted to quantitative indicators that express the importance and relevance of each particular topic addressed by the interviewed invitee (Hussey & Collis, 2014).

4.2 The research strategy design

The research strategy resumes the overall process of collecting and interpreting the data used on the research process to accomplish the objectives established in each phase. The figure bellow resumes this plan, the research strategy methodology design chosen along the thesis, that was several times corrected and amended considering the normal evolution and dynamics of the research work and especial along its empirical job. We can consider that the mix practices used would be building a Pragmatic mixed methodology of the work. In fact, what we have is sequence of phases using different research methods according to the convenient objective of research.

After design and preparation of the research, the initial phase of field work, we had to determine the evolution movement of the medium weighted latitude of the world agriculture production, all countries for the 4 decades selected, including the food commodities quoted in stock exchange. This was a quantitative, data mining, calculation tasks, processing and analysis, comprehending a very positivist and quantitative research phase.

Later to evaluate and check the determinants of the opportunity to develop the new European South West Grains Terminal, 3 research jobs are planned in conjunction with the same interviewees, treated and interpreted sequentially in the research work, all contributing to the discussion and conclusions of this thesis.

Phase	Objective	Paradigm / Ontology	Methodology / Process
1	Determine the tendency of the weighted average Latitude center of the World Agriculture Production, of the tradable stock quoted food commodities, along the past 4 decades	Quantitative / Positivist	Data mining, cleaning, processing, calculating, presentations of results
2	Evaluate the opportunity for Europe to develop and alternative Grains terminal in the Southwest zone ?	Qualitative / Relativist	In-depth interviews, interpretation and discussion analysis
3	Evaluate which are the most relevant competitiveness Port requirements, factors of attraction	Quantitative / Empirical observation	Empirical, empirical construct, port factors of competitiveness Survey,
4	Comparative analysis of the success factors of terminal XXI and an hypothetical grains terminal	Interpretive constructivist / Relativist	Case Study, comparative analysis

Table 16 - The research strategy phases proposed

4.3 Quantitative Data Analysis of georeferenced food commodities production

The geographical center of the medium weighted latitude of agriculture commodities production is moving to south in the globe, as the data analysis work revealed. This demonstration was made with an immense data mining job, during two phases has it will be detailed.

The first block of the research methodology is based in quantitative data analysis of credible sources, crossing Grains, food commodities production by country origin, along various decades, and the geographical correlation of this numbers weighing its latitude to determine if, and where to, the production of the food grain is moving in the globe. We will describe later the FAOSTAT data base and its carful criteria of collecting data from all countries.

As previously discussed in upper paragraphs, SPSS and EXCEL tools will be used to manipulate the huge amount of data downloaded from source, later cleared, to process the study. As we will see bellow, were created a serious of intermediate variables for calculations foreseen, also associating other databases for geographical information.

The data mining job and its treatment method was performed twice. Initially with short amount of data, few countries, 3 commodities and 3 discrete years, to preliminary validate results, checking the feasibility of the calculations and the opportunity of the exploitation of findings. And after this stage, in order to follow the treatment of the huge sample considered in the second data treatment job, the data clearing and statistical treatment of the data of all quoted commodities, along sequent 40 years and all world countries, largely extending the previous numbers of the research, validating the same findings.

4.4 Industry leader's in-depth interviews

The research strategy, after the Quantitative and positivist job done, would develop a second phase of research, to evaluate the opportunity of the construction of a New Grains terminal in the South West European zone. This was a qualitative research comprehending 3 jobs. Nevertheless, we are not in presence of a mix paradigm approach, Pragmatism paradigm, rather a series of methods to search in sequent phases, different kinds of findings, where for each phase a designed strategy was differently proposed.

For responding to the opportunity to hypothetically build this new terminal, the Qualitative research followed a serious of In-depth interviews with industry leaders. As ample of 13 participants was considered adequate, covering the targeted fields of expertize and geographical experienced knowledge in the international trade and logistics of food commodities. Especially experienced and acquainted with the transit in south Europe food commodities operations, people of targeted group of interviewees did include professionals of this kind. Experienced with the large cargo vessel Grains industry, in the different levels of logistics chain position on the operation: Port management and Government; Port infrastructures management and development; Supply chain managers; Logistics Directors; Agriculture commodities producers, Farmers; Traders and brokers from the top trading houses of Europe and America ABCD; and food commodities industry experienced Directors. All the key actors of the supply chain of food commodities might be involved in this evaluation, as potential users of the facilities.

Many types of qualitative studies share common aspects, they are descriptive, and rather than proving or disproving a hypothesis, they explore some aspect of human experience in depth. In qualitative studies, the focus is on the wholeness of the experience rather than its parts. The focus is also on meanings and essences of experience rather than parts of the experience that can be measured more easily. The purpose of qualitative studies is to develop ideas and theories about human experience rather than quantified results.

The theme guided in-depth interview explores the discussion with the participant source of information, reflecting about the given topics, discovering the views and

experiences of the interviewee along the discourse. The guide lines for this interviews are later presented in the sub-chapter “6.1 - Guide lines for the interviews”

For this research work phase of the thesis, as it was early proposed and explained, a series of 13 in-depth interviews were performed, following the action plan to guide the process in the subsequent steps taken:

1. Identifying the persons to invite within the Focus profile (competences, experience, geolocation);

2. Selecting and inviting the prominent sector leaders who have the commitment to collaborate in the research;

3. A formalized an informed consent agreement to participate in the research was proposed, before the interviews, ensuring respect and preserving the integrity of the views of respondents;

4. Interviews were semi-structured, free ongoing discourse, but also guided, based on previous notes about the items that need to be answered about the ports, services, routes, locations and facilities;

6. Interviews were primary data collected, where the narrative about the theme in discussion was built according each participant expertise and experience. The grains facts assessment recognition. Ports facilities and managerial services and competitiveness. The opportunity to locate a new Grains terminal, in discussion. The possible impacts generated. The interview collected information about impressions, perceptions, both positive and negative feelings, difficulties, events, timeline, complications and opportunities encountered by interviewees during their participations, expressing ideas, conceptual models, evaluations and perspectives;

7. In addition to the primary data, the secondary material involving notes, memo, e-mails, technical reports, comments the researcher on ongoing projects, all were considered in understanding the evaluation of the Opportunity in discussion;

8. It was understood that the perception of a world changing geography for food commodities production origin was not in the awareness of most participants, although decision makers and leaders in the industry, so the interview was time consuming and needed to allow the preliminary interpretation of the data suggested. The research was developed to

reconstruct the process of choosing port facilities taking into account the various decision factors in the supply chain and all economy of the operations of Grains and Seeds in the South European region.

The results of the interviews, later translated and transcribed, were treated in a hermeneutical interpretative discussion, to extract the main propositions, contributing later to the final discussions and conclusions.

Starting the in-depth interview, to obtain a climate of relaxation and deconstruction, the interviews were made majority, 10 out of 13, out of the work place in a log time break with coffee, lunch or dinner context, to allow more informal conversation and free conversation. Rarely a few interviews were in the context of meeting rooms, and none was in office desk context.

Starting with greetings and appreciations for the availability from the part of the invitee, the interviewer introduced his target objectives and context of research, explaining the reasons and purposes of his previous request, even anticipating the answers to three often unformulated or hided questions to discover: Why this research? Why me? What is the purpose for? The clarification of these questions in advance was immediately relaxing and decompressing the climate, giving contextualizing the purpose of the interview.

In addition, it was specified that it was a free interview and open, and that it is the interviewees opinion that matters, their point of view, their situation or their story that interests and that there are no right or wrong answers. It was also indicate the duration of the interviews and, in certain cases, discuss the choice of the place for the interview not without effect on the remarks of the influence of the office context (Blanchet & Blanchet, 1994).

It was essential to inform and indicate that the interviews were digital audio recorded with electronic device and explain their meaning for the rest of the work. Written consent was expressed and signed in the usual form. Also informing about the transcription maintenance or even a duplicate of the recording. Guarantee the confidentiality of comments made and, wherever possible, respect for anonymity was also given. It was useful not to come back to these different preparatory elements at the time of the meeting, preparing them before at the beginning of the interview, also answering other questions about the methodology and treatments, presentations of the information and conclusions. The pre

arrangement and booking of the space, granting a conformable and quite environment for the interviews, was not neglected during these meetings.

4.5 Factors of competitiveness survey

The competitiveness factors of the Ports in the world, bringing more or less attraction for a certain port to serve its ship-owners clients, since the last 3 decades, is largely studied by many authors and scholars. Using a selected and consensual construct for evaluating port services competitiveness and attraction, the research took the opportunity to meet the interviewees, information sources available, to procure the evaluation of those variables in a standard written survey, this way equal for all sources.

The survey in all cases was presented and responded, after the in-depth interview job finished, collecting specific opinions of the main variables of the research. The surveys were used for further empirical treatment, discussion analysis, incorporated in the conclusions, final chapter.

As we will detail further down, the construct was appended with some more specific variables, to englobe particular factors of processing cargos of Grains and seeds in a Port, for which some specific services and capacities are necessary or welcome.

4.6 The case study, Terminal XXI, for a parallel similarity analysis

A case study about the Terminal XXI was elaborated, taking in account a conjunction of similarities encountered, therefore looking to enrich the discussion and findings with a comparative analysis of the new existing terminal. It is a relatively recent container terminal in Sines, as it will be described later. A case of exploratory comparative analysis was settled and discussed. The researcher considered to some extent to compare the factors of competitiveness on the strategy of this project with the hypothetical case of a European South West maritime Grains terminal.

Some of the similarities are obvious to exploit, the strategic view of the geolocation, the physical characteristics of port having the characteristics of a deep-water port, able to receive large vessels. The transshipment vocation consequence of both these previous factors as it will be discussed later.

The case study shall permit to discuss and identify the eventual parallelism and opportunity, looking also to other development factors and models of the case study. Discussion themes like the risk management for the Portuguese Government, the business opportunity to the concessionaire that took over a BOT construction operation project, the commercial opportunities and the traffic developed, as well as the beneficial impacts for the hinterland ZAL and ZIL of the Port.

4.7 Résumé of the Chapter Research methodologies

The research strategy designed for this thesis is comprehend in 4 phases, each one with its research tasks, not fully independents, but rather complementary and focusing the objectives and research questions proposed. To determine the tendency movement of the weighted average Latitude center of the World Agriculture Production, a Quantitative, Positivist, data mining job was performed. For the evaluation of the opportunity for Europe to develop and alternative Grains terminal in the Southwest zone, a Qualitative set of 13 international specialists participated in an In-depth interview task, for interpretation and discussion analysis. To evaluate which are the most relevant competitiveness port requirements, factors of attraction, a Quantitative and empirical survey evaluated the port factors of competitiveness. Finally, the success factors of terminal XXI and a hypothetical grains terminal was a Case Study, making the comparative analysis of the success factors.

5 Southern evolution of world agriculture production latitude

As previously detailed in chapter 2.2 The evolution of agriculture in the southern hemisphere, strong changes in farming operations towards industrialization of the crops, introducing bio-enhancement of vegetable varieties, whether by natural blends or OGM manipulation of seeds, also introducing chemical technologies in phytosanitary treatments, all these factors urge world agriculture yields development in the past decades, in particular during the second half of XX century, absorbing and spreading from the more developed countries their technologies to developing economies.

Remarkably progress was operated in the southern hemisphere countries, bringing inside their lands the big farming houses to exploit large acreage opportunities in these countries with low investments, when compared with their own origin states cost of land. Big areas in the southern countries were deforest and farmed for agriculture production, in countries like Brazil, Argentina, more recently Paraguay. From North America and Europe, recently from Asia, many big farming houses went in developing countries buying, taking concessions or renting land for installing massive farming operations, very technological grounded. All around these occupations at the end of last century, many ONG movement raised awareness of actions of the controversial “world land grabbers”.

Figure 81 - Land grabbers urged in the agriculture world

Among other regions of the agriculture world developing, Latin America has seen an increase in land transactions (Guereña, 2016). A process of intensification of agricultural systems was developed both in the consolidated agricultural regions and in the new areas on the new virgin territories which are incorporated into agribusiness circuits. If, in Brazil,

Paraguay and Bolivia, the possession of agricultural equipment and land is common, in Argentina and Uruguay, the subcontracts for agricultural work to services companies is very frequent, and the optimization by scale economies of production involves in addition, sometimes temporary, of land leased. The search for greater profitability results in contractual associations between all actors that assume the agricultural activity, together with other players, such as capital investors, what it ensures the means necessary to gather the required resources for the agriculture operation, land, agronomic consultancy, machinery, labor work, commercial information, and other essentials to have a productive project, possibly recurrently renewed, while other locations might surge more competitive. Controversial ONG movements showed strong awareness against this massive agriculture operations cascading all around in the world, in order to fight against “land grabbers”.

Very quick the lessons learned, instructed the local farming houses and developed them to also grow into strong players in the agribusiness world. Moreover, the main protein source, the soya harvest, that found a free entry in Southern countries without no limitation for OGM farming, having appropriate temperature and rain, promptly become leader in protein suppliers in several continents in the globe. It is not a secret, every senior professional on the business knows that the southern countries and especially the south America agriculture origins developed intensely its volumes, in the specific food commodities more favorable of theirs’s climate and soils, contributing towards a large volume production, and at the same time, covering the demand of the increase demand of food request in the world. As we saw in previous chapter, in the last generations, meat consumption grew well above the population growth, especially in the developing countries, simply put, before we were “eating rice”, now we want “fish and meat”.

It is now essential to demonstrate the validation of this qualitative findings outcome, and in a data analysis quantitative research job to determine the numerical value of the displacement of agriculture production latitude.

The quantitative research work was performed based in a data analysis made in two phases, to validate what was the conviction of the authors and many others industry leaders.

In the preliminary “project thesis” report, it was formulated the hypothesis that the production of food commodities is coming to “south” getting lower in latitude, that means

the large scale agriculture production of grains and seeds is growing more and faster in the south countries, bringing the medium production weighted latitude to move from north to south. The preliminary Data Analysis work it was stated as limitations of the preliminary data treatment, although any way large, using a reduced amount of data. For this first step, the research work used a restricted data range of food commodities, the analysis was also limited to the fifty biggest countries in the production of food commodities related to last year of analysis, and especially, the data analysis work was limited with only three discrete years separated by one decade interval, ignoring all interpolations between the decade years.

Nonetheless, this preliminary research was very important to confirm the research question findings, once it showed that the production latitude of grains and seeds had a southern tendency in past generations. The job being done with such number of limitations, but enough to pre-validate the confirmation of the research question answer “yes, it is coming to south”, nevertheless, did not gave indication of how much this displacement to south was relevant.

The researcher endeavors for this thesis was then to validate the preliminary Data Analysis work with a new phase, of the Data Analyze including much more significant elements, bringing:

- More food commodities analyzed – considering the “traveling commodities” the most trade world food commodities, using the standards grains and seeds, which are standardized as global commodities and quoted on the CME stock exchange (CEBOT and LIFE commodities);
- 195 states in the world, major producers, from all UN countries are now being considered for the second validation of the hypothesis;
- Along the 30 years, all years, considering each year the respective production values for each food commodity, using a moving average algorithm for the medium waged latitudes of all productions years.

5.1 The FAOSTAT data mining exploitation

FAO organization is a specialized agency, a sub-organization of UN. FAO is leading initiatives towards the assurance food security for all, so people all around the world can access quality food being active and healthy, defeating hunger. Counting more than 194 member states, the organization is actively working in above 130 states worldwide fighting hunger, in fields like sustainable farming education, water, desertification, irrigation, agriculture techniques, meat production, sustainable techniques, forests, agriculture markets, climate change, costal fisheries, food waste, among many other thematic actions. To sustain its programs, FAO makes use of the foremost credible database of agriculture world data, the FAOSTAT, making part of a collection of other information valuable instruments, periodically produced like monthly reports, infographics, publications and many other resources of information around agriculture and hunger in the world.

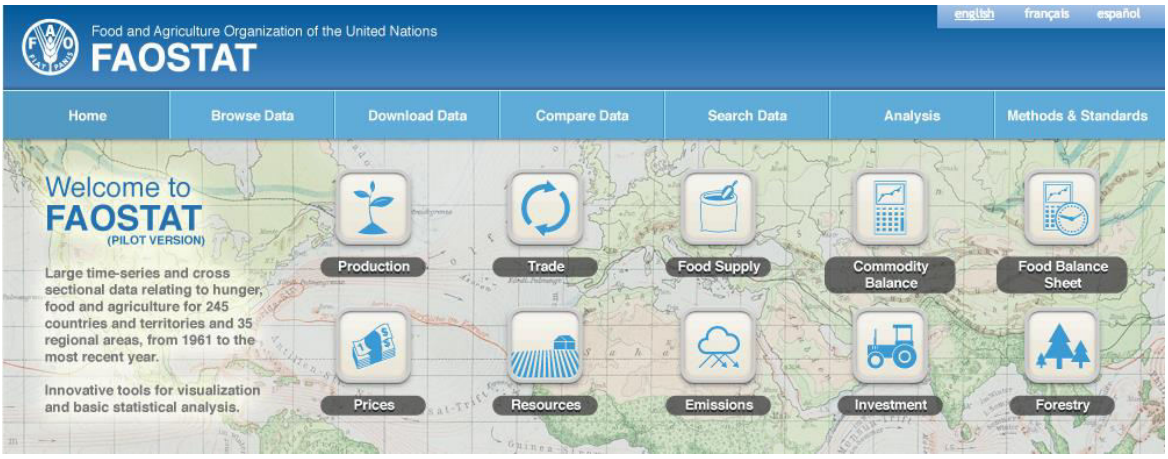


Figure 82 - FAOSTAT database for food and agriculture data, FAO

FAOSTAT providing access to global food and agriculture data, detailed per country, credible annual data, is the most credible source of information regarding food information statistics in the world. From early 1960 the FAO organization is collecting data from the progressively adherent countries of UN. Still today no absolute perfection is achieved in this information sources, strong limitation is still being struggled by FAO operatives in many countries in the world. However, this data is the most reliable source we have, as referenced by many other authors and scholars. Creating and harmonizing standards with many other world and local country governments and organizations, the diverse departments of FAO

include : Statistics Division (ESS); Animal Production and Health Division (AGA); Plant Production and Protection Division (AGP); Agricultural Development Economics Division (ESA); Nutrition and Food Systems Division (ESN); Social Policies and Rural Institutions Division (ESP); Trade and Markets Division (EST); Fisheries and Aquaculture Policy and Resources Division (FIA); Forestry Department (FO); Climate, Biodiversity, Land and Water Department (CB). All these departments are coordinate by the Office of Chief Statistician (OCS).

Figure 83 - Activities in the Statistical Programme of Work, FAOSTAT

FAOSTAT worked in several fronts of activities, sustaining the data collection, with tools for broadcasting in education, research and strategic support of nations; establishing and adapting standards and methods to collect and provide data; also building capacity, human and technological to provide trustworthy services worldwide.

Agriculture is a major and primary sector for most domestic economies and represents the main source of livelihood for a large proportion of population in the world. However, this sector has not fully benefited from statistical capacity building programs, which have traditionally targeted areas considered to be more strategic, such as macroeconomic statistics and industry, until FAO started demanding the countries for data in early 60's. FAOSTAT was the demanding application, prodigious contribution tool for the world countries to develop reliable statistics around food and agriculture. This is not unconnected to the significant erroneousness and deterioration in the availability and quality of agricultural statistics of many countries in these recent decades. However, since FAO actions engaged progressively the nation's governments, especial in developing countries, the agriculture and food department services, main players in the sector, have become aware of the importance of

decision-making based on reliable, up-to-date and harmonized information. Recent episodes reinforced this awareness, like the food crisis of 2007-2008, and then the episodes of sharp rise and high volatility of food prices in 2001, the Arab Spring revolutions started with the bread price escalations, the revolution spreading all around the Arab countries in a fight against a mix of poverty, hunger and government totalitarianism. The establishment of early warning systems for food security is based on the existence of reliable and regularly updated statistical information.

FAOSTAT is also very important to provide statistical information for economic improvement programs, both in less and high developed economies. This is also the case for economic assessments of agricultural policies, such as input subsidies or producer price stabilization schemes. Finally, the usefulness of quality agricultural statistics is reinforced by the multiplication of initiatives aimed at developing the agricultural sector in industrialized countries as well, but nevertheless, at the forefront of which are the programs for the development of Food sustainability and Agriculture in developing countries worldwide.

FAOSTAT was largely accessed in both phases of the datamining jobs of this thesis research work. For the purpose of these exploitations, gathering data from 4 decades of all countries, the reliability of the figures is in confidence interval good enough to sustain the conclusions that are in the objectives and scope of this research work.

5.2 Georeferenced data creation using the IMO latitudes

For the purpose of this research, the data accessed in FAOSTAT data base refers to volumes and economic data, referred to a political geographic base identified per country. This data edition did not had any georeferenced to extract any type of geographical coordinates like longitude and latitude. We can understand that a data element, example the production crop of Maize volume in Spain, in the year of 2018, is in official data 3.842.519 tons. This figure is taken from the data base, digging after the agriculture production crop for maize, in Spain, for a period chosen by years of harvest. It is understandable that this production is not georeferenced at FAOSTAT level, so more detailed regions than the national level have not a common ground of political management of the territories. Of course, we can

say that the Spanish production of maize is distributed among the important agriculture regions of the country. How much maize in Andalusia, in Galicia or Asturias, we do not know from FAOSTAT. But for the purpose of this study, the territorial unit of data, is not that relevant for the global evaluation of the evolution of world latitude of production.

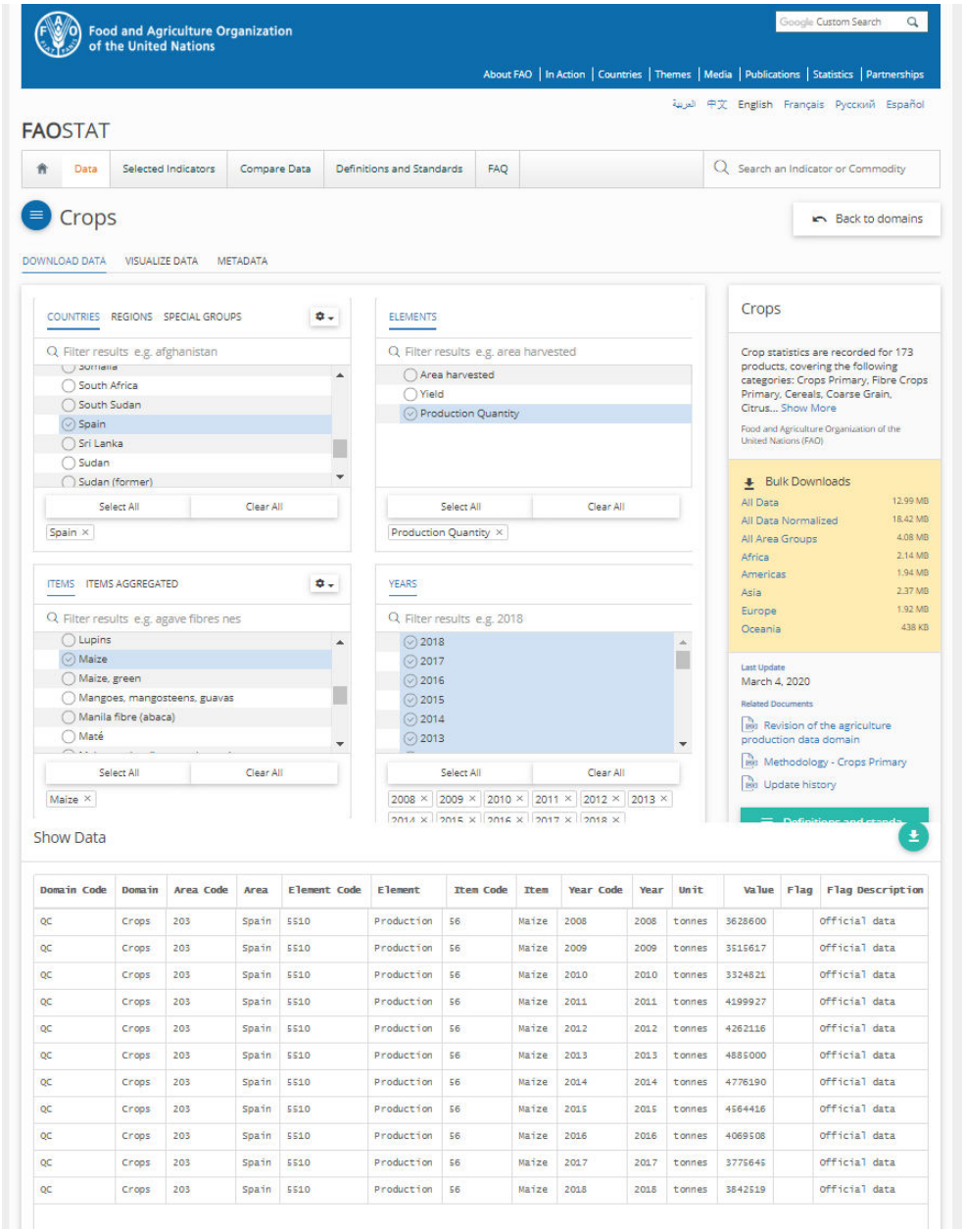


Figure 84 - FAOSTAT data availability per country, consultation example

The data was collected from FAOSTAT. The crop productions of all countries, for all tradeable agriculture commodities along 40 years, all data from 1975 to 2014. Unless by the name of the country of origin, considering the geopolitical countries divisions, not other

georeferenced could position in latitude this data for calculating the southern movement of the medium weighted crop, along each interval of years of the production, for those sequenced data elements. For this reason, another data base of the latitudes and political countries capitals was matched with Faostat data. Later even a moving average was calculated for better visualization of the moving tendency to south.

Willing to calculate the variation of the georeferenced attitude of the average weighted production of world crops, of all food tradable commodities, along the 40 years, it was necessary to find a solution to reference the latitude of each production. Note that the research is looking for the "delta", meaning the deviation, so it is not relevant to discuss whether we consider the latitude of the country capital city, the country geographical center, or any other referenced city. Being interested for the "variation", this is a relative interval quota, hence the origin point is not relevant, it is important that it keeps the same reference along the 40 years of data analysis, as the world variation will give always a relative delta to any position. Note also that many capitals are changing, as well as borders themselves, as we will see further.

For overpassing this limitation of giving latitudes to the crop production figures, the research considered a georeferenced data base, from an international organization using truthful city latitudes and longitudes for navigation purposes, the IMO International Maritime Organization, from where the research took the georeferenced coordinates for the capital cities of each country.

IMO
INTERNATIONAL
MARITIME
ORGANIZATION

Figure 85 - IMO headquarters in London

Founded in 1948, the Organization International Maritime, called IMO, is a specialized institution of United Nations in the field of maritime transportation. As we saw, 90% of world trade merchandizes are being transported by sea, so the IMO goal is to take the responsibility for establishing a supranational fair and efficient framework of regulations, intended to be applied in the whole world. Maritime industry is indeed by its nature essentially globalized in all its dimensions: geographic, economic, legal, social, and environmental, among others. Up to 1982, this organization was called “consultation” and losing this term shows the expression of a deeper power in regulatory affairs of UN for the Maritime world.

The international founding text of the IMO was signed, in the after war, in 1948 UN Convention in Geneve, establishing the specialized agency International Maritime Organization. The Founding Convention came into effect ten years later in 1958, during which the regulatory frameworks were prepared, also by then, the role of IMO was extended to introduce new transnational maritime concerns like environmental, professional maritime training and legal issues related to seas and its traffic.

The Maritime Law has to be separated from the Law of the Sea, being the first corresponding to all the specific legal regulations directly applicable to the mainly economic activities linked to the sea, focusing the regulation framework in the actions, while Law of the Sea governs the relations between countries, the different states, concerning the usage of the oceanic and all aquatic international territories, and also the exercise of their power of governing over the marine zones. IMO relates predominantly with the maritime law, even if numerous of its instructions derive from the Law of the Sea. There are additional international bodies that specifically regulate the Law of the Sea such as the DOALOS, the Division for Ocean Affairs and the Law of the Sea, and the ITLOS, International Tribunal for the Law of the Sea.

Two manual major correction were to be operated. Although both are UN specialized agencies, one for maritime affairs, the other for food and agriculture, IMO Data base and FAOSTAT do not match strict the same countries denominations. The city latitudes, database origin are coming from an intelligence public access database. Although very approximate, does not have exact the same countries breakdown. It is true that along the years many political and geographical frontiers changed, obliging a “manual” section or agglomeration of

the data provided by the data base, to maintain the coherence along the 40 years studied in this data analysis work. Autonomous and other small territories, especially small islands, are not always classified in the statistical data of FAO as states, or other countries. A criteria table in annexes shows these cases, which due to their reduced size are not relevant in volumes of agriculture production, making no relevant change on results. In any case, the coherent allocation of latitude of the territory did not change along the 40 years of analysis, so maintaining the "delta" variation is valid in any case. Examples are Virgin Islands, Samoa, Northern Mariana Island, Tuvalu, Liechtenstein and others.

5.3 Variables constructions and conversions for calculations use

One main objective of this thesis is to demonstrate and calculate the value of the latitude change of the world Agriculture production. First of all, the question to clarify and understand is: What means world agriculture production latitude? This is not a universal scalar quantity, so we must understand the meaning of this value and define it for the purpose of demonstrating the objective of the thesis. Therefore, we need to evaluate the variation "delta" and its evolution, up and down, along 40 years, 1975 to 2014. The research must identify if and how much the medium weighted latitude of agriculture production, considering all countries, all food commodities tradable, is changing in latitude. For the purpose of exploring the evolution, a moving average calculation in graphics illustration will help to visualize the evolution, the movement, along these 40 years considered in the study, in north or south trend. The moving average is an arithmetic average of the weighted latitude along the years, the graphic presentation of the moving average helping to identify the tendency and movement of the value. In our case, we are trying to evaluate whether or not, the weighted latitude is moving south along the years of production, meaning that agriculture production is becoming stronger in the southern hemisphere.

For the purpose of this study, the base variables are direct imported from data mining in the downloaded FAOSTAT file sources. The sources, the origin data feeding the complex and gigantic database of FAO, are the member states of UN, which are consistently present in an annual base, reporting the Data Questionnaires of FAO, the "Annual Production

Questionnaire" addressed to the member countries. Along the years, in general the countries agriculture and food administrations also automatized and harmonized their data collection and reporting. In each country, the original source of data from producers is coming from obligatory questionnaires, whether on paper or on-line support tools, complemented after by the administration validations, surveys, expert observations and estimates.

The research used the FAOSTAT data as such, however, in the preliminary phase, some data clearing was performed to determine the confidence of the data elements extracted, which did not seemed relevant, once the FAOSTAT already pre-preformed these operations.

Nevertheless, the quantities of production are not enough for calculating the objective, but some further processing of these variables and calculations, so several intermediate variables and calculations were performed to achieve the necessary results.

All countries productions were georeferenced with a latitude, this latitude should be maintained consistent along the 40 years of calculation, for the same territory, as the study focus on the variation change of the medium weighted latitude of production, so political changes on the country's borders, should not change the geo-referencing of that same production for the purpose of the study. Therefore, as we study the change, what we call already "the delta" of the latitude for the production of a certain territories that the capital, the borders or the state aggrupation changed along this years it was kept in the same initial latitude, as per initial capital latitude. Some problems could be observed with the changes of the political geography. Example, production crop figures of the former Union of Soviet Socialist Republics were from 1975 until 1991 all assembled and referred to Moscow capital Latitude, but after 1992 until 2014 they split in several states occurred and individual productions were published in FAO database, so we consider that these productions figures, from new independent countries like Russia, Ukraine or Georgia among others, are allocated to Moscow latitude anyway. This does not change the reference of the production, not introduce variations in the latitude by political factors, not desirable for the objectives of the study; another case, Sudan Republic divided in 2012 the territory in two, becoming North and South Sudan, but both productions were kept to the former latitude, not to interfere with the variation. Another example of correction, in this second example joining territories, China, three data political sources along the period had been joined in the same latitude, for this

territory. It is well known, UN does not recognize the independence of Taiwan, but the data is collected and published in an exceptional regional territory separated account in FAOSTAT, called “Taiwan province of China”, that as a different source of data from the so called “China Mainland”. Moreover, also “Hong Kong Special autonomous region” keeps separated data until 1990, beign in 1991 integrated in “China Mainland”. For the purpose of this analysis of variation of production latitude we consider the sole latitude of Beijing, being 39 grades and 55 minutes North, for all the productions, not interfering any change on latitude caused by political borders changes or discussions. Another third example of correction, the Western Sahara territory is not recognized independent in UN, beign in fact since 1965 the biggest country on the United Nations list of non-self-governing territories, where UN is peace keeper between independentists and neighbors occupants (Morocco partially occupying), but agriculture data is available in different account from any of the pretending occupants, so the productions were referenced to Dakhla city, being the same 23 grades and 30 minutes north, as reference for the 40 years of production figures. Some few further examples with other territories could be described in the same type of principles, in any case, the methodology keeps the same latitude referenced for the production, not changing the variation, which is in fact what we do not want to affect nevertheless any political changes happened during the period of the study to the borders of the territory.

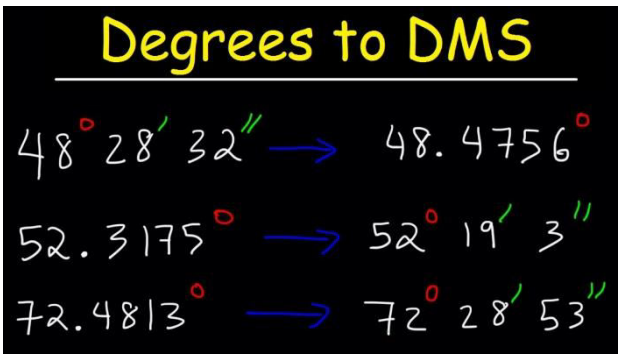


Figure 86 - Conversion grades, minutes, seconds to decimals

We need a tool for arithmetic calculations on latitude, regarding manipulation of mixed decimal with sexagesimal systems of latitude (grades, minutes, and seconds), to manipulate and calculate “waged medium latitude” using decimal calculus, to evaluate the evolution along the 40 years of the analysis, and in the end, to revert back to Latitude in

grades, minutes and seconds. Therefore, a list of intermediate variables was created to make this conversion and allow the calculation over the 194 countries considered.

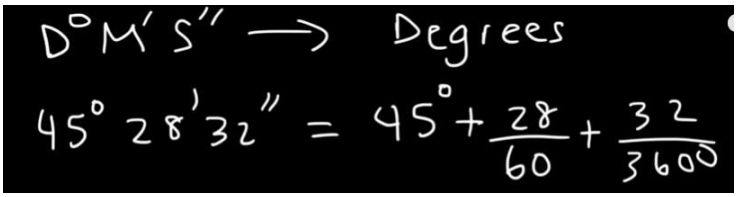


Figure 87 - Calculation of the conversion example

Even more, North and South descriptive in the latitude of a place is corresponding to the latitude referenced to Equator line, but in different direction. To calculate a medium, we have to reference all latitudes to one sole line using the same sense. In this purpose, we referenced all latitudes to the South Pole, like if it was the base line zero coma zero. For example, a latitude of 30 degrees north becomes 120 degrees, counted like if it was an azimuth angle from South Pole origin to the respective place; also in the same logic, a latitude of 30 South becomes 60 degrees, counted from south pole base line. All these conversions were necessary in order to establish a single sense and reference line, and used the decimal arithmetic calculations. For each country production it was calculated a “new latitude ref” to allow operations of the calculations of the medium weighted average production of countries, and moving it along 40 years. In the end, the reverse calculation was operated to give back a common latitude measurement, again North and South, in 90 degrees interval and the fraction part of the grade in minutes and seconds.

Country	Capital	Latitude	Longitude	2 digits	min-decimal	grd+min	NS	NEW LAT ref
Afghanistan	Kabul	34°28'N	69°11'E	34	46.67	34.47	N	124.4667
Albania	Tirane	41°18'N	19°49'E	41	30.00	41.30	N	131.3000
Algeria	Algiers	36°42'N	03°08'E	36	70.00	36.70	N	126.7000
Angola	Luanda	08°50'S	13°15'E	08	83.33	8.83	S	81.1667
Antigua	W. Indies	17°20'N	61°48'W	17	33.33	17.33	N	107.3333
Argentina	Buenos Aires	36°30'S	60°00'W	36	50.00	36.50	S	53.5000
Armenia	Yerevan	40°10'N	44°31'E	40	16.67	40.17	N	130.1667
Australia	Canberra	35°15'S	149°08'E	35	25.00	35.25	S	54.7500
Austria	Vienna	48°12'N	16°22'E	48	20.00	48.20	N	138.2000
Azerbaijan	Baku	40°29'N	49°56'E	40	48.33	40.48	N	130.4833
Bahamas	Nassau	25°05'N	77°20'W	25	8.33	25.08	N	115.0833
Bangladesh	Dhaka	23°43'N	90°26'E	23	71.67	23.72	N	113.7167
Barbados	Bridgetown	13°05'N	59°30'W	13	8.33	13.08	N	103.0833
Belarus	Minsk	53°52'N	27°30'E	53	86.67	53.87	N	143.8667

Table 17 - Latitude Conversion table, example from part of 195 territories

By building the data file for calculation, apart from the territories matching among time with the same cities Latitude, processing sexagesimal to decimal and re-reference the latitudes to be able to operate, were created some intermediate variable to allow the calculations. The addition of all quantities, per year and per country, was combined to determine the weight of the all tradable food commodities production volumes, per country of origin, the “7 Com” expressing the total weight of food commodities in one country in a certain year. As this variable for each country was available together with its latitude, we could calculate the “weighted latitude” of the country for that specific year. By combining all countries 195 weighted latitudes, we could determine the “all countries medium weighted latitude” of each year. This was the final variable of which the tendency over the course of 40 years the research wanted to see. Plotting the figures for all years, we got the chart of all years medium latitudes. The moving average was calculated and drawn to show graphically the clear tendency of the movement of that average, when expressed in a graphics form, turn out to be evident the southern movement of the weighted average of all countries, all food tradeable commodities production latitude.

For calculating the moving average of this final Quantity “the weighted average medium latitude of 7Com all countries”, we consider the SMA simple moving average

operation, performed by the calculation with a crossover of four values to smooth and make evidence of the tendency of the graphic line associated. The moving average line is like zooming out from the graphic results, looking from distance to the curve built on individual results from all years, jumping up and down, but showing a predisposition movement in the results.

Figure 88- A moving average curve example showing tendancy, NYSE

5.4 Limitations of discrete countries and latitudes

For the purpose of this research, data precision, extreme accuracy is not relevant for the type of conclusions regarded to be defined. However, the awareness of some limitations are encompassing the results. Agriculture production data is referenced by the political geographic borders of the countries, the "discreteness" of the country's borders does not reflected a possible continuous agriculture territory. Example, we may observe a neighbor agriculture territory in the north of Italy, like the plains of the province of Cuneo, the south of France plains of Avignon, in the exact same latitude. These productions are however contributing to very different latitudes determined by the geopolitical reference of the respective latitude of the political capital of the country. In this study, we assumed the georeferenced latitude for the production figures, the latitude of the political capitals of the respective territory referenced by FAOSTAT and IMO, so, respectively in Rome and Paris, that in fact are distant like latitude 48º50'N for Paris and 41º50'N for Rome, being 7 grades

latitude representing approximately 780 km, although we selected two neighbors farmhouses, where their crops are in close latitudes. As we saw before, this attribution does not affect in any bias the calculation of the variation, once this latitude assignment remains stable along the 40 years of analysis in the respective territories.

Figure 89 - Avignon and Cuneo referenced to respective capitals

The unit geographic data area is considered the country, and the assignment of latitude of the capital concentrates in that value all the production of the territory. Corresponding as such in political geography, for the production of each territory the respective latitude is maintained along the 40 years of the analysis, not changing the medium latitude calculation by any eventual change in the division of the territory by political reasons, if it occurred, this manual correction was operated.

However, it remains a minor limitation, the existing fluctuation of weighted medium latitude of production inside each country territory, because the FAO statistics does not allow the detail of regional data. For example, the production in the south of France increased, relatively to the north, and although it impacted slightly the world displacement of the geographic weighted center of production, this observation was not registered in the national data. The regional detail is lost in FAOSTAT figures, France production beign always referred to Paris latitude in the analysis. Being a political referenced data base, we do not have the figures for each geographic latitude interval, unless per country, which is a non-uniform geographic distribution in latitudes intervals and sizes. This limitation is implicit when data used is from a geopolitical databank, having the country as the base unit of the records, like it is the case in FAOSTAT. It is definitively not relevant for small countries, but in "continental

size" countries, like USA, Russia, China or Brazil, this could have a small effect on the medium latitude value, but nevertheless not so signifying when looking at world global level. It remains a limitation on the detail of the calculation.

5.5 The preliminary synthetic study results

The research quantitative work was performed in two sequent phases, a preliminary validation to verify the tendency showed by the data available, in second research data job, the precision and quantification of that tendency beign also an objective.

The preliminary synthetic study was developed to access a pre-validation of this research question, considering three discrete years 1991, 2001 and 2011 and the data of the 50 most significant countries in 2011, considering the values for the 3 main food commodities in 2011, the maize, wheat and rice.

FoodCommoditiesMoove_Belmiro_VerA1.sav [DataSet3] - IBM SPSS Statistics Data Editor

File Edit View Data Transform Analyze Direct Marketing Graphs Utilities Add-ons Window Help

	Name	Type	Width	Decimals	Label	Values	Missing	Columns	Align	Measure	Role
1	País	String	12	0		None	None	8	Left	Nominal	Input
2	Maiz2011	Numeric	20	0		None	-1	8	Right	Scale	Input
3	Rice2011	Numeric	20	0		None	-1	8	Right	Scale	Input
4	Wheat2011	Numeric	20	0		None	-1	8	Right	Scale	Input
5	Maiz2001	Numeric	20	0		None	-1	8	Right	Scale	Input
6	Rice2001	Numeric	20	0		None	-1	8	Right	Scale	Input
7	Wheat2001	Numeric	20	0		None	-1	8	Right	Scale	Input
8	Maiz1991	Numeric	20	0		None	-1	8	Right	Scale	Input
9	Rice1991	Numeric	20	0		None	-1	8	Right	Scale	Input
10	Wheat1991	Numeric	20	0		None	-1	8	Right	Scale	Input
11											
12											

Figure 90 - Three commodities, three decade years considered 1991, 2001 and 2011

This introductory data job was expected to make a preliminary validation of the research question, not reaching so much precision on the quantification of the "delta" in latitude, expected to tend to south along the decades. Like this, by reducing the data mining and processing job, all the necessary manual corrections, the research could validate, in a preliminary phase, the fact that the agriculture production latitude is tending to south. This idea is on the minds of professionals in the industry, as we will confirm later in the "in-depth

interviews" opinions, but, nonetheless, no research about this topic is known to have been performed before.

It would be very important to validate the finding first, using reduced data processing on the preliminary phase, and then to dig and process huge amounts of data, as it was done in the second quantitative research data job. In a second phase, the preliminary finding beign validated, a new Data Analysis work would be made to evaluate how much the food commodities productions came south on the globe in the past decades.

For this initial purpose, several data sources were found, and the work focused on official sources of agriculture production data. A diverse number of origins revealed that agriculture data is available and spread in many local and regional data bases, like official departments, regional services, industry associations, unions, research institutions among many others. All these data sources are in general sub-data units of FAOSTAT giant global data base, whether their sources of data are obtaining the information prior to the reporting to FAO from the official delegations of FAOSTAT national contributions of data, or are subsequently downloads of FAO ready available data. The sequence of data being in "source or applicant", it is not relevant, as consistence could be observed in several samplings of agriculture production for a certain same country, year and commodity.

After searching several different possible sources, the methodology followed was to start the data mining job with sources of data available from FAOSTAT and IMO. Both these data bases where not immediate and automatically ready to be used. A long learning route, to be able to access, reformat and convert raw data files, subsequently processing and operation job of screening, cleaning and matching the data was done.

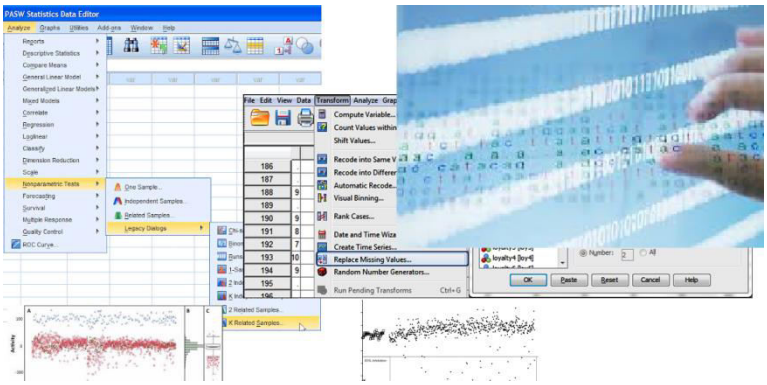


Figure 91 - Data screening prior to compute analysis results

The data was manual adjusted for all the corrections as previous referred, then was screened in order to warrant that the elements of the data base were valid to use, reliable, linking the results of the test performed with the research hypotheses.

The integration of two sources databases for the countries raised some problems that were solved manually and tested conditions were made automatic to try-out countries matching, with manual confirmation in discrepancies cases like “Republic of Timor Lorosae” of “Timor-Leste”. FAOSTAT, from FAO, an UN organization, is a huge data base, one of the most commonly used by food analysts in global scale reports and research. The public can have free access to data up to 2 years, so today up to 2018, the previous preliminary analysis study with 3 decade year beign made with data up to 2011. The data downloads may be configured with many different parameters, regarding the construction of the data base variables and contents to extract from FAOSTAT bank. The FAOSTAT data base is permanently monitoring the global agriculture, trade and food supply. It involves many types of tracking data on agriculture, land use, fishing, forestry, food aid, nutrition and population growth. To make sense of it all, researchers at the FAO, the Food and Agriculture Organization of the United Nations, built FAOSTAT, the world's largest database of food and agricultural information, with more than a million statistics covering five decades and 245 countries and territories.

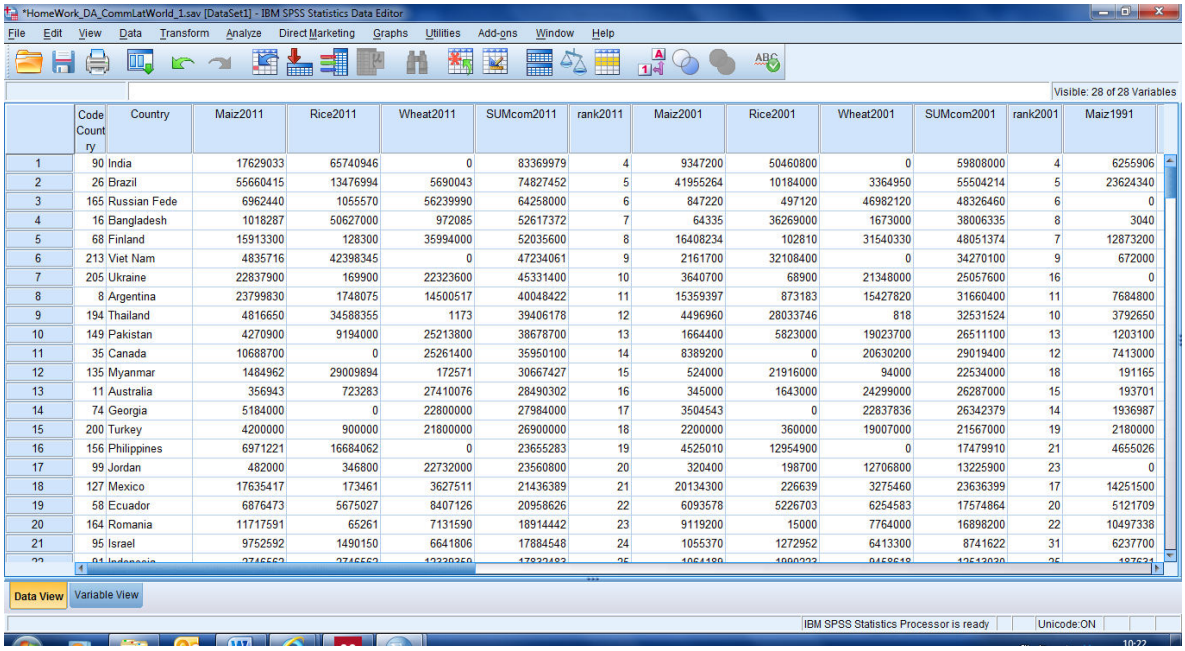
From IMO International Maritime Organisation we got the Latitude and Longitude of each country referred as the Capital city, for all countries on the globe.

Latitude had to be newly referenced in order to be used weighing the three commodities production volume each decade year. Latitude as we know is referenced in grades, minutes and orientation North or South, example Lisbon is 38°42'N, being 38 grades north and 42 minutes. So a “NEW Latitude” variable was calculated to be able to resolve two problems, as explained before:

- The use of the same referential origin would allow calculating weighing average positioning, but we could not have north and south figures. So a reference point to the South pole was established to get the same origin point for all countries, by adding 90 grades on the north latitudes, and subtracting from 90 grades on the south latitudes. For example, Lisbon would be 90+38 = 128 grades from the south pole;
- Also the minutes were converted to decimal by a simple operation /60X100. So the example of Lisbon would be 128,70 grades from south pole, being in fact the angle between

south pole and the latitude of the Lisbon. The same was made automatically to all capital cities of the countries.

So, after many operations and variables compositions the final Tidy data aspect was the following SPSS Screen:



	Code Country	Country	Maiz2011	Rice2011	Wheat2011	SUMcom2011	rank2011	Maiz2001	Rice2001	Wheat2001	SUMcom2001	rank2001	Maiz1991
1	90	India	17629033	65740946	0	83369979	4	9347200	50460800	0	59808000	4	6255906
2	26	Brazil	55660415	13476994	5690043	74827452	5	41955264	10184000	3364950	55504214	5	23624340
3	165	Russian Fede	6962440	1055570	56239990	64258000	6	847220	497120	46982120	48326460	6	0
4	16	Bangladesh	1018287	50627000	972085	52617372	7	64335	36269000	1673000	38006335	8	3040
5	68	Finland	15913300	128300	35994000	52035600	8	16408234	102810	31540330	48051374	7	12873200
6	213	Viet Nam	4835716	42398345	0	47234061	9	2161700	32108400	0	34270100	9	672000
7	205	Ukraine	22837900	169900	22323600	45331400	10	3640700	68900	21348000	25057600	16	0
8	8	Argentina	23799830	1748075	14500517	40048422	11	15359397	873183	15427820	31660400	11	7684800
9	194	Thailand	4816650	34588355	1173	39406178	12	4496960	28033746	818	32531524	10	3792650
10	149	Pakistan	4270900	9194000	25213800	38678700	13	1664400	5823000	19023700	26511100	13	1203100
11	35	Canada	10688700	0	25261400	35950100	14	8389200	0	20630200	29019400	12	7413000
12	135	Myanmar	1484962	29009894	172571	30667427	15	524000	21916000	94000	22534000	18	191165
13	11	Australia	356943	723283	27410076	28490302	16	345000	1643000	24299000	26287000	15	193701
14	74	Georgia	5184000	0	22800000	27984000	17	3504543	0	22837836	26342379	14	1936987
15	200	Turkey	4200000	900000	21800000	26900000	18	2200000	360000	19007000	21567000	19	2180000
16	156	Philippines	6971221	16684062	0	23655283	19	4525010	12954900	0	17479910	21	4655026
17	99	Jordan	482000	346800	22732000	23560800	20	320400	198700	12706800	13225900	23	0
18	127	Mexico	17635417	173461	3627511	21436389	21	20134300	226639	3275460	23636399	17	14251500
19	58	Ecuador	6876473	5675027	8407126	20958626	22	6093578	5226703	6254583	17574864	20	5121709
20	164	Romania	11717591	65261	7131590	18914442	23	9119200	15000	7764000	16898200	22	10497338
21	95	Israel	9752592	1490150	6641806	17884548	24	1055370	1272952	6413300	8741622	31	6237700

Figure 92 - Tidy data crossing Faostat and IMO databases, SPSS screen

With all Tidy data organized, we could then operate the analysis and calculating the variation on the three decade years of the average latitude food producing, to see its evolution in the case of these three representative commodities in the most 50 significant countries of 2011. A successive work flow of operations were preformed as described ,using Excel and SPSS. After calculating the average of total weighted NEW Latitude for each year, for the three commodities of the 50 countries, we came to the conclusion that along the decades, the food production is coming down, the preliminary results confirming our hypothesis.

total weight NewLAT	total weight NewLAT	total weight NewLAT
2,6926E+11	2,09623E+11	1,72708E+11
TONS 2011	**TONS 2001**	**TONS 1991**
2.187.382.733	1.700.103.459	1.389.637.023
MED - New LAT 2011	MED - New LAT 2001	MED - New LAT 1991
123,10	123,30	124,28
33,10	33,30	34,28
33°06'N	**33°18'N**	**34°17'N**

Table 18 - First phase job results, the latitude is moving to south along the decades

So the initial hypothesis is validated. Food production is coming down to South, that means global agriculture production latitude is moving to South along these three last decades.

Considering 1 grade in latitude is approximately 112 Km terrestrial distance, in further research we could estimate the impact of this result in terms of:

Cost economics;

Time to market

Time use of vessel;

Perishable grains losses;

Ecological “foot mark” on CO2 and other emissions;

Other impacts.

Once the preliminary data research apparently validate the tendency, it would be important to validate the hypotheses with much more consistent data. Also, strong limitations could be appointed to this preliminary phase.

5.6 Identifying limitations of the first phase conducted to a second data job research

Considering only three commodities grains although the most expressive, maize, wheat and rice and for this preliminary study, many other grains like barley, sorgo, soybeans, or seeds like sunflower or canola are relevant to evaluate, eventually making other production growth or decrease that could impact the conclusions of the study.

As discussed before, soya became in the last decades the most important source of protein for animal feeding. This means that feed compounds for meat production are today obtaining their vegetable protein source based in soya, or soya cake, the farina after extraction of the soya oil. Also, as we saw in the preceding chapter, the South America continent countries are the most relevant origin of soya today, due to the GMO seeds use to be highly productive, available soil, water, sun and temperatures. And this leading position of the soya producers is gained after an exponential evolution of the soya crop sizes of southern America countries that overpassed USA in the recent years. Note that in the first data analysis, soybeans commodities are not included in the lot of chosen commodities for the analyse. So we may expect, considering these commodities, the results will be even more favourable to the southern movements of the weighted medium latitude of the world agriculture production. It is very relevant the fact that also some of these commodities are traded in their various forms, for example the soya complex, including all the products and sub-products like soybeans, soya oil, soymeal beign today the biggest feeding ingredient in meat production.

By considering only 50 countries with the bigger volumes of these initial food commodities, maize, wheat and rice, in the 2011 production, we neglect other 145 countries from the 195 of the second research data analysis. If including all countries, in these excluded 145 “smaller” food producers, not only we will get more precise validation of our research question, also we will find many more southern hemisphere countries, where agricultural development is in a later stage, so still with low volumes, although with bigger growing rates, so with higher proportional increments than in the three decade years considered. We might expect that the result, moving the medium average latitude to south, will be more significantly when considering all countries.

5.7 And food production keeps going down for the next decades

The planet still has significant parcels, virgin territory resources which could in principle be changed to arable acreage, augmenting the harvest agriculture land surface, allowing the world crop to keep growing based in land surface. Contrariwise, the degree to

which this can be comprehended is somewhat very limited. The big share of the lands actually not in agriculture production, not cultivated, has crucial ecological role that could be lost, this beign today a major topic on environmental awareness and sustainability management for all countries. Also, they are mostly located in just a few countries in Latin America and sub-Saharan Africa, where the lack of access and infrastructure could limit their use at least in the short term. Taking these limitations into account, FAO estimates that by 2050 the area of arable land will be expanded by 70 million hectares, or about only five per cent. This would be the net balance of an expansion by 120 million hectares in the developing countries, and a contraction of arable land in favour of other uses in developed countries by 50 million hectares (Alexandratos & Bruinsma, 2012). Potential for Cropland Expansion? Going south even more.

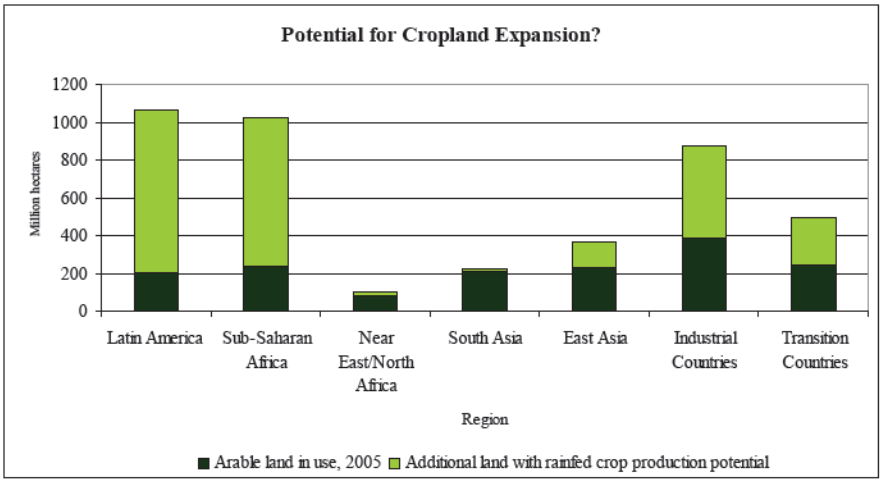


Figure 93 - Potential cropland expansions is in the south
Source: Bruinsma (2012)

The availability of fresh water reserves for the required production growth shows a similar picture. At global scale, there are sufficient capacities, but these are very unevenly distributed. Irrigated agriculture covers one fifth of arable land and contributes nearly 50 percent of crop production. Hence, it is extremely productive. An increasing number of countries are reaching alarming levels of water scarcity and 1.4 billion people live in areas with sinking groundwater levels. Water scarcity is particularly pronounced in the Near

East/North Africa and the South Asia regions and, is likely to worsen as a result of climate change in many regions.

5.8 Second data job, computing more data for more accurate calculation of the southern deviation

The research work, after validating the first question answer, go towards a more accurate calculation of the southern deviation of the medium weighted latitude of production of all food tradable commodities in the world. A second data mining work in FAOSTAT and reprocessing all variables constructed was performed considering now, as in comparison with the first preliminary approach, more variables, all years, all tradable food tradable commodities, the grains, accounted by FAOSTAT.

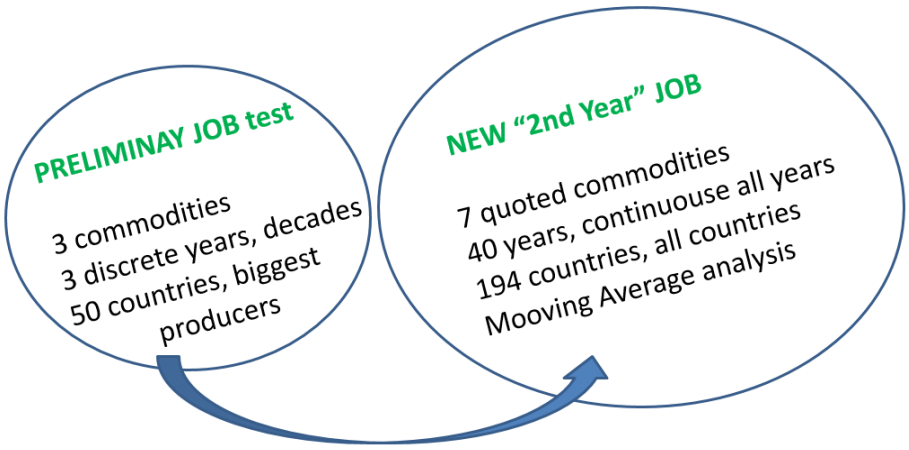


Figure 94 - The reinforcement on the data analysis job

On the second year research, in deed, an entirely new job was made from scrape involving many more data elements from the same data banks sources. Using though the same research methodology and calculation techniques already described, the same construction of variables, the same intermediate variables, a completely new data analysis task was implemented to achieve more detailed and reliable results, using much more data elements along 40 continuous years. Once preliminary validated the research question, the researcher endeavors for his thesis was to convey more robustness and forcefulness to the results and conclusions, validating the same preliminary findings, having an approximate

quantitative size of the value, how much the latitude displacement to south of the medium weighted average production latitude for all agriculture commodities has moved down.

The new Data Analysis work, with fresh and much more significant elements, was then performed, bringing several improvements on the scenario of research, as in Figure 94 - The reinforcement on the data analysis job :

- More food commodities being analyzed - instead of the three major in 2011, maize, wheat and rice, in the second data analysis job we considered all the seven CME quoted agriculture food commodities, meaning all quoted world food commodities in NY and Paris. It is about the founding historical commodities traded on commodities exchange bourses (also historic) of CBOT and MATIF, that are specialized in food commodities, the exchange bourse Chicago beign integrated today in the NYSE CME, and Paris MATIF integrated trough LIFFE also inside CME Euronext. These are considered all the globe “traveling commodities”, the most traded in the world standardized food commodities grains (Kang & Mahajan, 2006a). Commodities definition is intended to attribute the following properties:
    a) be available from a significant number of different suppliers;
    b) be standardized, products from different suppliers must be easily interchangeable, with very equal characteristics;

  For long time, including today, in the case of seven grains (barley, maize, millet, oats, rice, soybean, and wheat) has been used the international standards for grains and seeds (Kang & Mahajan, 2006b), which regulate quality, quantity, and delivery place and time, beign standardized as global commodities and quoted on the CME stock exchanges (CME Group, 2011).

Commodity: Barley Grade: MALT 1		Season: 2017/18 Standard Reference No.: CSG 20	
QUALITY PARAMETER	**SPECIFICATION**	**COMMENT**	
Varietal Purity Min (% by count)	95	All approved 2 row Malting varieties of the current season	
Moisture Max (%)	12.5		
Protein Min (%)	9.0	N X 6.25 @ 0% Moisture Basis	
Protein Max (%)	12.0		
Test Weight Min (kg/hl)	65.0		
Retention Min (% by weight)	70.0	All matter remaining above a 2.50mm slotted screen – 40 shakes in the direction of the slots	
Screenings Max (% by weight)	7.0	All matter passing through a 2.20mm slotted screen – 40 shakes in the direction of the slots	
Germinative Energy Min (%)	95	IOB 4ml Germinative Energy test	
Germinative Capacity Min (%)	98	IOB Germinative Capacity test (stain)	
Rapid Visco Analyser Min (units)	130	RVA units	
Falling Number Min (sec)	300	Falling Number result	
Defective Grains Max - (% by count, 100 grain sample, unless otherwise stated)			
Shot	Nil	Cleaved	1
Sprouted	Nil	Broken (% wt 100 gram sample)	2.0
Dark Tipped	10	Distorted	5
Field Fungi	5	Dry Green or Sappy	1
Skinnings	15	Severely Damaged (count per half litre)	1
Insect Damaged (count per half litre)	10	Pink Fungal Staining (count per half litre)	1
Foreign Seed Contaminants Max - (count of seeds in total per half litre, unless otherwise stated)			
Foreign Grain	85	Wheat, Cereal Rye, Triticale, Cultivated Oats, Rice	
Variation a	25	Wild Oats, Wild Radish Pods	
Variation b	Nil	Barley with Coloured Aleurone Layer (blue / black)	
Type 1 (individual seeds)	8	Colocynth, Jute, Long Head Poppy, Mexican Poppy, Field Poppy, Horned Poppy, Wild Poppy, New Zealand Spinach, Parthenium Weed, Saffron Thistle	
Type 2	Nil	Castor Oil Plant, Coriander, Crow Garlic/ Wild Garlic, Darling Pea, Opium Poppy, Peanut seeds and pods, Ragweed, Rattlepods, Starburr, St. John's Wort	
Type 3a	2	Bathurst Burr, Bellvine, Branched Broomrape, Bulls Head/Caltrop/Cats Head, Cape Tulip, Cottonseed, Dodder, Noogoora Burr, Thornapple	
Type 3b	4	Vetch (Tare), Vetch (Commercial)	
Type 3c	4 seeds / 1 pod	Heliotrope (Blue), Heliotrope (Common)	
Type 3d	1	Double Gees/Spiny Emex/Three Cornered Jack	
Type 4	20	Bindweed (Field), Cutleaf Mignonette seeds or pods, Darnel (Drake Seed), Hexham Scent/Melilot (only acceptable if no tainting odour is present), Hoary Cress, Mintweed, Nightshades, Paddy Melon, Skeleton Weed, Variegated Thistle	
Type 5	40	Knapweed (Creeping/Russian), Seebania Pea, Patterson's Curse/ Salvation Jane	
Type 6	Nil	Columbus Grass, Johnson Grass	
Type 7a	1	Chickpeas, Clover, Corn (Maize), Cowpea, Faba Beans, Lentils, Lupins, Peas (Field), Medic Pods, Safflower, Soybean, Sunflower and any other seeds or pods greater than 5mm in diameter including broad bean	
Type 7b	50	6 row barley, Bindweed (Australian), Bindweed (Black), Brome Grass, Musk Weed, Onion Weed, Phalaris Glumes, Poverty Weed, Ryegrass on stalk, Sheep Weed, Sorghum Grain, Three Horn Bedstraw, Turnip Weed and any other Foreign Seed not specified in Types 1-7(a), Foreign Grain, Variation (a or b) or in SFS	
Small Foreign Seeds (% by weight)	0.6	All Foreign Seeds not specified in Types 1-7(b), Foreign Grain, Variation (a or b) that fall below the 2.20mm screen during the Screenings process	
Other Contaminants Max - (count per half litre, unless otherwise stated)			
Foreign Material (% by weight)	1.0	Other than already specified	
Cereal Smut / Cereal Ergot (entire load)	Nil	Includes Bail and Covered Smut, any Cereal Ergot	
Loose Smut (weight in grams)	0.1	Weight of all pieces per half litre	
Ryegrass Ergot (length in cm)	0.5	Length of all pieces present aligned end on end	
Pickling Compounds or Artificial Colour (entire load)	Nil	Pickled grain or artificial colouring	
Chemicals Not Approved for Barley (entire load)	Nil	Residues of any chemical compound not approved for barley, used in contravention of the labelled instructions or chemicals in excess of the MRL	
Stored Grain Insects & Pea Weevil – Live (entire load)	Nil	All life stages	
Insects – Large, Live or Dead	9	Includes Rutheigien bugs, ladybirds, grasshoppers/locusts, sitona weevils, wood bugs & pea weevil (dead only)	
Insects – Small, Live or Dead	10	Includes all species of aphid, mites & stored grain insects (dead only)	
Snails	2	Dead or alive	
Sand	50	Individual grains	
Earth	9	5mm max in diameter	
Stones (g per 2.5L)	4.0	Maximum total weight of all Stones retained above the 2.2mm and 2.5mm screen per 2.5L	
Objectionable Material (entire load)	Nil	Presence of meat meal, blood meal, fish meal, poultry offal meal or other animal proteins. Sticks (>1cm in length & 0.5cm in diameter), stubble (>3cm in length & 1cm in diameter), glass, concrete, metal, animal excreta, animal carcasses, tainting agents or any other commercially unacceptable contaminant, odour or taste	

Table 19 - Example of a barley grade and quality standard, CME

- Many more countries, meaning all country states considered that UN recognizes today, 194 states in the world, from small to major producers, all UN countries being

now considered for the second Data Analysis job, for the revalidation of the hypothesis;

- Along the 40 years, all data for each country, each commodity, from 1975 to 2014 all agriculture production data, all years with no intervals, considering for each year the respective production values for each food commodity,
- In the end, the tendency was illustrated using a graphical moving average algorithm for the medium weighted latitudes of all countries, and the productions of all years.

The second data mining research showed what was even more evident in the evolution of the southern movement of the medium waged latitude of production of food commodities.

5.9 Grains production is moving to south

The conclusions are led by arithmetic results of the calculations performed with the available data, displayed in a final graphic moving average.

Calculations of the weighted medium latitude of production of all countries, for all seven commodities combined, follow exact the same procedure as described previously in chapter “5.5 The preliminary synthetic study results”, granting this time the use of many more items for each variable. A second FAOSTAT databank was downloaded to source the productions of all years along 40 years of production, all countries.

The same screening techniques and manual adjustments using SPSS and Excel was performed to calculate the moving average, and the value of the southern displacement of latitude.

The new job faced different problems to treat large volumes of data from FAOSTAT. We came across the same challenges but in much bigger size, a gigantic task beign encountered:

a) The territorial inconsistence along years, yearly not consistent, being the biggest manual adjustment task, now with 40 years and 194 countries;
b) Again, FAO data is not georeferenced with coordinates.

c) Mixing data bases to get georeferenced, for the data collected also oblige many manual corrections;

d) Huge volume of data, approx. 200 X bigger than before: 194 Countries x 7 food commodities x 40 years data + 12 composed variables – almost 150.000 items for calculation;

e) Data clearing of large volume of elements;

f) Data processing of large volume of elements.

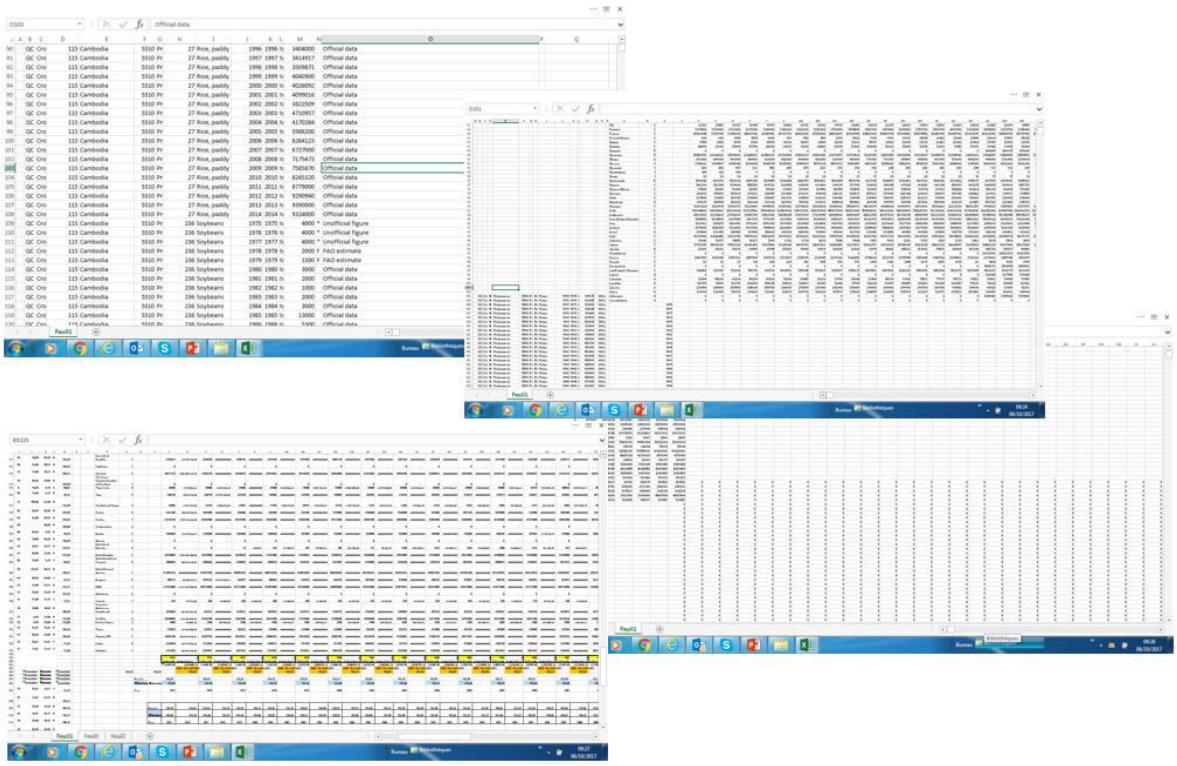


Figure 95 - New data mining from FAOSTAT for 50 countries, 40 years

A long trajectory was performed departing from data selection again, from the original databases. Note that the second job was performed in subsequent years of the PhD preparation of this thesis, the data considered was larger, referring to earlier departing dates until later finishing years, covering 4 decades with all years of production included, belonging to a more recent period of time interval . This new fresh data was available in the second data download for the large data job.

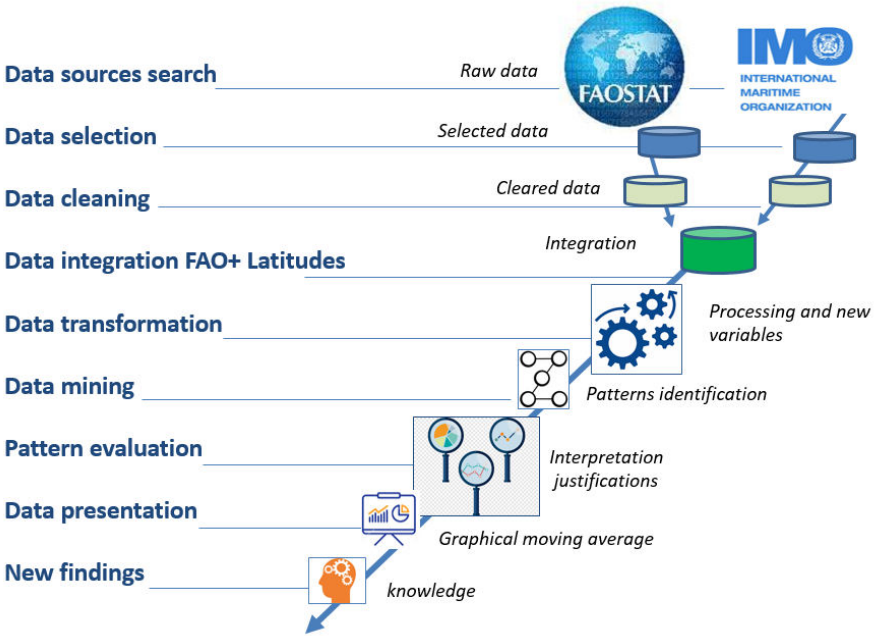


Figure 96 - Steps involving the data mining job

After the data cleaning, integration of latitudes with FAOSTAT data elements, the followed operations of transformation of latitudes to the “NEW Latitude variable” were built to operate the medium average latitude, retrieving the minutes and the north and south orientation, and converting to a decimal latitude referred to a single origin on the globe, the South Pole. All the intermediate variables were built and processed again for the second data job, like explained in the previous chapter.

The final result interpretation processed the graphic for acquiring the moving average line tendency presentation, to enhanced the result, showing at the same time the quantification of the south displacement of the average weighted latitude of agriculture production of the seven tradable commodities.

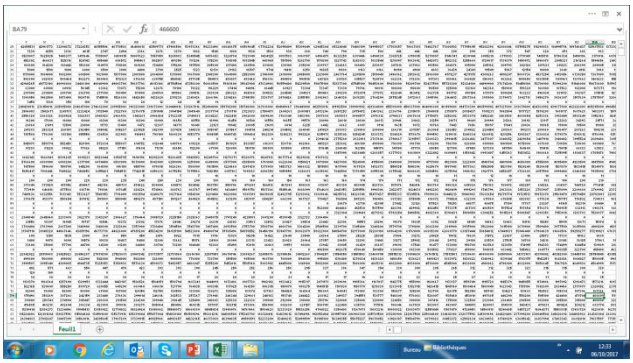


Figure 97 - Computing 150 thousand data elements

Long data mining jobs were performed, computing more than 150.000 data elements to produce the final results, as shown below.

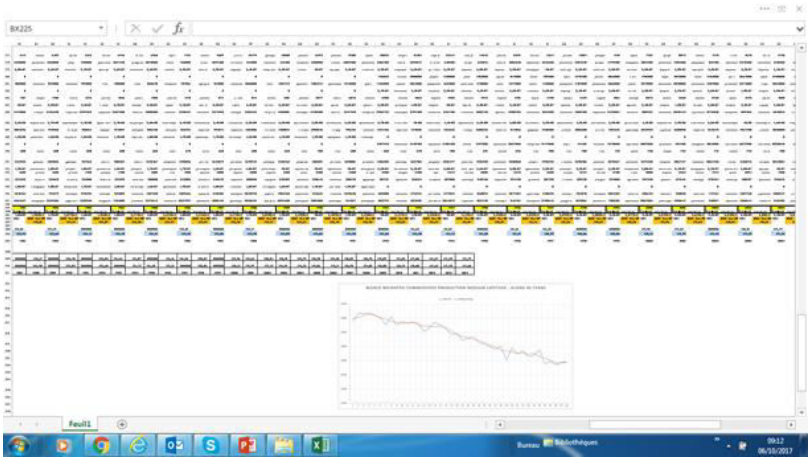


Figure 98 - Graphical moving average calculation and presentation

All the data mining, for the second job, produced a more detailed and precise result, showing that the preliminary findings were confirmed, even more supported now.

Year	New Lat	Moving Average
1975	123,59	123,85
1976	124,62	124,10
1977	124,61	124,40
1978	124,76	124,59
1979	124,35	124,46
1980	124,11	124,06
1981	123,01	123,92
1982	124,19	123,60
1983	123,07	123,41
1984	123,38	123,48
1985	123,27	123,31
1986	123,51	123,36
1987	123,28	123,06
1988	122,17	122,90
1989	122,63	122,89
1990	123,48	122,82
1991	122,98	122,90
1992	122,52	122,65
1993	121,62	122,25
1994	121,87	121,72
1995	120,87	121,38
1996	121,16	121,31
1997	121,36	120,99
1998	120,57	120,86
1999	120,36	120,56
2000	119,96	120,13
2001	119,62	119,99
2002	120,04	119,43
2003	118,10	119,39
2004	119,79	119,23
2005	118,98	119,06
2006	119,38	119,17
2007	118,52	118,90
2008	118,70	119,05
2009	119,59	118,58
2010	117,52	118,42
2011	117,86	118,08
2012	117,37	117,63
2013	117,78	117,70
2014	117,79	117,68

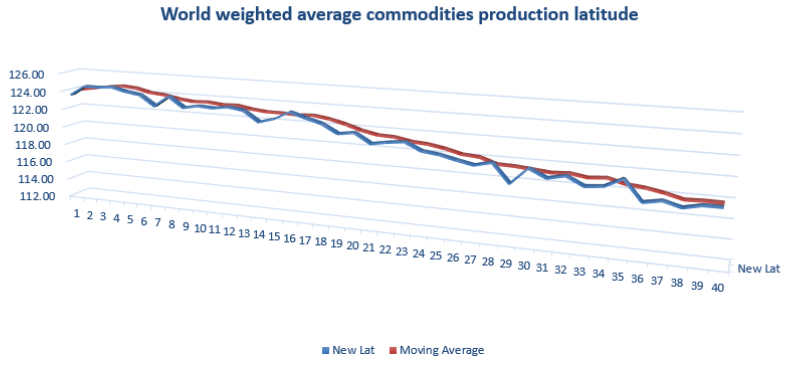


Figure 99 - Data mining final results presentation

The Data Mining final results presentation brought the evidence and reinforced the preliminary results already obtained with only 3 commodities, only 50 most significant

countries and 3 decades. It is noteworthy that the southern movement of the latitude is now considerable more manifest, as we will discuss further.

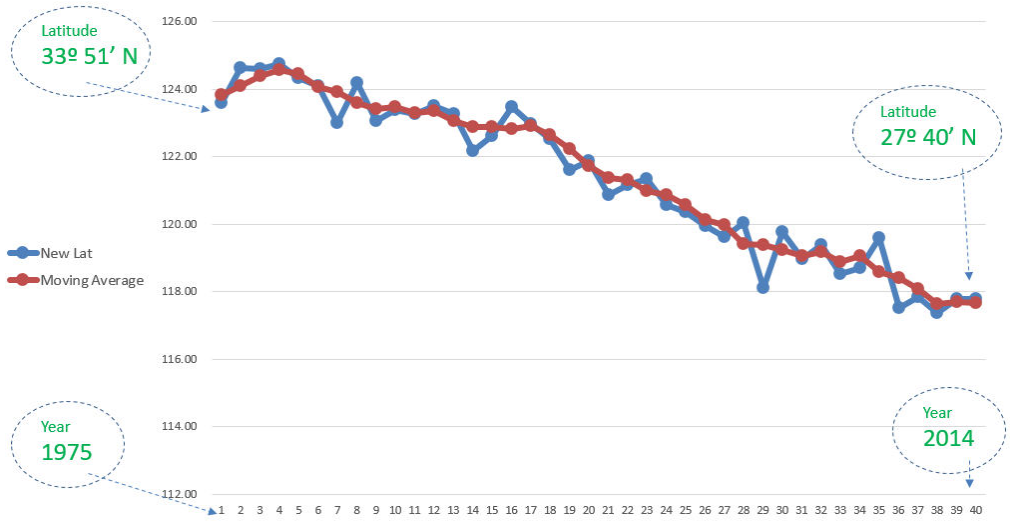


Figure 100 – Evolution of the weighted average production latitude along 40 years, of the world tradable agriculture commodities

The results show that the evolution of the weighted average production latitude of the world tradable agriculture commodities along 40 years is displacing to south hemisphere six grades and eleven minutes 6º 11' S. To understand a proximate equivalent of this measurement in terrestrial distance, it is around 700 km. This means that the global center of farming production moved to south 700 km, or 380 maritime miles, at a cruise speed of 10 knots, taking 38 hours navigation of a large vessel.

5.10 The discussion of the results of this latitude movement chapter

Substantial more elements for each variables were used to recalculate the movement of the latitude in the second data mining job. The results figures are broadly more significant than in the first data mining job. From a validation of tendency figure, from an initial indication movement of 110 km, we have now an estimation of 700km in the second data work, showing a much considerable result and potential impact of the movement of the

center of agriculture production. Introducing all commodities, all countries, made a great difference in the calculations, reinforcing the southern dislocation.

Figure 101 – World agriculture production got down 700 km

In the first data job, only 50 more important agriculture production countries were considered, despising the almost 150 minor countries, although in fact here we find many more southern developing economies. The 50 biggest are in majority the hold and traditional economies of the north hemisphere. Including later all countries, in the second calculation we took into account the contributions of all tiny little economies that have observed significant proportional larger developments in their production, these smaller developing economies beign very likely to be in southern hemisphere. Therefore, the fact of including all countries, pushed the results further to south.

Secondly, even more importantly, including all tradable 7 commodities, we incorporate the soybean which was not considered in the 3 biggest commodities before, in the course of the preliminary data job. And as we saw in previous chapter “2.1 - The food production and population evolution along 4 decades”, today the food commodity traders are moving thousands of tons of the soya complex around the world to produce livestock, chicken, pork, cattle and fish. Soybeans rose its farming exponential as protein source for meat production, and due to the weather conditions and OGM farming constrains it was mostly in southern countries that this development occurred, mainly in South America, examples like Brazil and Argentina having prodigious growth rates in the soya complex production along the last decades. Therefore, again, the fact of including all commodities pushed the results even further to south.

The findings are common sense for professionals from logistics, trade and agriculture business, there are numerous evidences of the agriculture development of the southern countries of the hemisphere, especially in South America countries like Brazil, Argentina recently Paraguay, also in South Asia countries like Australia, Malaysia, and it is expected by all experts exploratory or prophetic discussions, that Africa will be the next territorial expansion region for increasing world harvesting areas and feed reserve. Yet, we couldn't find any research focused on the calculation of this movement connected to the discussions of its impact, or a research showing an alternative logistic global infrastructures design. This displacement to south on the tradable grains is impacting world logistics, especially the seaborne trade, in particularly in Europe, where this thesis is focusing, traditional ports for farina and seeds beign just above upper north Atlantic coast, in fact, high above in the North Sea coast. Never before, in our literature and review articles, has the "status quo" of the logistics intended to answer this fact been questioned, the query beign raised now. View the findings, the research question is obvious. Should Europe look for alternative logistics ports for grains and seeds?

This means that, in the last 40 years, all seaborne navigation of food commodities to north hemisphere countries is now, in medium terms, making an extra path N-S along 380 miles to deliver grains and seeds cargos. During these decades, we can hypothetical visualize that a potential London milling wheat factory buyer trading the grains from France "Le Havre" port, and unloading the cargo through the port of Portsmouth England, says: "The geography did not changed for me, I'm still reaching the same ports, making the same miles"; but a colleague of him willing to buy corn for other milling factory, also unloading in Portsmouth, corn that was previously coming from New Orleans USA, at a distance of 4.627 nautical miles, is buying and loading instead the corn grains in the agriculture region of Porto Alegre, a Brazilian state, using the Rio Grande port, at a distance of 5.735 nautical miles from Portsmouth. Therefore, the second trader displaced the seaborne logistics operations to south with 1.108 nautical miles more. For a standard 80.000 MT bulk carrier vessel, with a speed of 10 knots, this represents an extra 5 days of navigation.

The impact of this medium displacement of 380 nautical miles to south is enormous when we consider all seaborne trading that are traveling to north countries, particularly to

Europe, where grains traditional ports are in the north sea coast. Later chapter will roughly estimate and discuss around the appraisals of this impact on the main multiple views of the problem, economical, time to market, environmental impacts and others.

6 Industry leader's discussions about logistics efficiency gains, a new South West European Grains transshipment Hub

Along 2020 and 2021, the researcher performed a series of thirteen individual interviews with industry leaders in different types of activities, all involved in the global commodities business, as stated above. These sources of information, the thirteen interviews that were considered, initially were settled on the research for sixteen leaders, all selected and later personally pre-invited to participate in these study in-depth interviews cases. The majority of them trough personalized individual and direct contact, using a preliminary phone or a few Zoom conversations due to the pandemic period, introducing the theme and the discussion purposes. The researcher got then a previous acknowledgement of the invitee to participate in the investigation process, fully informed and available to consent. In the first contact, the leaders were told about the objectives and methodology of the research work, when agreeing to participate, further information was delivered/transmitted together with the permission statement, providing the introduction of the theme and guidelines for the interview and the questionnaire. Later, when confronted with the need of signing the permission and informed statement, two of these sources declined the invitation, to comply with the confidentiality and non-disclosure rules of the large corporate companies in which they were involved in. One of them considered that her information would go very easily to be connected with the business in the large world leading multinational where she is chief trader in the protein for the Mediterranean and Middle East region. Who else is importing these large volumes of soya meal in the Black Sea? Nevertheless, her opinions and experiences, once again, reinforce the main concepts and conclusions of this study and only emphasize its explanatory and deductive analysis results, adding valuable commentaries of experience, in the international trading of large-scale transfers of food commodities between continents.

Still another two contributors gave up because these invited participants could not participate in time, being very occupied in permanent professional displacements, after numerous attempts, by means of different cumulative reasons related with availability, covid-19 quarantines and isolations, international traveling, among other reasons. Therefore, from

initial 16, we had 4 invitees missing. Two of them were international commodities traders, which the researcher did not replace, considering that other participants also represented this function, class of experiences and geographies. One other is a senior manager of agri-business in Brazil, but other participants had also contributions for this function, class of experiences and geography. The fourth one missing case is an engineering specialist in port terminal construction, which the researcher considered valuable and a singular experience in the context of the sources of information, so a replacing invitation later sent to another invitee participant was made, completing the portfolio of sources following the criteria of the same kind of profile, professional experience and work field. To this source of information that was later invited, the researcher delivered the same set of documents, and finally, his participation was acknowledged. By including this later invitee in the board of the interviewed experts, the panel of sources for in-depth interviews was completed. The final invitees group was composed of thirteen specialists, considered high value sources to carry out a qualitative study by questioning international professional managers, senior traders, logistics directors and others, through an in-depth interview.

The study collection of thirteen interviews permitted to gather information, in order to later process and interpret the outcomes. This results will be represented by descriptive and codified variables, compared and related to the concepts described in the Theoretical Model diagram “Figure 104 - Theoretical model proposed for the interviews”, and after all they will be examined together, using codifications for discussions, deductive and inductive analysis.

6.1 Guide lines for the interviews

The interviews were pre-prepared with some common guide-lines not shown to the interviewed invitees, taking precaution not to guide results, keeping the larger possible freedom on the subjects, free speech and informal conversation style, looking to understand the topics through life experience, shared practices and outlooks. It was important to see how people understand things and what are individual opinions and visions, although oriented in the questioning and discussion frame scope of the inquiries focus theme.

Different interview cases about the world grains movement reality were developed, and for each one we considered a division in two phases, each one focused on the specific main topic: first, the issue of eventual new European southern port entrance for grains; and second, the port competiveness essential factors, throughout the discussion of its intrinsic services and capabilities.

The methodology of in-depth interviews wanted to grant the opportunity to listen some industry leaders, seniors experienced, during free direct personal interviews, with durations around between 45 minutes up to 110 maximum minutes, that were lightly steered, free conduct as possible, in order to collect empirical data. These interviews were later analyzed, and for this it was necessary to audio record, later to process and to transcribe partially as necessary to treat them for further interpretation and discussion analysis. Useful for carrying out this qualitative study, these steps served as a bridge between carrying out the research interviews and developing the conclusion that will appear later in the thesis. The analysis and transcription of interviews should not be underestimate at any moment, is was a long task and sometimes became a difficult and minacious job, leading to classify, reorder, reprocessing or refining the collected materials. The sociological transcription is an exact copy of the audio record of the speech of the intervenient, translated from the language used, in general the most comfortable for the interviewed guest. Several different languages were used by the interviewees in the meetings (Portuguese, Romanian, English, Spanish and French), in convenience with their origin, also professional location and context of the interview. We could consider that speakers using different languages could have made small deviations on the interpretation of worlds. In fact, the researcher did not consider this a problem, not being a relevant issue, because the industry, the international trade of commodities and port operations uses very standardized terms and concepts, usually using the English base term, so common terminology in this business sector is facilitating the understanding, and avoiding confusing concepts. We find different style in the application of the terminologies between participants, from American to English, from Brazilian to Portuguese, however, we let the interpretation of translation to easily match the meanings. During the interviews process, there were no pictures or images recorded, either collected,

also not considered being relevant, only audio records, saved in digital sound files, complemented by hand written notes.

The first phase of each interview, also the major one, was about the relevance of alternative entrances for grains and seeds in the West Europe continent, considering this southernization of the average production latitude in grain commodities in the world. The results of the findings of the quantitative analysis of the Chapter 5, in a visual synthetic résumé, was briefly presented prior to the discussion of the scenario of an alternative port entrance. This hypothesis, splitting and balancing cargos with the traditional ports north ports of Europe, in ARA region and Hamburg, could eventual bring more competiveness and efficiency to the food and feed industry in Europe.

6.2 The information sources, intervenient invitees relevance

For this empirical study phase, the information sources were, as above described, thirteen interviews conducted with industry leaders, covering professional senior experiences in logistics, trade commodities, port operations. The group consisted of sixteen chosen and invited representatives of the main sectors related to agriculture, trade and logistics operations in the regions focused on this analysis. Their leading experience in international markets, trading commodities, especially agriculture food commodities, also in the trade and logistic operations, especially related to port systems and operations, gave a very complete coverage of the field and territorial areas in examination. With the valuable collaboration of these interviewed actors that are broadly covering the scopes of the research, and given the vast curriculum and the knowledge and professional experience over time of these people, we can trace the coverage on the map below, as in the figure Figure 102 - Interview invited participant's coverage experiences and geographies. For each interview invitee, a reference number is assigned to each interview, in the annex "8.2 - Classification of the regional focus and area field of experiences", so we had a large covered experienced board of participants. The choice of the interview invitees took in consideration their professional life experience, being largely recognized by public and pairs in the industry, the predisposition for the research participation, and relevant, the time and place availability for the interview. Life

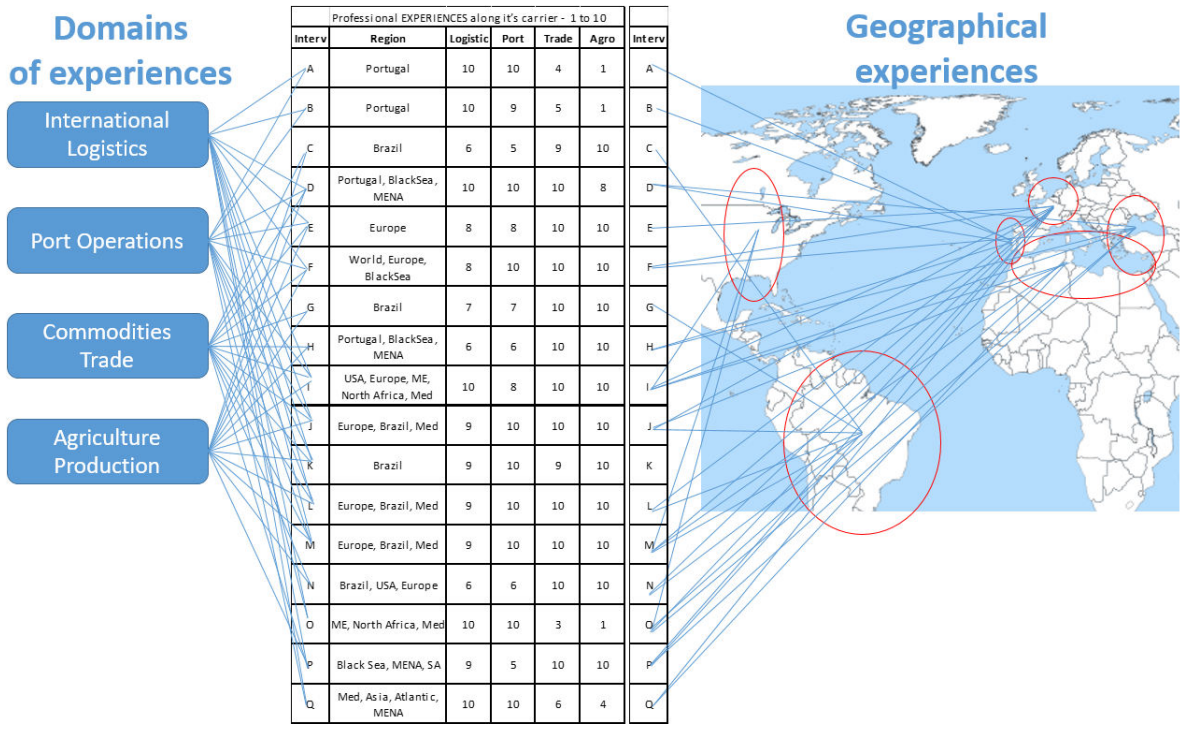
experience regarding the main issues of the topics of the interview gathered various and complementary fields:

- International Logistics - all experience as managing operation of loading, unloading, transportation of grains and food stuff in international operations, mainly using rail transportation and port operations, intercontinental sea born trade, also focused in the Mediterranean Sea, North Africa and Middle East regions, Black Sea, and others;
- Port Operations – this experience is relevant for the interviews range of experiences, people managing or having previous experience in port processes, interconnecting the hinterland with seaborne trade, knowing the complexity of the port systems especially in agriculture food commodities;
- Commodities trade in Agriculture – markets, trade movements and deliveries around the world. Some of the interview invitees are largely experienced in international trade, long time leading experiences with the big four world traders and others around the globe, daily buying and selling leads, experiencing the constrains and costs of the logistics chain and port systems for food commodities as it is;
- Agriculture Production – some of the interviewees are international Agribusiness people with actual or former managing responsibilities in Agriculture production large-scale farming. The perfect interconnection of these agriculture operations with international trade is vital for the flow of commodities, especially in the harvest period for each commodity. Port installations and international trade are vital for large scale agriculture;

The final panel composed by twelve invitees for the in-depth interviews was by far covering these area fields of international trade and logistics operations, by professional experience shared, the participants beign quite available to cooperate and to give their views to participate and enrich the research work. People from three continents were interviewed during 2020 and early 2021. The testimonials participations were taken in informal conversation. Previously, the invitation phone talk did not pre-prepared the interview, just established the objectives and boundaries of the conversation during the in-depth interview, for assigning the invitee and scheduling the convenient moment and place. We may assume some of them could had curiosity to search about the matters, recent information and tendencies of the subjects, although this did not appear in any pre-prepared information, or thoughts, which could have changed the debate.

The interviews started then using the open discussion questions, after a short introduction and contextualization framework of the research. The interview were conducted in friendly conversation, audio recorded with previous written clarified consent for all participants.

For the purpose of sources relevance, making a classification of the professional life experience, a grade of 1 to 10 was attributed to each source. As we show in the map below, at least 10 or more invitees covered the “Domains of Experience”, given the high-ranked experiences (8, 9 or 10) in the final panel of experiences and geographies as in Figure 103 - The final panel domains of experience and geographies . As well the “geographical regions” in discussion were covered by the strong experience and expertise of the invitees interviewed, as in figures below. Note that the regional focus of the data collected was concentrated on the experience and opinions of professionals related to the movement of food commodities and their logistics systems, in the Atlantic region, connecting with the north sear ARA ports and all Mediterranean, down to Middle East and North Africa, also up to Black Sea regions.



Professional EXPERIENCES along it's carrier - 1 to 10

Interv	Region	Logistic	Port	Trade	Agro	Interv
A	Portugal	10	10	4	1	A
B	Portugal	10	9	5	1	B
C	Brazil	6	5	9	10	C
D	Portugal, BlackSea, MENA	10	10	10	8	D
E	Europe	8	8	10	10	E
F	World, Europe, BlackSea	8	10	10	10	F
G	Brazil	7	7	10	10	G
H	Portugal, BlackSea, MENA	6	6	10	10	H
I	USA, Europe, ME, North Africa, Med	10	8	10	10	I
J	Europe, Brazil, Med	9	10	10	10	J
K	Brazil	9	10	9	10	K
L	Europe, Brazil, Med	9	10	10	10	L
M	Europe, Brazil, Med	9	10	10	10	M
N	Brazil, USA, Europe	6	6	10	10	N
O	ME, North Africa, Med	10	10	3	1	O
P	Black Sea, MENA, SA	9	5	10	10	P
Q	Med, Asia, Atlantic, MENA	10	10	6	4	Q

Figure 102 - Interview invited participant’s coverage experiences and geographies

The relevance of the 16 + 1 invitees, later thirteen interviews participants, being senior leading professionals in their industry, gives sure indications about the quality of responses and materials collected for the research work done. Further interviews were not considered necessary as the territorial and area field of the sample was complete, also the coverage made, revealing redundancies already observed in the responses of the interviews. This lead to consider the sample adequate and no other interviews were required.

The information sources characterization, the personal and professional profile of the thirteen interviewees were performed and all taken in consideration for the evaluation and to border their perspectives and opinions, as in table below:

Table 20 - Invited interviewer's profiles, the information sources

Interv	Position / Organisation / CV	Location
A	Actual President of Port of Sines, Actual President of the Association of Portuguese Ports, Member of EU ports Association, and others. Graduated in Engineering	Sines Portugal
B	Member of the Board at Rangel, international logistics operator; Invited Auxiliar Professor at Católica Porto; ex-member of the board of Aveiro Port. Graduated and PhD in Economics	Porto Portugal
C	Member of the board of Nutre Farming Brazil SRL, experienced in farming management, silos logistics, export activities. Graduated in Economics	S. Paulo Brazil
D	Bunge cereals and bulk logistics manager in Romania; Ex-CerealCom international trader; graduated in management and logistics. Graduated in Engineering.	Sofia Bulgaria
E	Cargil international grains trader; ex-Bunge agribusiness director; ex-CHS international trader; graduated in economics	Gevene Switzerland
F	Prio Foods - Head of the Global Trading & Risk Management Desk with the responsibility for Commodity and Foreign Currency Exposures of the company worldwide. Graduated in Economics	Porto Portugal
G	Ex-CEO of Brasil Agro, leader agribusiness Brazilan group; Managing Director at Catalyst-Capital / AGT Partners; graduate in Economics Harvard	S.Paulo Brazil
H	Actual CEO of Ascenza Romania, Agriculture chemicals supplier, Former Commercial trader of Prio Agriculture Romania. Graduated in Agriculture Engineering	Bucharest Romania
I	CEO of Group Avril in North Africa and Maghreb region, former CEO responsible for EXPUR seeds extraction oils and Biodiesel, east Europe. Graduated in Engineering and Economics	Boston USA
J	Key Account Manager of REAGRO, senior trader in food commodities in Portugal. Very large experience in commodities trading, logistics, especially in protein grains. Graduated in Economics.	Lisbon Portugal
K	Secretary of State of Agriculture in Governo Estadual of Maranhao, Former General Manager of the Soya Farmers Association, others. Graduated in Agro engineering	São Luiz Maranhão Brazil

L	CEO of ACEMBEX, trading house of RAR Group, commodities trader, leader in Portugal, strong experience in South Europe trading.	Porto Portugal
M	Senior trader in ACEMBEX, responsible for several markets and commodities. Large international experience in trade commodities.	Porto Portugal
N	Senior Trader in B3, responsible team leader for international commodities trade, investment funds management and business developing	S. Paulo Brasil
O	DB Ports Senior Projects Manager - In charge of mega projects implementation within UAE, middle east and Africa region	Dubai UAE, MENA
P	Senior trader in BUNGE EU / Romania, responsible for Black Sea and Middle East markets for protein commodities	Clack Sea, EU, MENA, South America
Q	Grains Storage Expert Sea & Oceania, Head of Business Unit at Buhler Asia Pte.Ldt - Singapore, in charge for implementing large grain storage silos in port terminals around the globe, Buhler is a world leader in storage technology	Med, Asia, Atlantic, MENA

Although with contribution of the fifteen invitees, the final group was composed of the thirteen authorizing members of the panel, covering anyhow all areas of expertise and geographies, as below:

Interv	**Position / Organisation / CV**	**Location**
A	Actual President of Port of Sines, Actual President of the Association of Portuguese Ports, Member of EU ports Association, and others. Graduated in Engineering	Aveiro/Sines Portugal
B	Member of the Board at Rangel, international logistics operator; Invited Auxiliar Professor at Católica Porto; ex-member of the board of Aveiro Port. Graduated and PhD in Economics	Porto Portugal
C	Member of the board of Nutre Farming Brazil SRL, experienced in farming management, silos logistics, export activities . Graduated in Economics	S. Paulo Brazil
D	Bunge cereals and bulk logistics manager in Romania; Ex-CerealCom international trader; graduated in management and logistics. Graduated in Engineering	Sofia Bulgaria
F	Prio Foods - Head of the Global Trading & Risk Management Desk with the responsibility for Commodity and Foreign Currency Exposures of the company worldwide. Graduated in Economics	Porto Portugal
H	Actual CEO of Ascenza Romania, Agriculture chemicals supplier, Former Commercial trader of Prio Agriculture Romania. Graduated in Agriculture Engineering	Bucharest Romania
I	CEO of Group Avril in North Africa and Maghreb region, former CEO responsible for EXPUR seeds extraction oils and Biodiesel, east Europe. Graduated in Engineering and Economics	Boston USA
J	Key Account Manager of REAGRO, senior trader in food commodities in Portugal. Graduated in Economics	Lisbon Portugal
K	Secretary of Agriculture in Governo Estadual of Maranhao, Former General Manager of the Soya Farmers Association, others	São Luiz Maranhão Brazil
L	CEO of ACEMBEX ,trading house of RAR Group, commodities leader in Portugal	Porto Portugal

M	Senior trader in ACEMBEX, responsible for several markets and commodities	Porto Portugal
N	Senior Commodities Trader in B3, responsible team leader for international commodities trade	S. Paulo Brasil
Q	Grains Storage Expert Sea & Oceania, Head of Business Unit at Buhler Asia Pte.Ldt - Singapore, responsible for implementing large grain storage silos in port terminals around the globe, Buhler is a world leader in storage technology	Singapore Asia

Table 21 - The final panel of the sources interview

Therefore, a final map of Competences and Geographies settled, with the final thirteen sources participants, covering the areas of experience and the countries focused, subsequently considered valid for the purpose of the research work, as in figure below "Figure 103 - The final panel domains of experience and geographies".

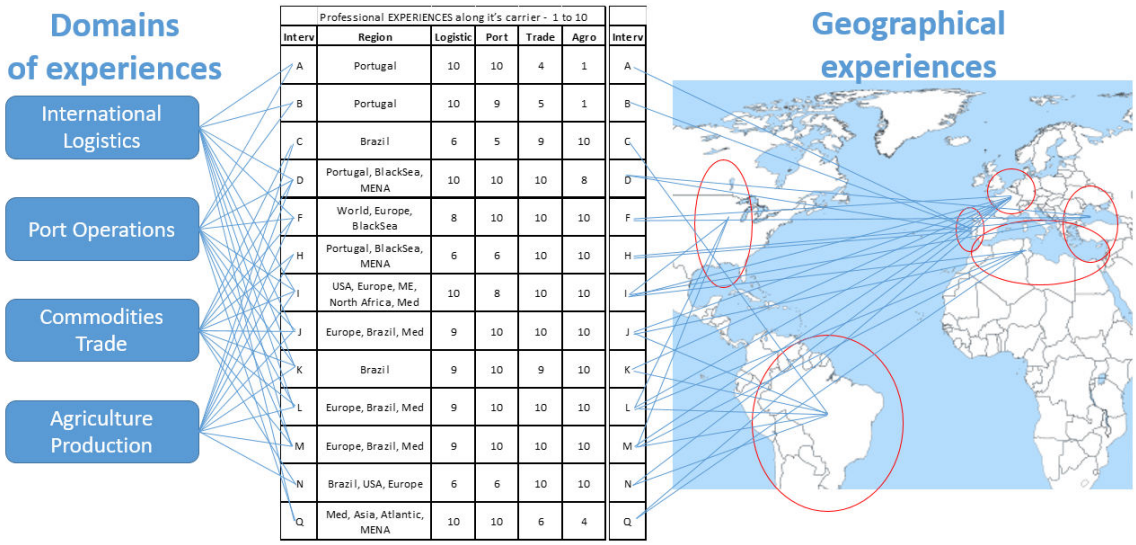


Figure 103 - The final panel domains of experience and geographies

6.3 The proposed theoretical model for the in-depth interviews, first phase, the south entry port issue

The interviews constituted and followed the format of a free conversation and discussion, although guided by a set of questions. These selected industry leaders and specialists were involved in order to reflect and discuss in free interviews. These questions are in concordance with the theoretical model of this research phase, reflecting the variables measured for the analysis and discussions of results, on which the conclusions are based. Along the interviewing phase of the research, the preliminary proposed theoretical model was slightly adapted and developed, as some participants introduced factors and variables in the research that were not beforehand foreseen, enriching the space of discussion and widening the views of the problems focused on.

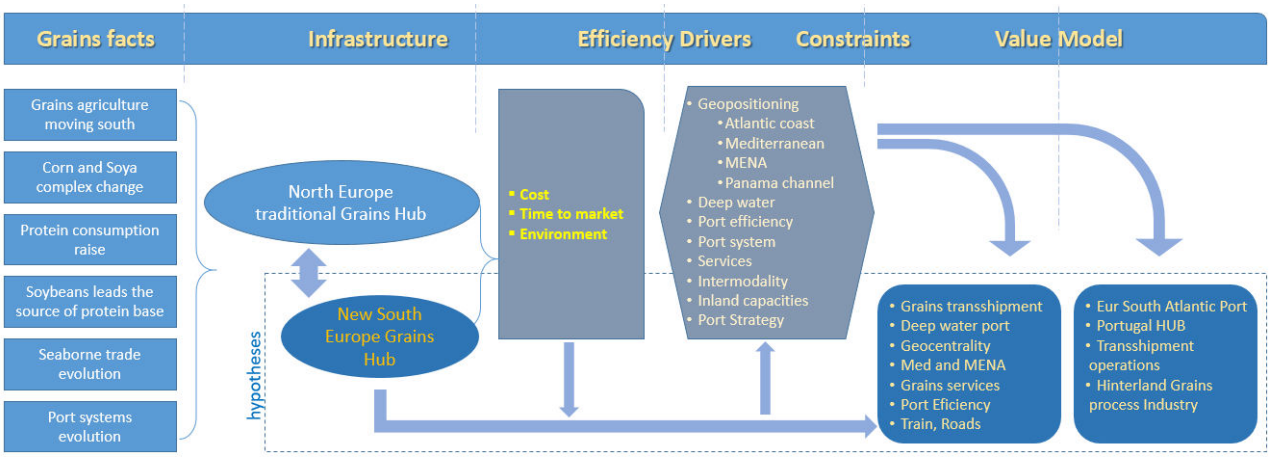


Figure 104 - Theoretical model proposed for the interviews

The theoretical model was previously discussed with all interview participants, and the aims of the research were clarified up to the "constrains" of the model, leaving the discovery of the "value model proposal" and "the Portuguese grains hub" hypotheses, eventual suggestion for the interviewees to discover and develop on their conversation, avoiding any guidance, leaving independent freethoughts, creativity and field expansion during the conversation, no borders or guidance from the interviewer.

Like any theoretical model, the limitations of concepts and relations are always appointed as deeper discussing emerge around this model with the interviewees.

From this model a structure of coded variables was conceived to guide the analysis and discussion of the data gathered in the interviews, the data sources, later to standardize the interviews analysis by common variables, also common concepts and structural places of the speech. With this common grild of variables, distributed in levels of incorporation, all the data were gathered, information content of the interviews, later beign revised and classified. The objectivity and transparency of the concepts are determinant to have common criteria of identifying, coding and counting the concepts in the data collected in the interviews. The variables were divided in three levels according and following the theoretical model conceived for the analysis, grouping the main factors in line with the need of responding the research questions targeted in this thesis.

On the first level of variables, we can find the evolution facts and factors in due course sustaining to identify the opportunity of an eventual southern entrance of grains and seeds in Atlantic west Europe ports, Mediterranean Sea, Middle East and North Africa. The second level of variables, the breakdown variables of the first level, which were identified conceptually “a priori”, was enriched in a second phase with the empirical data gathered from the interviews, during which some of these variables were upended along the numerous episodes of the interviews process.

The first two variables level 1, as in “Figure 105 - Structure of coded variables”, are recognizing the state of art, of both, the facts related to grains trading business around the globe, and also the existing infrastructures on the globe, especially in the Atlantic EU and MED regions. This plays also a role of triangulation and confirmation of the chapter “5 - Southern evolution of world agriculture production latitude” data analysis indications. The last three variables in level 1 are grouping the evaluation of the opportunity for a new port entrance for grains and seeds in south EU. These are, considered by the study, the main drivers that can force the search of alternative ports in Europe for this purpose, also the features and constrains that frame the evaluation of such an alternative, finally, what is the value model that sustains a future choice.

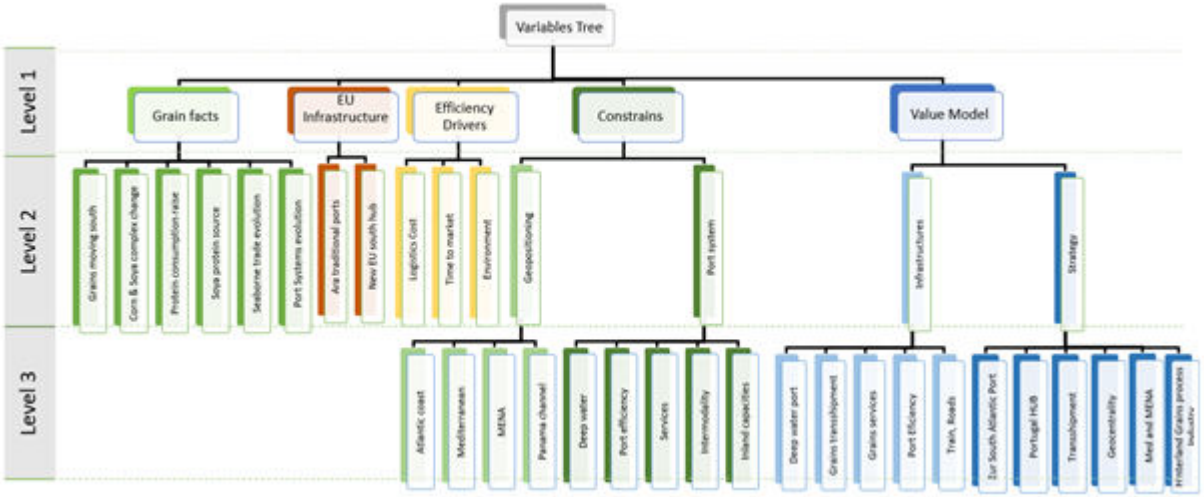


Figure 105 - Structure of coded variables

The variables conceptualization and their content description are crucial elements for the codification of the data gathered along the interviews process, in the hearing job. On the second level and third level of variables, the content description is detailed as in the table below:

Variable	Level 1	Level 2	Level 3	Concept / Content
1.0.0	***Grain facts***			
1.1.0		Grains moving south		the agriculture grown in the southern hemisphere and their yields, the change in weight of southern countries in the past 4 decades
1.2.0		Corn & Soya complex change		Corn (maze) and Soya, feed base heavy grains in the meet production, had special increase in the southern hemisphere countries, also due to the transgenic technologies
1.3.0		Protein consumption raise		world population protein consumption is rising, whether meet or direct vegetable origin.
1.4.0		Soya protein source		having higher conversion ratio, Soya became the main source of protein for meet production in the industrialized world
1.5.0		Seaborne trade evolution		Seaborne trade, took a primary role in the world commercial exchanges as commerce became global. Vessels looking to increased capacity, became bigger in size and draft
1.6.0		Port Systems evolution		Ports had to adapt for the increase of seaborne trade activities around the world. Ports became specialized, interconnected, incorporating specialized dedicated cargo terminals
2.0.0	***EU Infrastructure***			
2.1.0		ARA traditional ports		ARA meaning Amsterdam, Rotterdam and Antwerp, ports identified has a preferential hub for grains and seeds in the actual state of art of the European logistics trade support
2.2.0		New EU south hub		The opportunity and convenience to make a new hub port in the south of Europe
3.0.0	***Efficiency Drivers***			
3.1.0		Logistics Cost		The importance of the logistics costs in the product price and the overall impact of the product competitiveness
3.2.0		Time to market		The driver time to market importance in the food agriculture commodities business
3.3.0		Environment		Environmental concerns in seaborne trade operations
4.0.0	***Constrains***			
4.1.0		Geopositioning		
4.1.1			Atlantic coast	the importance of being an Atlantic coast port
4.1.2			Mediterranean	proximity and relation to the Mediterranean Sea countries
4.1.3			MENA	proximity and relation to the Middle East and North African countries
4.1.4			Panama channel	the interconnection of the Panama channel, recently enlarged bringing traffic from USA and Canada West coast, eventually from Asia zone
4.2.0		Port system		
4.2.1			Deep water	having or not the capacity to receive, big size vessels, with deep drafts
4.2.2			Port efficiency	the efficiency of the port to receive, discharge, provide services and amenities to the ship
4.2.3			Services	the availability of terminal services and port amenities
4.2.4			Intermodality	the interconnection with other transport means, essentials like efficient railways and road transportation, interconnections with the terminals loading and unloading infrastructures
4.2.5			Inland capacities	the relevance of the inland capacities for the industry provided by food commodities. Oils and meals extraction, grains milling factories, feed compound producers, food industry, others.
5.0.0	***Value Model***			
5.1.0		Infrastructures		
5.1.1			Deep water port	need for the option of choosing the deep-water port,
5.1.2			Grains transshipment	operate grains transshipment operations, by the means of the existence of systems to unload and load large bulk grains vessels, storage facilities, cleaning and drying capacities for grains treatments.
5.1.3			Grains services	Storage , cleaning, drying. Eventually bulk brake operation in containers, beans, big bags, or bags, the capacity to make the conversion of the cargo by efficient packing systems
5.1.4			Port Efficiency	efficiency, low waiting time, reduced time to operate the cargo load/unloading
5.1.5			Train, Roads, others	intermodal capabilities availability and efficient interconnections
5.2.0		Strategy		
5.2.1			Eur South Atlantic Port	the opportunity to establish a new south port in Europe for grains and seeds transshipment, and distribution by inland intermodality and short-sea shipping lines;
5.2.2			Portugal HUB	the opportunity to establish in Portugal, Sines, the south Hub for Europe, due to its Atlantic south geopositioning
5.2.3			Transshipment	the opportunity to focus in the transshipment operations, recognizing a week industrial actual scenario in the region
5.2.4			Geocentrality	the opportunity to profit from the geocontrality of south Portugal hub, placed in the South Atlantic West coast, Mediterranean Sea entrance, connecting the Med countries, North Africa region, proxy Middle East, and Black Sea regions
5.2.5			Med and MENA	Favorable position to serve Mediterranean, Middle East an North Africa markets
5.2.6			Hinterland Grains Industry	The importance of the development of the in hinterland grains industry transformation.

Table 22 - The initial table of variables and its descriptions resumes

6.4 The new Empirical Model constructed during interviews

A new Empirical Model, proposed later, results from the arrangements made along the research interviews, departing from the Theoretical model prosed in an initial stage of the interviews, introducing 3 new variables. Some of the sources referred to new variables of analysis, that were considered to be relevant, beign consequently introduced in the model, proposing the final Empirical Model at the last stage, as below "Figure 116 – Empirical Model, adjusted along the research work with the sources of information". Three variables, gathered along the interviews, in different moments and with different sources of information, were later recognized as common places for some of the actors interviewed. The new variables concepts are content related and described as follows:

Variable	Level 1	Level 2	Level 3	The content
5.0.0	***Value Model***			
5.1.0		Infrastructures		
5.1.6			**Crushing Hub - Soya**	A specialized port terminal for Soybean grains needs an inland "crushing capacity" to convert the grains in its primary sub-products: "Soybean meal" and "Soya Oil", which are often considered in the trading business as common commodities in the protein business, converting or mixing / splitting the cargos.
5.2.0		Strategy		
5.2.7			**Commodities Port Systems Routes**	The food commodities port terminals are specialized cargos, today need modern technology for loading and unloading, using specialized terminals and systems, inland storage is a must, that make the ports interact between them, moving this specialized food and feed raw materials between grains specialists.
5.2.8			**Concession Hypothetical scenario**	The Port Authority is a manager that takes care to open the opportunities for business development in the port terminals. This does not mean necessarily investing, or operating the activities. The role of a regulator and concessionaire position is to observe and study the information support for a decision for a tender towards the concession of a port terminal for food commodities, having a programed plan of investments balanced by a contractual period of exploitation of the activity concerned.

Table 23 - New variables up handed in the Empirical Model

A new empirical table of variables was defined as in table below:

Variable	Level 1	Level 2	Level 3	Concept / Content
1.0.0	***Grain facts***			
1.1.0		Grains moving south		the agriculture grown in the southern hemisphere and their yields, the change in weight of southern countries in the past 4 decades
1.2.0		Corn & Soya complex change		Corn (maze) and Soya, feed base heavy grains in the meet production, had special increase in the southern hemisphere countries, also due to the transgenic technologies
1.3.0		Protein consumption raise		world population protein consumption is rising, whether meet or direct vegetable origin.
1.4.0		Soya protein source		having higher conversion ratio, Soya became the main source of protein for meet production in the industrialized world
1.5.0		Seaborne trade evolution		Seaborne trade, took a primary role in the world commercial exchanges as commerce became global. Vessels looking to increased capacity, became bigger in size and draft
1.6.0		Port Systems evolution		Ports had to adapt for the increase of seaborne trade activities around the world. Ports became specialized, interconnected, incorporating specialized dedicated cargo terminals
2.0.0	***EU Infrastructure***			
2.1.0		ARA traditional ports		ARA meaning Amsterdam, Rotterdam and Antwerp, ports identified has a preferential hub for grains and seeds in the actual state of art of the European logistics trade support
2.2.0		New EU south hub		The opportunity and convenience to make a new hub port in the south of Europe
3.0.0	***Efficiency Drivers***			
3.1.0		Logistics Cost		The importance of the logistics costs in the product price and the overall impact of the product competitiveness
3.2.0		Time to market		The driver time to market importance in the food agriculture commodities business
3.3.0		Environment		Environmental concerns in seaborne trade operations
4.0.0	***Constrains***			
4.1.0		Geopositioning		
4.1.1			Atlantic coast	the importance of being an Atlantic coast port
4.1.2			Mediterranean	proximity and relation to the Mediterranean Sea countries
4.1.3			MENA	proximity and relation to the Middle East and North African countries
4.1.4			Panama channel	the interconnection of the Panama channel, recently enlarged bringing traffic from USA and Canada West coast, eventually from Asia zone
4.2.0		Port system		
4.2.1			Deep water	having or not the capacity to receive, big size vessels, with deep drafts
4.2.2			Port efficiency	the efficiency of the port to receive, discharge, provide services and amenities to the ship
4.2.3			Services	the availability of terminal services and port amenities
4.2.4			Intermodality	the interconnection with other transport means, essentials like efficient railways and road transportation, interconnections with the terminals loading and unloading infrastructures
4.2.5			Inland capacities	the relevance of the inland capacities for the industry provided by food commodities. Oils and meals extraction, grains milling factories, feed compound producers, food industry, others.
5.0.0	***Value Model***			
5.1.0		Infrastructures		
5.1.1			Deep water port	need for the option of choosing the deep-water port,
5.1.2			Grains transshipment	operate grains transshipment operations, by the means of the existence of systems to unload and load large bulk grains vessels, storage facilities, cleaning and drying capacities for grains treatments.
5.1.3			Grains services	Storage , cleaning, drying. Eventually bulk brake operation in containers, beans, big bags, or bags, the capacity to make the conversion of the cargo by efficient packing systems
5.1.4			Port Efficiency	efficiency, low waiting time, reduced time to operate the cargo load/unloading
5.1.5			Train, Roads, others	intermodal capabilities availability and efficient interconnections
5.1.6			Crushing Hub	Having the capacity to the extraction of oils and meals, being important for the oils seeds trading operations to manage together the complex of the seeds, oils and meals
5.2.0		Strategy		
5.2.1			Eur South Atlantic Port	the opportunity to establish a new south port in Europe for grains and seeds transshipment, and distribution by inland intermodality and short-sea shipping lines;
5.2.2			Portugal HUB	the opportunity to establish in Portugal, Sines, the south Hub for Europe, due to its Atlantic south geopositioning
5.2.3			Transshipment	the opportunity to focus in the transshipment operations, recognizing a week industrial actual scenario in the region
5.2.4			Geocentrality	the opportunity to profit from the geocontrality of south Portugal hub, placed in the South Atlantic West coast, Mediterranean Sea entrance, connecting the Med countries, North Africa region, proxy Middle East, and Black Sea regions
5.2.5			Med and MENA	Favorable position to serve Mediterranean, Middle East an North Africa markets
5.2.6			Hinterland Grains Industry	The importance of the development of the in hinterland grains industry transformation.
5.2.7			Commodities Port Systems routes	the strategic integration of Portugal in the main routes of the international commodities trading
5.2.8			Concession Hypothetical scenario	The opportunity to launch a concession to build and operate such a grains terminal in South of Europe, in South of Portugal

Table 24 - The final empirical model respective Table of Variables

Accordingly, the new structure of variables after the arrangement of the new empirical model becomes like below, showing the new three variables added to the previous conceptual model, before the interviews contributions:

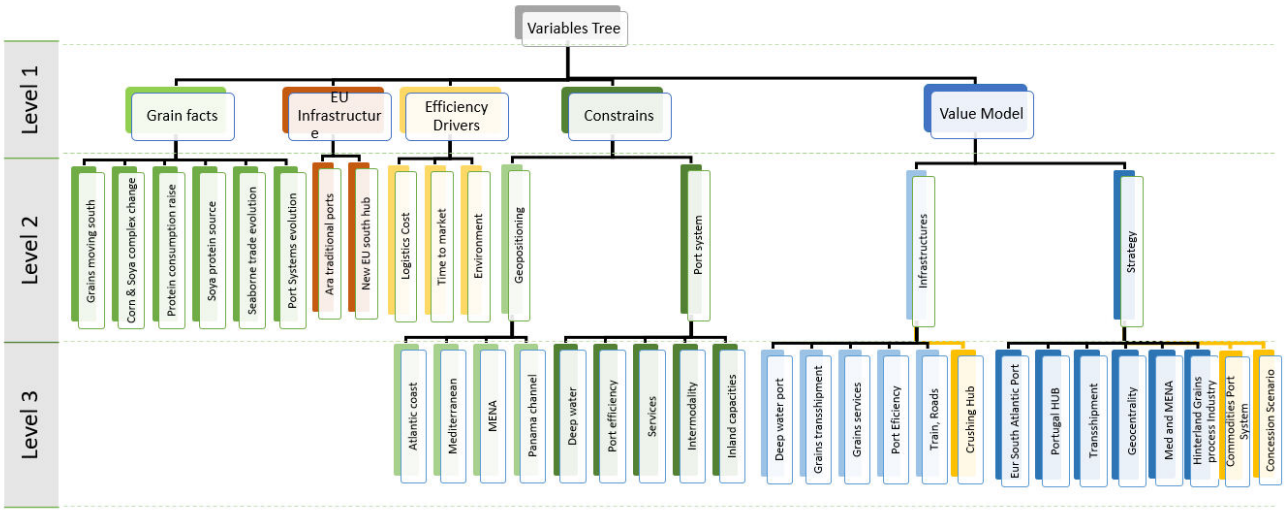


Figure 106 - Structure of coded variables of the new Empirical model

In addition, the new Empirical Model below enlarged by the three new variables appended during the interviews process.

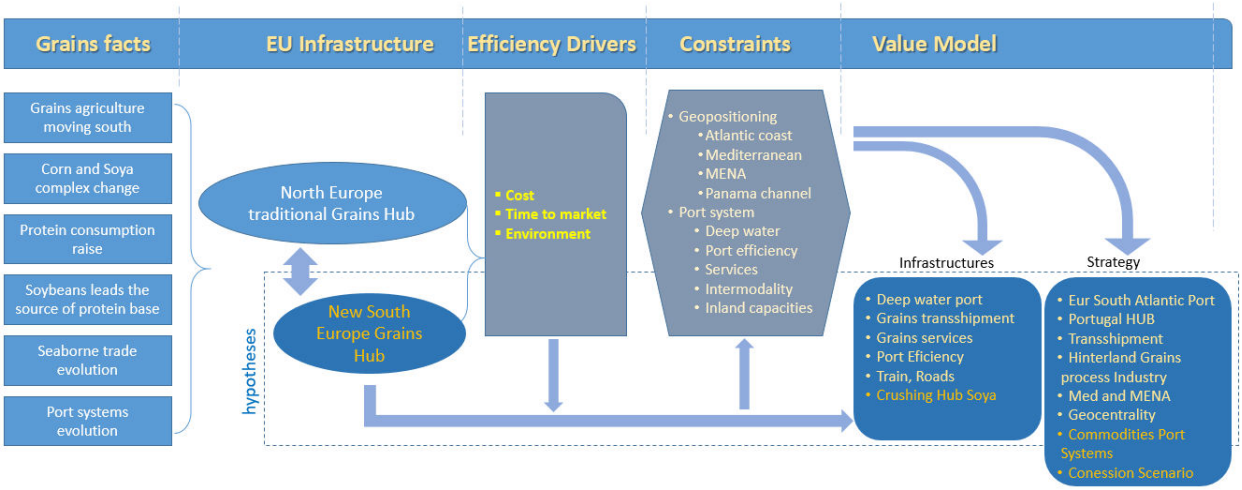


Figure 107 – The new Empirical Model

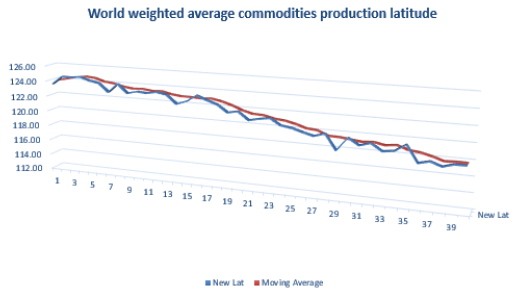
6.5 The contextualization note and the guided questions of the interview

Each interview is a personal conversation for the purpose of acquiring information from the interviewee invitee, this data must have importance and contribution to the research job ongoing, to give the background. There was a previously remittance of a contextualization text and a set of guiding question for the interview. Neither the text, nor the questions meant to be guiding the interview strictly on the subjects of the text. Instead, a free and exploratory conversation instigated to extract the maximum data and information. Something else is the psycho-affective domain, also present in the interviews relation, this phenomenon may bother the truth of the interview, may even embarrasse or change the data collection planned on the interview (Morin, 1966).

Therefore, five pages were printed leaflet, with introductory texts, placing five open questions and a final survey. The documents also included a typical declaration of Consent to take part in research demanded from the interview invitee. This systematic procedure was arranged and given to the guest on the beginning of the interview, not allowing pre-preparation about the context topics. It was composed by an introductory letter, inviting and revealing the frame of methodology of the research work for which the invitee was being entitled to enter. Also before the questions, a contextualization résumé text was presented:

> *"This study is about food commodities maritime logistics efficiency.*
>
> *Grains, food commodities, like wheat, barley, maize, millet, oats, rice or soybean are traded around the world coming from origins where climate, soil and agriculture development allow its best harvesting conditions and productivity, exported to the world food processing destinations whether to be directly consumed and/or processed and distributed to market in many different food forms and products.*
> *Nowadays, the worldwide logistics for Grains commodities, is mainly supported on large bulk ship carriers, getting larger and larger every year, as global consumption increases and transaction volumes also grows, at the same time, environment concerns and energy efficiency is a must to observe in maritime logistics. Vessels dedicated to grains logistics, are getting bigger every year in the past decades, looking to respond to higher capacities and efficiency on transportation.*

A preliminary research question of this study, answer that the medium latitude of agriculture world production for grains, is coming to South in the globe. Official data, was processed considering agriculture production figures, for the 7 CME quoted world commodities, being considered the globe "traveling commodities", the most trade world food commodities, using the standards for grains and seeds, Barley, Maize, Millet, Oats, Rice, Soybean, and Wheat. A total of UN recognized 194 states in the world were considered, gathering their agriculture figures production for these commodities. The evolution of the weighted Latitude, along 40 years, all years without no intervals, considering each year the respective production values for each food commodity, georeferenced per country, using a moving average algorithm for the medium waged latitudes of all productions years. The result calculated a drop of 6,2 grades on earth Latitude, represents approximately 700 Km, 380 maritime miles, representing for at a cruise speed of 12 knots for a vessel average normal speed, time spend of more than 30 hours navigation. In medium per vessel, in the last 4 decades. Now focusing on Europe Occidental logistics, the next question to evaluate is: Are the traditional European big ports, in the north, especially in the ARA region, leaders for large decades of international trade activities, still the efficient entrance for food grains?
Europe, should study also alternative logistics and industrial infrastructures to respond more efficiently to part of its food consumption, coming from south occidental coast.
"



After, the 5 open questions and topics for discussion were disclosed to guide the discussion, not necessarily searching direct answer, but rather a discursive conversation, following the topics, even though for each question the researcher had a clear intention of data extraction as intended, the following questions were guiding the interviews :

1. In the past 4 decades agriculture grains production grow in volume about 3 times on the globe. What is your description idea about this evolution in the different regions of the globe in the past decades? (Guide lines topics on discussion: production evolution per region; north-south; development countries; technology evolution; countries politics on agriculture production; climate change)

2. Agriculture production follows the best soil and climate, consumption follows demography and economics, these maps are not necessarily coincident, so important world agriculture logistics is a must as we know. In the logistic point of view, what trends are guiding the big agriculture commodities logistics supporting trading in the past decades?

3. Let's focus now in Europe, the old continent. Early on the XIX and XX century the port region on north of the continent (Amsterdam, Rotterdam, Antwerp) became an important entrance of goods in general and food commodities in particular for Europe. Taking in consideration your vision on the evolution of the geographical grains production areas, you might consider that other entrance ports would save hours of vessels navigation, reducing considerable impacts, justifying a strategic analysis of new entering ports for food commodities in Europe?

4. You have an idea what other alternatives ports to ARA, in Europe?

5. From your point of view and experience, which are the main geographical, physical and infrastructures limitations/requirements to be considered as ideal chosen port and region?

In the end, the survey questions, as in chapter "6.8 - Port Competitiveness requirements", were complemented with the new block of questions of this thesis, oriented for the strategic issues, rated with 1-10 scale of importance, beign shortly treated following the construct of Yeo and Roe and other researchers.

If not recognizing the global agriculture origins having a southern movement in the past decades, the thesis would lose its sense. Fortunately, all the interview experts were unanimously recognizing as an obviouse truth that this phenomenon is observed and cleared evidenced by their work experiences and knowledge of the industry sectors field, whether agriculture production, or international trade of food commodities. What it was for them most surprising, is the fact of this study being pioneer in the interpretation and think-tank orientation to reengineer the logistics solutions of southern west European ports logistics solutions.

6.6 The sources of information analysis and transcriptions

From the fifteen interviews made, between the year 2020 and early 2021, thirteen considered for treatment in the research purpose, all recorded with audible techniques not using video or images storage. These records later processed were the source materials object for several analyzing hearings, allowing the process of identifying the matrix of variables and structural places, permitting the coding and transcriptions of the source. The interviews treated anonymously, just amending the interviewer context and avoiding any personal identifying traces as possible. Nonetheless, we have to admit that one can always relate with great matching accuracy the contextual description of the source, with particular individuals, known at their functions at a certain moment in time.

The interviews processed by statistical analysis and descriptive content analysis, techniques which mainly analyzes the forms of verbal, written communication or unwritten, that take shape between individuals, encompassing thus both the literary text and interviews or speeches. Content analysis is a technique of research widely used in qualitative research. In terms of definition, content analysis is defined by Bardin, as a "set of techniques for analyzing communications aimed at obtaining through systematic and purposes of describing the content of messages, indicators that may be quantitative or not, that allow the inference of knowledge regarding production / reception conditions (inferred variables) of these messages". Cole (1988) cited by Elo and Kyngäs (2008) adds that content analysis is a "method for analyzing communication of written, verbal or visual messages". It is a method flexible, where there are no simple guidelines for data analysis, which makes that is a challenge for the researcher. One of the advantages of this method is that it uses a large volumes of information, and data sources are employed to confirm evidence. The interpretation of the results obtained can be done through inference, which is a type of controlled interpretation. For Bardin (1977, p. 133), the inference may "be based on the constituent elements of the classic mechanism of communication: on the one hand, the message (meaning and code) and its support or channel; on the other hand, the sender and the receiver".

6.6.1 Case 1 – Source A - Port authority administrator - Portugal

The first interview that has been classified from the panel of participants was made with a port authority administrator, a person with large experience in the ports administration in Portugal, with a strong engineering background profile, administration experience along several mandates in different port authorities, actually heading the biggest port administration in Portugal. The few preliminary contacts and phone conversations took place along the last two weeks of March 2020, preparing the interview and the visit in the port headquarters administration, that took place in 6th April 2020. The preparation of the interview gave the information about objectives, the scope of the study, and the clear

information of use and consent of the interview content gathered during the informal conversation, that also would be recorded for later processing in the study.

The table below resumes the information CV, the regional range of experience considered, and classification of the source A from the panel of interviews:

			Professional EXPERIENCES along it's carrier Classified - 1 to 10				
Interv	**Position / Organisation / CV**	**Location**	Regional experience	Logistic	Port	Trade	Agro
A	Actual President of Port of Sines, Actual President of the Association of Portuguese Ports, Member of EU ports Association, and others. Graduated in Engineering	Aveiro /Sines Portugal	Portugal	10	10	4	1

Table 25 - Description, region and experiences considered for source A

For this source, his expertize was classified with strong maximum values for the Logistics and Port factors, due to the solid experience in the field along his career. On the regional coverage it was classified covering Portugal, Atlantic west south European coast region, although we can consider his knowledge of the global logistics that any port authority is necessarily involved as in the globalization picture of the seaborne trade industry operating in any port space.

The conversation took place in a visit journey to the port site, where multiple discussions about the port activities were performed, about the main historical milestones and development, particularly its last few years of administration experience was largely shared in an informal conversation during the visit. An office interview period allowed in a comfortable environment to carry on the interview. The vision of the interview of source "A", a Port authority administrator, focused and oriented by the perspective of the port authority, regarding the aspects of the infrastructure and not so much of the trade and commercial operations of the agents operation there. Even more, the food commodities operations, although experienced in a previous port administration experienced by source A, is not actually present in this port complex visited.

The first block of variables, the agriculture world production moving to south, evidenced and recognized by source "A" from his general knowledge and longtime experienced relations with traders and cargo operations of cereals and seeds, also having a thoughtful vision about international trade and world tendencies in the food business.

> "the agriculture commodities production configuration changed in the past decades, the southern coutries increased considerably their role in the food produtction, due to the social economical development of these countries, especially South America, the political and stable ecnomical environement allowed the indutry to introduce technologies to grow considerable their agriculture productions"_t_7:35

There were large consensual ideas in the conversation about the observation of the food commodities geographical evolution, it was possible to discuss about the evolution of the grains and seeds production geographies and the raising trend that made the southern countries of the hemisphere progress their knowledge and technology in agriculture production countries.

> "The food matrix obviously changed in two generations. What was previously dominated by maize, rice and wheat, opened the way to soya that became a strong commodity in the international logistics in the end of last century. The soya logistics figures keep increasing every year, taking a prime role in the global trade and port operations of food commoditites."_t_1:05

The Port infrastructures evolution in the last decades is immense. The last decades, brought new economical origins of cargo in the world. Countries evidence strong developments, new world economies especially in the Asian zone, made big exporters of cargo countries like Taiwan, China, Malaysia, Singapore and others. In the field of food commodities, grains and seeds, also countries in the South America zone became strong exporters in the last decades. Regarding the reception in Europe, “the hold continent” has its recognizable main market zone in the central north of European continent. There is the strong consumption concentration, also transformation industry, so we have to recognize the leading density of the production and consumption that is higher than in the extended peripheral borders of the European continent. The historical development of the population, its richness and the transformation industry made old ports serving the north central Europe market zone, historically conceive, develop and confirm their role in the cargo trading. Southern ports in Europe developed specialized infrastructures and capabilities more recently, market size is conditioning the infrastructure development. Southern ports in

Europe have less traditional, more recent experience in specialized large volume of cargos like commodities.

> "Europe logistics infrastructure is now oriented to southern origins in fact. The old ports of north are dealing the commodities by traditional reasons but no doubt because of no other serious infrastructure in the southern countries."_t_7:35

Anyway recognizing the importance and centrality of the north Ports of ARA region, being an advantage when compared with ports like in Portugal, a peripheral zone of Europe. The advantage is especially base on distance, these north ports have a strong advantage for the reception of cargo because their proximity with the big market place, the central Europe zone. Although for transshipment operations this is no longer the same advantage, it can be made anywhere, like we are currently observing with container cargo being transshipped in large and increasing scale in Portugal port operations. However, regarding merchandize distribution, the efficiency of cargo logistics is strongly affected by its main factor, the mileage distance. Therefore, for transshipment operations, alternative ports not in the central Europe can be more efficient in the global efficiency of the logistics chain if the mileage is shorter.

> "The north ports are closer to the big center of consumption in central Europe. So if the consumption potential is there, makes sense to bring the merchandize closer to the consumption centers. But it is true that part of that merchandize and especially that part intended for transshipment of smaller cargos, the merchandises should not travel so much to the north and could be transshipped earlier in a south terminal."_t_8:03

Another important phenomenon to be taken in consideration, and can be observed in other sectors of activities, may bring confidence and trust in the economical operators using the port infrastructures. These are the combined resources for the all value chain of the logistics operation. The port, the carrier liner, the trader, the final clients are many times assigned to matrix of ports systems interacting with confidence and trust. Routines in operations, specialization and experience, as well as periodical and permanent operations, cover the needs of the economical agents, using the combined infrastructures of port maneuvers and seaborne transports. The economical managers can trust on that “route to flow the cargo, on time and with no surprises”.

"…the strategy of port operators to associate ports interconnecting regular lines, allow creating routes for merchandize that trading operators can follow with confidence. This developed the port systems interconnections and cooperation in specialized cargos. Example, the APS Singapore operator in Sines bases its strategy in its triangular operation using their sites in Sines, Panama and in the Pacific coast"_t_38:25

The interviewer, looking the actual picture of the traditional ARA and Hamburg domain in the commodities reception and distribution transshipment of food commodities, gradually recognized the potential opportunity for the role of a southern port in Europe making more efficient at least part of the cargos distribution in the south Europe and Mediterranean zone.

"…makes all the sense the development of a new infrastructure for grains, food commodities, in a southern port of Europe. Part of the merchandize coming from the southern countries, especially Brazil and Argentina, earlier from reaching the north destinations, might be diverted in smaller transshipments to southern ports and Mediterranean zone."_t_8:302

The trigger argument is the “efficiency of the value chain” of the product; this is the main decision argument for the necessary pronouncements and investments to be made in a southern port. The time to make and the resources is not secondary, but the conviction is that it will happen eventually. The port authorities relate their investments and developing plans according strategic decision oriented by government strategic options, but also by the market opportunities to develop the main mission of best economy for trade and supply of such infrastructures, in favor of the populations served.

"…if the logistics solution to be found might create value to the product, then it makes sense, this will happen. The matrix of variables must converge giving more value to the product, so the investments might be sustained to make the logistics change for a better efficiency scheme. This is the trigger question to be undertaken seriously by the authorities and operators. If we demonstrate that an alternative logistics is more efficient, brings value, it allows to pay the investments, then this is solved, the change will happen eventually. In my point of view there are conditions, it makes sense to study and evaluate further. Of

course not only for Portugal, but foreseeing the potential markets in Iberia, Mediterranean, North-Africa."_t_8:22

The conversation allowed many considerations that were made about the opportunity of a potential grains terminal in a southern port of Europe. Even possible scenarios were hypothetically discussed.

Seaborne transport is kept consistently growing in the world trade flows, being the most efficient way of transporting goods. The sea is the best, most efficient, less costly and already built by nature, highway to transport cargo. The world's ports activities are in line and growing its operations, new ports being built or extended everywhere, and maritime infrastructures keep their evolution in line with the needs and tendencies. The new Panama Channel, or better, the renewed Panama Channel after enlargement of its capacity of transfer size of vessels, was largely discussed looking the impact on the this south port of Portugal.

"The enlargement of the Panama Canal is important for all the traffic system, because it's all interconnected in the end. Nevertheless, today Sines receives vessel like 23 K TEUs, some of the biggest in the world and Panama channel cannot transfer these vessels. However, it is true that Sines got more traffic due to this recent enlargement. Example a new liner, a weekly connection from Sines to the Port of long-beach in the west coast was opened after the enlargement of Panama channel, also a new line from Chile, the west South America coast was developed, so new opportunities came, and Sines is very well positioned for the traffic coming from Panama to east, to Europe."_t_38:26

New infrastructures and upgrades, increasing traffic and volumes, and are obviously causing or giving the opportunity for a double effect on the logistics and trade opportunities. We can receive new and more cargos from those origins, but we may also export and send to new destinations, increasing trade and commercial opportunities for the final clients.

"…the Panama opportunity for Sines may also be seen the other way around, this is to send the merchandize to the west coast in smaller vessels that can cross the channel. Sines would have the great opportunity to make the transshipment for this operations"_t_41:08

In the chapter of the “constrains”, the discourse of the “source A” took long and deep relevance on the works being done and programmed for the railway interconnection to the Port. It is relevant that the Port authority is making priority significant investments in a capable intermodal and resourceful transport system for connecting the port with the hinterland. Not only the surrounding area of the Port, or the Portuguese hinterland, but also looking the Spanish territory and south Europe connections. The intermodal capabilities of the transport system connecting the Port is a priority factor of the competitiveness of the services. Relevance to this factor was given in the discussion interview, the interconnecting roads and train facilities are important for the Port services context, in particular the improvement of the railway infrastructures are well present in the Port strategy for the next years. We should not forget that this port initially focused in energy (combustibles, gas, and coal for the electric power plat in the zone), became after in the last years a commercial container and break-bulk cargo in many domains. These new markets oblige to rethink the intermodal capabilities of the Port, and with relevant attention to the railway infrastructure, essential for terrestrial cargo transportation.

> "(…) still in the framework program EU 2020, until 2023 we have several upgrades in the train infrastructure being done, to improve the Port accessibility and interconnection with the European rail system. The port authority has engagements inside the port area, and the railway infrastructures national company is doing the improvements in the context of the investments foreseen in the investment plan, ongoing. Until 2023 we are concluding the new or upgraded Elvas to Caia, a new line between Elvas and Evora is in construction now, also a new line between Evora and Vendas Novas, some are upgrades others are new lines. We also have renovation works ongoing in the line from Vendas Novas until Grandola, also in the Sines port lines, creating some bypasses to allow longer train compositions, improving from 450m to 750m trains. From Sines we have today many trains flowing to the Iberian hinterland like, Sevilha, Merida, Madrid and others, the line is in fact fully loaded and its why the investment to upgrade are being done. In addition, we make trains for the Beira Alta line, more to the Iberian north, although at Entrocamento we find some limitations with the traffic in the “north line”, also the length of the trains composition is limited. For Sines is it very important to be able to operate 750m long trains compositions, more efficient, much more cargo. The question is not so much the speed, for cargo, low speed is ok as long as it keeps going and does not stop. Also for the south of Portugal, Algarve region, some investments on the line Sines to Ermida are being done. All these investments are to be

concluded 2023. Other new investments for the new European framework, notably a new line Sines Grandola. In addition, Spain must conclude many improvements to make this network efficient. The railways are emerging in the entire European continent. The connection up to Germany is now a priority project. The change of the Iberian “bitola”, the width between the rails, in Spain to France, is a main constraint in this connection. An important issue for the rail cargo in Iberia, which must be resolved in the rail operations between in Irun from Spain to France. The logistics system to change is not a problem but must be improved, also the lines in France must warranty availability for the traffic. This is a problem today, as we say the speed is not a challenging, 5 or 10 hours is the same for a cargo transfer, but it must be a trustful operation. Once appointed a schedule, it must be fulfilled, unexpected delays are frequently observed in the France railways availability to open time slots for cargo coming from Irun - Spain, chronic delays mistrust the option of rail cargo for the operators, because they cannot trust in the time-schedule of the operations foreseen. The European taskforce for train transports is studding this process to make the necessary changes to avoid these problems on the border Spain-France, making the operation flow according good standards of service which are today essential for the players"_t_31:32

The interview focused after in the specificity of actual cargo operations of the Port. Apart from the vocation for servicing the Petro-chemical complex in the area, which initial gave life to this Port, not many other economical operations on the inland industrial zones could be relevant for the Port, some secondary industrial activities surrounding the petrochemical complex for some sub products, or services. These are the generality of other activities in the zone for the moment. This phenomenon is also the trigger for a renewed strategy of diversification and attraction of new economic activities to the ZIL (Industrial and Logistics Zone) of the port.

Nevertheless, this port knows its main assets, allow to attract new operations, not depending from the hinterland activities. In fact, the dynamic expected is to be the opposite, the port to bring new activities for the ZIL.

Being a deep-water port, allowing special bigger sizes of vessels, making more efficient the logistics of cargo in long distance. For the time being, not suffering so much congestion, meaning availability for the vessels operations, easy to book and discharge/charge not waiting long time for operational slots. Having a privileged geolocation in the south Atlantic coast, easily on the passage accessing the Mediterranean Sea, MENA region and Black Sea. This port may serve operators just in transshipment of cargo between vessels in different destinations

and sizes, not interacting or depending the hinterland territory. All operations necessary are inside the port, the cargo is not leaving the port. This is an obvious vocational opportunity for this port strategy, making operations in the logistics transshipment business. The port services have to be particular efficient and competitive for its clients.

> "… as well as being a south Atlantic deep water port, the transshipment operations are for Sines very important, it is very well positioned to do so. Transshipment can be done anywhere, as it does not depend on inland facilities, just port operations. So being competitive and efficient is the most important for the logistics operators and ship owners"_t_13:09

No doubt, as seen in many other places in the world, progressively, the port operations of transshipment also gradually encounter means for the hinterland operations in the transformation and processing industry related to the cargos, creating value and jobs in the port region community.

Looking to the grains opportunity, Sines can be in fact as also a transshipment port for Grains. Facilities for storage, cleaning and drying would be important in such a context, but in the eventuality of a grains terminal becoming effective.

> "…for sure the port of Sines is very well positioned for the transshipment operations of the grains, like already happens with the containers. Operators can bring big vessels, we have deep water draft and long quays, allowing from here to brake the load and distribute in transshipment operations along the region, Mediterranean, Next Middle East, North-Africa, West Atlantic Europe south coast, and others."_t_10:13

More recently, after this interview and some presentation sharing the findings of this research, we could observe that the Port of Sines really took interest in deeper analysis of the grains, food commodities, and transactions in the world, with special attention to the South America soybeans protein source movements. The Port of Sines has long time strong relations with other Brazilian Ports, and this challenge is launched, the Port Authority is interested to proceed further research.

With Source A, we also took the opportunity to discuss and use the source for the evaluation of the "Terminal XXI" case study evaluation as in chapter "6.9 - The comparative case Terminal XXI in Port of Sines".

From this Source A we can resume the subsequent table of variables and identify important structural places and ideas as follows:

Variable	Level 1	Level 2	Level 3	A	SP
1.0.0	***Grain facts***	***Grain facts***			
1.1.0		Grains moving south		3	X
1.2.0		Corn & Soya complex change		1	X
1.3.0		Protein consumption raise		2	
1.4.0		Soya protein source		2	
1.5.0		Seaborne trade evolution		2	
1.6.0		Port Systems evolution		2	
2.0.0	***EU Infrastructure***	***EU Infrastructure***			
2.1.0		ARA traditional ports		1	
2.2.0		New EU south hub		3	
3.0.0	***Efficiency Drivers***	***Efficiency Drivers***			
3.1.0		Logistics Cost		4	
3.2.0		Time to market		2	
3.3.0		Environment		1	
4.0.0	***Constrains***	***Constrains***			
4.1.0		Geopositioning			
4.1.1			Atlantic coast	1	
4.1.2			Mediterranean	3	
4.1.3			MENA	2	
4.1.4			Panama channel	5	
4.2.0		Port system			
4.2.1			Deep water	4	X
4.2.2			Port efficiency	5	X
4.2.3			Services	5	X
4.2.4			Intermodality	6	X
4.2.5			Inland capacities	7	
5.0.0	***Value Model***	***Value Model***			
5.1.0		Infrastructures			
5.1.1			Deep water port	5	X
5.1.2			Grains transshipment	5	X
5.1.3			Grains services	3	X
5.1.4			Port efficiency	4	X
5.1.5			Train, Roads, others	5	X
5.1.6			Crushing Hub		
5.2.0		Strategy			
5.2.1			Eur South Atlantic Port	3	X
5.2.2			Portugal HUB	4	X
5.2.3			Transshipment	4	X
5.2.4			Geocentrality	3	
5.2.5			Med and MENA	1	
5.2.6			Hinterland Grains Industry	2	
5.2.7			Commodities Port Systems routes	1	X
5.2.8			Concession Hypothetical scenario	4	

Table 26 - Variables count Content Analysis for source A

6.6.2 Case 2 – Source B – International Logistics Operator - Portugal

The case 2, or Source B, is an interview with a member of the Board of a leader company, global logistics operator, in Portugal. This person is presently a professor in University Catholica Portuguesa, matching his pragmatic ability to make analyses, systematize the opportunities, and extract his thoughts and conclusions in a structured scientific manner. This industry leader was also in the past, a member of the board of a medium size, Port Authority in Portugal. His experience and vision considered very relevant, so this source has the potential to view in multiple dimensions, from different angles and perspectives. The same person, today an University teacher with a clear scientific mind set, had a strong experience in the management of a port authority, is now a leader logistics operator and so a port services user. He can have unique multiple view of the port operations, its potential opportunities and weakness.

The few preliminary contacts and phone conversations took place along the first week of April 2020, preparing the interview, that took place in 13th April 2020. The preparation of the interview gave the information about objectives, the scope of the study, and the clear information of use and consent of the interview content gathered during the informal conversation, that also would be recorded for later processing in the study.

The table below resumes the information CV, the regional range of experience considered, and classification of the source B from the panel of interviews:

			Professional EXPERIENCES along it's carrier Classified - 1 to 10				
Interv	**Position / Organization / CV**	**Location**	Regional experience	Logistic	Port	Trade	Agro
A	Member of the Board at Rangel, international logistics operator; Invited Auxiliary Professor at Catholica Porto; ex-member of the board of Aveiro Port. Graduated and PhD in Economics	Porto	Portugal	10	9	5	1

Table 27 - Description, region and experiences considered for source B

The conversation with the source B taken in friendly, peaceful moment and environment, allowed to discuss and exchange ideas about the main topics and also enter in details with some of the most closer subjects, that the participant chose to discuss deeper.

A general introduction to the initial findings about the growing trend of the agriculture production in southern counties matched the common sense of the interviewer, from the experience himself had during the period he integrated one Port Administration for several mandates. During that period, he could observe the growing tendency of the agriculture products coming from south origins.

> "It is common sense, the agriculture new areas developed special in south America developed the agriculture commodities trade frim these origins in the last decades. This I experienced in the port administration management were I took part."_t_1:09

In addition, the soya becoming one of the most prominent seeds in the trading business of food commodities, the interviewer had the experience in the Port Administration period. During that period, this source of protein, requested predominantly for the feeding industry of the region, knew a strong increase in the trade figures during that period, becoming an important cargo type on the overall grains and seeds bulk cargos on that port. But when considering the transshipment of this bulk cargo, some doubts could be observed in the speech, when the final destination client was able to buy the complete vessel. Along the conversation, anyway the base reason of “cost effectiveness” was in the end the bottom line of decision of the operator, in his opinion. If the overall cost were more efficient bringing a large vessel from the origins of the cargo, to a European south port, and then after, entering in a chain of transshipment operations with smaller bulk delivery vessels, this would be certainly preferred if cost effective.

> " (…) the soya become the best protein source. The issue is that the destinations ports might be able to receive big vessels and not need to divide with other destinations. But yes, in smaller market destinations where the traders need that cargo to be smaller, transshipment of smaller quantities in smaller vessels is the obvious solution. Once again the economy of the operation will rule the choice."_t_11:29

The infrastructure of the Port must follow the technological progress and be constantly updated. A Port not updating its infrastructures and equipment to best of the state-of-the-art becomes ineffective. Progressively it will start losing the clients, in the end that old equipment will become useless. From his experience, some of the most important permanent expenses of a port Authority are to maintain the navigation channels, immediately after to modernize as necessary the equipment and infrastructures, then comes all the rest. Renovation is necessary and it is a continuous process in Port infrastructure.

The rapid evolution of the sizes of vessels places serious problems to many Port Authorities. Costal interior Ports being more protected, but necessarily have to use access channels that require constant dredging for keeping minimum depth levels. The Port experienced this case of problems, throughout interviewer B managerial work experience. During last decades trade had a significant increase, quantities grew into higher trades, and vessels trailed becoming larger. During his managerial experience in Port Authority, he could observe this tendency in all sectors of activity, containers, brake bulk cargo, bulk liquid and bulk solids. All are moving increasing quantities in larger vessels.

> " (…) the seaborne trade especially in the last 20 years, observed a big increase in the vessels size"_t_3:20

Although recognizing the agriculture southern latitude phenomena, also the opportunity to make a new hub in the south Europe zone to allow the reception, process, and transshipment of the grains earlier when originated in the south hemisphere, the overall cost of the logistics operation will rule the options of the trader. It makes sense if it is less expensive. The logistics sector struggle with low margins, looking for miniscule efficiencies and large scale to save costs, making the transportation of each ton of cargo more effective.

> " (…) for the grains brought from the south hemisphere is then the rational of the economics that will rule the operations. Are we getting economies in a transshipment operation in Portugal to divert to other smaller destinations? (…) No doubt, the traders and operators will look to the global economic operation to evaluate alternatives. I believe the time to market is not the main driver of the question, one or two weeks, even three or four, is not a big deal for the grains. Typically, will be the economics of the overall operation, which will

> dictate what options to take in consideration. (…) In general, and I mean 99% of the decision in trade options are on the economics of the overall cost. This is figurative, but it approaches the real criterions of the logistics managers"_t_5:45

In its opinion, the killer question is the total cost of the operation end-to-end compared, this will validate or not the opportunity of any logistics new scenario. Moreover, if it is validating the new set-up, so it will happen in due course.

> "I see a clear advantage, still to be quantified, making the transshipment operations in South of Portugal, for the distribution of this cargos coming from Argentina / Brazil with destination to south of Spain, Italy, Back Sea, and North Africa, which we know are big consumer of grains and meals. The cost of this transshipment operation should be very efficient. I believe today we might move cargos in ARA zone like 2 euros per ton, being possible due to very efficient systems of unloading and loading, that justified by great volumes moved there. A new terminal should compete with this and be able to access efficient technologies, to compete in time and cost."_t_6:35

The essence of a possible concession is in mind as an instrument to validate and measure the interest of such an operation in a south port of Portugal. An open tender process allows the private operators to manifest their interest for such an infrastructure, this will be the final test for the infrastructure opportunity.

> "(…) makes all the sense to evaluate the economics of all these scenarios, and if there are operators interested to take the operation this is the best way to test and also to transfer the risk from the port authority to the operators, if they are interested is because it recompenses and it will be disputed"_t_14:12

The interviewer made strong and deep considerations around the value model of this hypothetical infrastructure in a new Port. From experience, all together, the operations have more costs, and greater costs, than usually initial predicted. A prudent analysis must be carefully done to allow this new logistics equation. No doubt, that time to conclude the trade, usually mistreated by operational people or even the traders, is very important in all the efficiency of the cargo transportation economics. It is not only the depreciation of the cargo, although being an organic vegetal cargo is a critical point, but also, all the economic risks with

the quotation exchange of the cargo, and the financial cost a long time, the carry cost. Those are very relevant each day the operation consumes.

> "(…) time to market is a variable that economics like me embrace cautiously. You affect not only deterioration of the cargo, but also market opportunities and financial “carry costs” which usually the operations do not care but that are very important. In large cargos, the financial amounts covering this operation are very costly in terms of cost of capital but also in the hedging of the operations. As long as it stays, deeper is the risk and the costs go higher exponentially with exposure to markets flotations"_t_19:07

From his experience in the Port Authority and today in the global logistics business, from his experience along the professional career, the environment concerns and regulations develop intensely along time, but especially in this past decade. All the issues that may try to preserve the planet are very welcome and each day a new enforcement comes on regulations, as actions towards reducing carbon emissions, better energy efficiency, reduce Sulphur emissions, reduce waste and avoid water pollution.

> "Environment impacts are every day more important and bigger concerns for the international community. The authorities, the public in general that is concerned with the planet, being the oceans a very sensible issue for preserving fauna, aquatic flora, corals and other concerns"_t_18:44

The strategy should orient and adjust the actions plan of any Port administration for integrated scenarios of development, considering all stakeholders in the Port community, making the Port every day more relevant for the country economy, and contributing to the richness in the zone, creating value added activities in the region, bringing value to the existing activities. Prosperity to the community throughout new investments and jobs.

In a final comment ending the conversation, the interviewer relocated the real responsibility for the possible operators of a hypothetical concession of such a terminal in a south port of Europe.

> " (…) if the concession is opened and the operators come, then the operation should have green light"_t_15:20

From Source B we can resume the subsequent table of variables and identify important structural places and ideas as follows:

Variable	Level 1	Level 2	Level 3	B	SP
1.0.0	***Grain facts***	***Grain facts***			
1.1.0		Grains moving south		3	X
1.2.0		Corn & Soya complex change			
1.3.0		Protein consumption raise		2	
1.4.0		Soya protein source		2	X
1.5.0		Seaborne trade evolution		3	X
1.6.0		Port Systems evolution		2	
2.0.0	***EU Infrastructure***	***EU Infrastructure***			
2.1.0		ARA traditional ports		1	
2.2.0		New EU south hub		2	
3.0.0	***Efficiency Drivers***	***Efficiency Drivers***			
3.1.0		Logistics Cost		3	
3.2.0		Time to market		2	
3.3.0		Environment		1	
4.0.0	***Constrains***	***Constrains***			
4.1.0		Geopositioning			
4.1.1			Atlantic coast	1	X
4.1.2			Mediterranean	1	X
4.1.3			MENA		
4.1.4			Panama channel		
4.2.0		Port system			
4.2.1			Deep water	1	X
4.2.2			Port efficiency	1	X
4.2.3			Services	1	
4.2.4			Intermodality	1	
4.2.5			Inland capacities		
5.0.0	***Value Model***	***Value Model***			
5.1.0		Infrastructures			
5.1.1			Deep water port	1	X
5.1.2			Grains transshipment	2	X
5.1.3			Grains services	1	
5.1.4			Port efficiency	1	X
5.1.5			Train, Roads, others		
5.1.6			Crushing Hub		
5.2.0		Strategy			
5.2.1			Eur South Atlantic Port	2	
5.2.2			Portugal HUB	2	
5.2.3			Transshipment	3	X
5.2.4			Geocentrality	1	
5.2.5			Med and MENA		
5.2.6			Hinterland Grains Industry	2	
5.2.7			Commodities Port Systems routes		
5.2.8			Concession Hypothetical scenario	1	X

Table 28 - Variables count Content Analysis for source B

6.6.3 Case 3 - Source C – Agribusiness Manager – Brazil

The next interview classified from the panel of participants was made with an Agribusiness international manager, board member of a large agriculture production company operation in Brazil. Preliminary contacts and phone conversations took place along the first two weeks of April 2020, preparing the interview and the meeting, that took place in 23th April 2020. The preparation of the interview gave the information about objectives, the scope of the study, and the clear information of use and consent of the interview content gathered during the informal conversation, that also would be recorded for later processing in the study.

The table below resumes the information CV, the regional range of experience considered, and classification of the source C within the panel of interviews:

			Professional EXPERIENCES along it's carrier Classified - 1 to 10				
Interv	**Position / Organization / CV**	**Location**	Regional experience	Logistic	Port	Trade	Agro
C	Member of the board of an Agribusiness company operation industrial agriculture production in Brazil. Experienced in several other countries. Also responsible for the supervision of logistics and trade of Soybeans production in large scale. Graduated in economics.	S.Paulo / Balsas Brazil	Brazil	6	5	9	10

Table 29 - Description, region and experiences considered for source C

The third interviewee, source C, is an agribusiness manager long time on the board of an international Agriculture farming company. In these last years, his experience mainly focused in the Soybean farming production, relating in his activity with the farming operation, crops harvesting, trading, grains logistics and exports. In his managerial experiences are several world geographies, notably Mozambique, Romania and Brazil, having a solid experience in the agribusiness managerial field along his professional career. On the regional coverage he was classified covering Brazil and its transatlantic logistics, although we can consider his knowledge related to several regions he worked in, also allowing a global logistics view as the globalization of the trade industry obliges.

The conversation took place in friendly context, during which multiple conversations about the recent agriculture trends in Brazil and movements of the big players in the Agribusiness market recent evolution. An office interview period allowed in a comfortable environment to carry on the discussion.

The vision of the interview of source “C” focused on and was oriented by the perspective of the agriculture production, being an Agribusiness board member and manager in an important international farming house, but not disregarding the deep experience on the trade and logistics of the products after harvesting. Having had a strong experience in several continents, this source was able to discuss in view of a globalized perspective, specially focused in the Atlantic south-north cargo movements that relate and are well known in the context of his professional activity.

A new geographical center displaced to south, considered for the agriculture production evolution in the last four decades was not at all surprising issue for the interviewer. He is in Brazil agriculture operations for long years of activity and without difficulty could recognize this result on the recent historical development of the industrial agriculture in Brazil and in the South America Continent in general.

> "(…) the production is growing in the south countries; we have good soil and clime, and still growing the planting areas to increase the harvest surface. Agriculture became very sophisticated in the last decades in Brazil, introducing technology, adapting and developing the best genetic of the seeds, introducing soil correction technology, specific phytosanitary treatments for the local plagues. The great potential of this country rapidly attracted the biggest farming companies of the world; they are all here, Americans, Asians, also some Portuguese, which came to develop large agriculture operations inside Brazil. It was cheap, still is. Depends with what we compare. Therefore, Brazil quickly became today the largest Soybean producer in the world. The same happened in Argentina, is now developing very fast in Paraguay the new discovery land, Venezuela is always a political problem although a country with great soil and clime potential. South America will keep leading the protein production in the next comings years. Maybe in another 10 or 20 years’ time, some Africa countries might also become important agriculture producers, but it depends of economic development this means also political stability, which is difficult to observe or predict."_t_17:22

The interviewee “C” has closer look in the logistics of the Soybeans trade operations. In Brazil like in many other countries, agriculture commodities trading business is dominated by the few world leaders in food commodities. These global companies established in Brazil are a market leader in the production of some of the grains varieties. The trade movements and operation of these global companies are very connected to the big logistics operations forward. For example, in the crop period, the big traders are looking to assure and buy the grains to secure the cargos of vessel programmed and scheduled in the port much before the harvest period. Farming companies are well acquainted with anticipated sales of the crop, cashing earlier, closing a price, securing the future cargo for the trade operator. Compromising partially, like 50 to 70 percent of the expected crop, the farmer company rarely is facing replacement of penalties if not delivering. Nonetheless, weather and tropical storms are sometimes challenging the mechanics of the agribusiness trade conducts, causing troubles for all.

As the world food commodities demand raises, the trade is increasing size of the cargos, the efficiency of the logistics requires the maximum value per ton. Vessels are getting bigger and looking along time, to reduce cost per metric ton of cargo. Vessel size is a critical factor on the level of cost per ton of cargo. Building larger vessels bring economies for the trade business, but also get more constrains to the logistics operations. The draft and the size of the vessel must accommodate with the depth and length of the birth in the terminal to lodge the operation. This evolution of the requirements for the maritime logistics operations new demands, periodically oblige the ports to invest upgrading their capabilities to adapt. Sometimes, over the limits, the logistics operators choose to change port.

> " (..) the vessel sizes are very important to make the shipment costs low. Trading with small vessels make no sense today. Especially when we are talking about intercontinental trading. Big vessels are the solution for reducing the cost per ton. So deep-water ports are essentially "_t_41:08

Discussing the trade business of food commodities, between South America and Europe, source professional “C” from his experience could immediately identify and glue to idea and opportunity to operate sooner the cargos of Brazil and Argentina in a southern port in Europe. From his experience, today traders are taking many cargos to specific destinations

in the world; Brazil is a big exporter for instance to China. However, in Europe, the main imports are made by the trading houses using their facilities in the ARA region.

> "(…) it makes all the sense for the south countries on Europe, Mediterranean markets and north Africa, to receive grains from southern origins, like Soybeans form Brazil, through a cargo split in a port in the south Europe. It has to be a deep-water port to allow big vessels, if not the advantage is lost with small vessels. Exporting Beans form Brazil, it makes all the sense to split the cargos sooner before ARA, to send a fraction of the tons in Mediterranean markets for instance."_t_16:27

The source deeply underlines the opportunity to split or change the logistics if infrastructures for grains could be used in a southern port, able to receive big vessels. The size of the vessel will oblige long births and deep-water ports. These requisites imposed by the economics of the logistics operations today in the food commodities intercontinental business.

> "A south Europe port with capacity to receive big vessels from Brazil could save great logistics costs when the final destinations are the south markets, north Africa, Middle East, Black Sea. This port must be able to handle the big bulk cargos vessels, minimum up to 150 K MT, meaning like 17 m draft. The type of cargo bulk vessels leaving South America are big load cargos, we are not sending small cargos, it is very expensive. Usually we are not sending a vessel 20.00 MT to Europe, not economical. Today less than a Panamax size makes no sense. Therefore, it needs large berths terminals and deep-water ports. This is the main constrain in the south ports of Europe." _t_14:10

Other factors also important in the logistics of food commodities are contributing to reinforce the idea of southern alternatives. Making the trip in shorter time is very important; the vessel is released earlier allowing more trips per year using the same investment and crew. In addition, the cargo will have a shorter carry-cost, the financial cost along the time of the operations, but also very significant is the risk exposure during the travelling period. In a week, a few days, or hours, the value of cargo can abruptly change its value. For good or worse. Historical moments showed how critical is the risks exposure to quoted commodities market. Hedging the cargo in “futures” financial markets is possible, difficult, costly sometimes expensive and reluctant if the market has no liquidity enough, or speculation is

high. By limiting and reducing the time of travel the cargo, traders are therefore reducing risk exposure, closing the gap end-to-end between the seller and the future buyer of the commodity. Ideally, a trader would choose to sell the cargo always in the exact moment of buying it, in this case the exposer risk disappears.

> "(…) time-to-market is very important for Soya. Financial costs are high, risk exposure is dramatic, or you have to have the capacity to hedge the trade until sold-out, which is not so easy especially when markets are unstable and liquidity gets scarce and expensive. Also in the point of view of quality, the beans, especially the Brazilian beans have high humidity, and heating (fermenting process of the cargo) is a very challenging problem"_t_15:30

Knowing well the trading operations in the Atlantic south to north movements of food commodities, the source reflects about the opportunity to establish a grains terminal in the Atlantic south Europe zone, outstandingly in Portugal. In his opinion, not only the shout America cargos will benefit from this opportunity, but also, it is very expectable that the African country might develop its Agriculture capabilities, as political and technologically the region is observing evolution. Many development ONGs are working in this continent, in the agriculture domain to bring and empower the populations of Africa, earlier to fight against hunger, but later, to use their agriculture capabilities for generation of profit.

> "An Atlantic port in Portugal would be ideal not only for the south America beans, also the corn, which are today probably the main leading commodities entering Europe from the south Atlantic gate. However, in the years to come, the Atlantic coast of Africa will become also exporting grains. Those countries have similar natural condition like Brazil to produce grains; agriculture is developing rapidly, not as fast as it could due the political instability and security deficiency. Nevertheless, in time, Africa will develop its Agriculture and will be supplying the world. As well as Brazil did. Once again is south origin towards Europe. Angola, Namibia, Uganda, Nigeria, many countries are being targeted by the agriculture farming industry. Most probably, once again like in Brazil, it will be the big industry players, the big world groups, developing the industrial farming. Else, local small farmers will take many years to emerge. They will have Government leaders, ONGs and political movements pro and against industrial agriculture, but in my opinion . . .this is business as usual."_t_17:58

Brazil farmers are already looking opportunities in the African countries, some already moved in some preliminary exploitations of opportunities. For sure, this is today a trend. The phenomena will increase the origin of food commodities in the south hemisphere.

> "Brazilian farmers are making the initial moves in Africa. Although there is still a lot of land surface to open in Brazil, the land in Africa is also available and became cheaper when compared with Brazil today, maybe the environment constrains are less restrict, Brazil became very administrative and bureaucratic regarding the large farming houses, especially when we are talking about opening new areas. Not necessarily deforesting, this is no longer possible today, for example, Amazonia is an important preserved and protected area. However, just for clearing vegetation, is very bureaucratic and time consuming. Some farmers and agri-consulting companies are moving in Africa, some are choosing Angola, Guinea or Mozambique, due to the common language between people of Brazil. Not always succeeding well, context difficulties are very powerful in Africa as we all know, but farmers are resilient by mind and formation. Soon the results will come. "_t_20:07

Recognizing and underlining the opportunity of an eventual new trade zone in the south Europe zone, convenient for commodities with origins in the south part of the globe, the conversation inflects to some reflections about the location, these are natural subsequent thoughts. The main entrance countries of the Mediterranean Sea area obviously in dispute. Not forgetting the North African countries, new economies, state controlled economies, some of them with rich oil resources, able to pay large state investments. Also this North Africa countries struggle on the food security problems, with deeper concerns. A strong port infrastructure for grains is also a strategic resource in this sense.

> "Portugal, Spain, or Italy could have this role for the south Europe. An alternative could maybe even the north Africa countries, Tunisia, Algeria, or Egypt if there would be political stability or local investment is such a terminal."_t_45:12

From Source C we can resume the subsequent table of variables and identify important structural places and ideas as follows:

Variable	Level 1	Level 2	Level 3	C	SP
1.0.0	***Grain facts***	***Grain facts***			
1.1.0		Grains moving south		5	X
1.2.0		Corn & Soya complex change		3	
1.3.0		Protein consumption raise		1	
1.4.0		Soya protein source		1	X
1.5.0		Seaborne trade evolution		3	
1.6.0		Port Systems evolution			
2.0.0	***EU Infrastructure***	***EU Infrastructure***			
2.1.0		ARA traditional ports		1	
2.2.0		New EU south hub		3	
3.0.0	***Efficiency Drivers***	***Efficiency Drivers***			
3.1.0		Logistics Cost		4	
3.2.0		Time to market		1	
3.3.0		Environment		4	
4.0.0	***Constrains***	***Constrains***			
4.1.0		Geopositioning			
4.1.1			Atlantic coast	5	
4.1.2			Mediterranean	2	
4.1.3			MENA		
4.1.4			Panama channel		
4.2.0		Port system			
4.2.1			Deep water	5	X
4.2.2			Port efficiency	1	
4.2.3			Services	1	
4.2.4			Intermodality		
4.2.5			Inland capacities		
5.0.0	***Value Model***	***Value Model***			
5.1.0		Infrastructures			
5.1.1			Deep water port	5	X
5.1.2			Grains transshipment	3	
5.1.3			Grains services	1	
5.1.4			Port efficiency	1	
5.1.5			Train, Roads, others		
5.1.6			Crushing Hub		
5.2.0		Strategy			
5.2.1			Eur South Atlantic Port	5	X
5.2.2			Portugal HUB	5	
5.2.3			Transshipment	4	
5.2.4			Geocentrality	1	
5.2.5			Med and MENA	1	
5.2.6			Hinterland Grains Industry		
5.2.7			Commodities Port Systems routes		
5.2.8			Concession Hypothetical scenario		

Table 30 - Variables count Content Analysis for source C

6.6.4 Case 4 - Source D – International grains logistics manager

The case 4, or Source D, is an experienced logistics manager in the grains and seeds domain in the Black Sea region. He worked in the recent years with important trading companies, and he is today working with some of the biggest trade houses of the world, in food commodities global trade. He is experienced in zones like Black Sea, and all the connecting ports and zones with that trade with the region. Closer countries important markets like Ukraine, Bulgaria, Moldova, Georgia, Turkey, Israel, Syria, Egypt and Italy; but also with distant zones like Middle East countries, North Africa, South America, Spain, Portugal, France, ARA zone, and others. This professional knows and visits many ports installations around the world, in the scope of his professional functions, duty calls and displacements. He has a strong experience in bulk logistics of food grains, upcoming from his extensive professional career with the major trading houses of the world.

Preparatory contacts and phone conversations took place along the first weeks of February 2020, preparing the interview, that took place in 15th February 2020. The preparation of the interview gave the information about objectives, the scope of the study, and the clear information of use and consent of the interview content gathered during the informal conversation, that also would be recorded for later processing in the study.

The table below resumes the information CV, the regional range of experience considered, and classification of the source D from the panel of interviews:

			Professional EXPERIENCES along it's carrier Classified - 1 to 10				
Interv	**Position / Organization / CV**	**Location**	Regional experience	Logistic	Port	Trade	Agro
D	Bunge cereals and bulk logistics manager in Romania; Ex-CerealCom international trader also supervising logistics global operations; working for ADM grains and seeds, project manager in Bulgaria. Graduated in management and logistics.	Sofia Bulgaria	Portugal, BlackSea, MENA	10	10	10	8

Table 31 - Description, region and experiences considered for source D

The discussion with the source D was taken in a welcoming, quiet moment and environment, allowed discussing and exchanging ideas about the main topics and entering in

details with some of the closer subjects to him. As expected, deeper insights were naturally exploited in subjects matching the professional profile of the source.

A general introduction to the initial findings about the growing trend of the agriculture production in southern counties accorded the common sense of the interviewer, from the experience himself has in the trading business. The main movements, flows of food commodities cargos around the world, are not a novel story for this source, he knows and appraises the general logistics of grains and seeds from place to place in the world as a professional implicated in industry. Reinforcing the idea of growing agriculture in the south zones of the globe is the counter balance movement of inputs for agriculture. The interviewee referred to a well-known movement of fertilizers for the south hemisphere that is a pure consequence of the agriculture growth in the zone, the relatively recent developments, of the seeds production in this region of the globe.

> "(…) it is clear that we observed a displacement of the agriculture production for the south, also the consumption raised in the south part of the globe, essentially in Latin America, Brazil and Argentina. The logistics movements shows that, the fertilizers are moving to the production areas in south America" 1:15

Recognizing the agriculture development of the southern countries in the recent decades, also led the interviewee to discuss about the opportunity taken by the South America countries to develop theirs cultures oriented to the soybeans production. These grains are nowadays an important and valuable crop for the developed countries, positioned to stream the value chain towards the meat production, supplying a rich vegetable protein, and oil, essentials for the feed industry to prepare rich compounds, with great economical value and high conversation rate for the meat industry.

> "(…) the consumption of corn and maize, for the meet production has been replaced by the protein seeds; in Latin America they have good weather conditions to grow these crops. And I believe this tendency still keeps growing in the next years."_3:01

The conversation always had focus on the logistics operations, as in the interviewee worldwide vision and expertize. The phenomena of the recent decades increase of protein

source in the south American continent is thriving, reflected in the seaborne logistics between these continents and the rest of the blocks of the world. Asia, Europe, Africa are the natural destinations of the protein exported from South America. The tendency for bigger cargos along time accompanied the production and consumption raise verified along the last decades. In Europe consumption of feed protein, that knew a strong increase in the past decades, after bringing large vessels from South America, and the distribution for the feeding industry performs inside the continent and along the European coast, bringing also cargo to other outside destinations. ARA region ports and Hamburg are well known exporters of protein, but its origin is the transshipment of cargo from USA and South America essentially.

Discussing and reflecting deeply about the opportunity for the transshipment of these cargos, splitting to different destinations, in a southern port in Europe, source D is quite positive suggesting the efficiency gains of such an option. If a new terminal in the south Europe zone would allow goof storage and transshipment of grains and meals cargos, at least part of the vessels coming to north would divert its cargos early, partially avoiding longer transportation to the north ports of Europe. The idea makes all the sense, but requires deeper analysis of the opportunity and feasibility of the size of the operation, in the end if the traders and logistics operators find a gain in this option, it will be pursued.

> "As lower we could break the cargo and distribute, more efficient would be the transaction. In addition, it would improve the transformation industry locally. "_t_15:10

The logistics operation is always looking for efficiency, on the vessels type, cargos sizes, port operations, storage facilities, and other factors. International commodities trade is every day more complex, professional, information is flowing very fast, markets move fast and are very volatile. Financial speculation in futures markets are not driving logistics. Logistics world take care of the physics of the grains, the real material grains and seeds, from one origin place to other destination market. However, these future markets and the speculation on the quotes and prices are conditioning the margins and the trade leads a lot, obliging the logistics to become more elastic, fast responsive, quicker reactive, and more cost efficient. The logistics cost discount the price for a market origin-destination. For example, the

price of the wheat in ARA is today 200 USD MT, so the price in Lisbon discounts (selling) or increases (buying) around 25 USD per MT, which is the cost of logistics in a Handy vessel between Rotterdam and Lisbon. Traders are always looking for the best way to bring cargos. In some regions, they have options and look for the best one, choosing between maritime, river barges, trains or trucks. The world trade relies on the logistics capabilities to interconnect the markets.

> "Commodities grains and seeds are very standard cargos, they can travel with many different operators in standard conditions, and the logistics market needs to be very competitive. We always need to keep the total cost as low as possible. This will affect the commodity price, and we need to make it more accessible. Price of logistics is very dependable of two main factors distance and combustibles price, quotations are per ton, so size matters. "_3:32

Size matters, the vessel size decreases the cost per ton. Of course, bigger cargos oblige transshipment operations splitting the merchandize for smaller ports and markets. The economy of the overall operation will rule the choice and determine the best cost to contract the operation. IN transshipment of bulk grains, the operator always calculates small cargo losses, operations time, and cost of the discharge-storage-charge operation. Nevertheless, if the vessel cost allows fit-in the transshipment total operation cost, this is not the sole driver, but probably it will be the best option in many cases.

> "(…) a Panamax vessel from South America may bring a cargo at 10 to 15 usd/Mton and carry around 80.000 tons, a Handy vessel may cost 3 times plus or more, carrying one fourth of the cargo, in medium terms. Of course, at massive commodities markets, very standardized, considering also that there is continuous demand from Europe, the idea of efficiency brought bigger vessels, and keeps growing. The ports are also continuous adapting to bigger size vessels"_4:40

The interviewee D has large experience in trading cargos and managing logistics contracts with ARA region origins. The ports in the north are intensely charged. Waiting times are sometimes very costly for the ship handlers that reflect on the cargo logistics operation that will later reflect on the commodity availability cost. It is well known the phenomena between the traders, industry cannot stop. Milling or crushing plants are continuous process

factories and need continuous feeding of cargo. Large units have enormous costs to restart, if they stop. Their internal stocks are at certain moment of critical levels for a few hours or days. When ports are blocking for any congestion causes, whether technical causes, long time strikes, ice, storms, or other impediments to discharge, the commodity prices straightaway slope bullish.

> "A typical protein soya cargo coming from south America, going north ports of ARA / Hamburg, face not only the sailing time to the north, about 5 or 6 days more, but also we know to reach ARA ports vessels face strong and long congestions, that obliges to wait sometimes several days to discharge. In addition, in winter bad weather makes it worse. A south port, no congestion, with nicer weather, would be great choice"_15:17

A grain terminal is today a very sophisticated installation, high investment that must be profitable having a high turn rate of the capacity. For example, a 200 KMT terminal should make minimum 2 M MT operations to pay the investment and operational costs. It must be very efficient.

> "Ports tend to be specialized, terminals equipped for specific cargos, inbound and out-bound ports, and the logistics looks for maximum eficiency"_4:50

Source D is a specialist in the Black Sea regional and Constanta port, the leading Port in the Black Sea. Since he knows Constanta port, in the last 15 years, it is now the 4th big specialized grain silo and terminal in operation in Constanta. Before it was only the old after-war period silo with 40 K MT. All of these terminals built and operated in joint maneuvers between big traders and logistics port operators. In total, the port has already over passed the 1 Million MT storage capacity, having a trade like 15 Million tons per year in 2020.

Many new big transformation operations, in the down-stream industry, are looking to connect to the port, directly with conveyors or pipes, or by train rail-cars. In his experience in Constanta ports, the cargo uses a panoply of transport means interconnecting to the terminals. Interoperations of transports is very important in modern logistics, for efficiency, cost and time of the operations must be optimized. Today you might reach the terminal with the commodities coming from trucks, rail cars, silo storage, barges, and all at the same time,

filling with maize a Panamax bulk carrier in 7 days. The same to unload it, depending on the cargos commodities.

> "(…) the big cargos are diverted to smaller vessels, trains, road transports, or feed by pipeline or conveyors directly to the inland industry _4:50

From experiences in Portugal, and knowing Sines infrastructure, there is still a lot of the infrastructure network to develop, in his opinion. The port of Sines was not for general cargo, food commodities, or even containers. It was built and equipped for energy. Coal, oil and gaz. The food commodities are merchandizes not fitting today in this infrastructure. The idea makes sense, as a principal, but it would have to be well equipped, investments costs money, it must be profitable.

> "I presume, one serious problem of Sines is the lack of a good and efficient train infreastructure"_14:18

Knowing very well the central market place of ARA ports for food commodities, the interviewee had large experience in trade operations with these destinations, especially exporting cereals like wheat, maize, barley, also oil seeds like sunflower or rapeseed, from the Black Sea. In the main food commodities imports we can see Soybeans and Soymeal. Also these terminals are today making transshipment and joining cargos on the black see region to occidental or Mediterranean ports. For example, it is common to join wheat from Russia and Ukraine, with Romanian wheat to deliver in ARA. Or sunflower from Ukraine and Romania to deliver in Egypt.

Ports are the operational arms of the international trader movements, and reversely, they can affect the trading opportunity, making the trade operations possible or impossible. Therefore, the ports logistics capabilities have to adept according the best suitable operations for the markets. It is a fact, in the last decades the south markets developed in Atlantic zone, Mediterranean and North Africa zone. We are no longer looking only around Berlin and Paris. The consumption and the markets developed everywhere.

"(…) we can easily understand the ports of ARA are close to the central Europe, big cities, dense populations, existing historical industry. The big ports developed were there are big consumption centers. So central Europe is obvious a big traditional consumption center. But life changes, and logistics looks for efficiency and many other big cities and industrial centers developed around the Mediterranean, North Africa, East Europe, MENA, everywhere there are now industry and production clamming commodities at good prices"_7:47

During the interview, source D shared some experiences in the past that could illustrate the opportunity of transshipment in the south zone of Europe. The operation was made with crude vegetable oils for Biodiesel, but in any case, could illustrate the efficiency gains for the operations of transshipment in the south of Europe.

"Some years ago, I already experienced to displace the transshipment of cargos from South America to South Spain to bring smaller vessels to Constanta. We made this for the biofuels, because it was a clear logistics advantage. In addition, time to market was very important. I do not remember doing this with protein grains; I believe the small grain terminals in the south Europe ports are not so available to allow this kind of operations. In the biofuels business we have lots of tanks, no problem to find space somewhere."_10:12

Knowing the protein and oil market in Europe and in the world, with many years of experience, the source D stated his clear opinion about the opportunity to develop the future of down-stream operation in the sector he knows well. The protein sector, crushing oils seeds, like sunflower, rapeseed or soybeans, produce vegetable oils or meals. The oils follow the chain to edible refined oils, or to technical oils, for painting industry or biodiesel refining and transterification, among other uses. The meals, the solid part of the seeds that remains after oils extraction, converts its protein content trough the feed industry, to produce animal meat. In his opinion, having a grains terminal, rapidly the transformation industry would come to place, using the advantage of the port proximity to access in better conditions the raw materials for food products.

"An oil and meal extractor factory is obviously there in the future. The trade operations will have more options if there is soya meal in the complex. Where there is a Soybean port you have closer an extraction operation, to convert meal

> for the local feeding industry but also to re-export on the port, we know many examples where this is as such."_t_22:15

The operation could start based on the transshipment of big cargos. This would be essential to justify the investment and sustain the operation in the near future. Progressively, in medium term, the industrial investments would come «to benefit the proximity of the grains port terminal, allowing strong economies in the down-stream industry of the food and feed value chain.

> "(…) the big cargos divert to smaller vessels, trains, road transports, or feed by pipeline or conveyors directly to the inland industry _4:50

Having experienced the imports of protein cargos from the north Europe to Black Sea, the source D can easily foresee the advantage of an operation made sooner in the European south coast, or Mediterranean entrance has hi experienced already. Time to market, and distance flow of the cargo are lost in the operation.

> I have the experience of trading in the Black Sea, were cargos from Latin America are going in the North Sea in a Panamax, discharging, and then smaller handy vessels are bringing the merchandize to the black sea. However, comparing with a transshipment in Portugal or south Spain, we could save 4 or 5 days of a Panamax going up, and then the same 4 or 5 days of a Handy coming down carrying the same commodities. The cost is enormous; we can estimate an impact of 10% or more in the cost of the commodity. So it makes all the sense to avoid it diverting and making the transshipment sooner in the south to serve the Med and East region of Europe and North Africa."_7:20

The interviewee observes the prospect of building a new grains terminal, for large cargos, oriented towards the trade and transshipment of grains and seeds. An opportunity that could interest any large commodities trader or operator in the market. Knowing from his experiences previous developments cases in several ports, the concession scenario could be the best way to test the chance and eventually validate the project.

> "I'm positive, not sure, but if a south port would launch a tender for a grain terminal in the South Europe, from the big trading houses, ABCD, ADM, Bunge,

> Cargill, Dreyfous, one or more of them would be for sure interested to take the position. I presume they would compete to get the position before the others. If this opportunity comes to reality, they will go there for sure."_10:50

Portugal had an historical role in the transshipment operation from South America to Europe. The geo-positioning south West Atlantic, of the Portuguese territory and its territories insulars in the Atlantic sea, give an exceptional advantage as a platform in the role of distributing cargo to north and Mediterranean European Ports.

> "(…) in the 17th century we had this platform, making the Atlantic distribution from the south continents and Europe countries, it was in Azores. The port of Praia da Victoria in Azores had a transshipment vocation between Brazil and several destinies in Europe. Facing by then other type of problems, the old vessels would stop, in long distance journeys, searching for basic needs like water and fresh food for the crew. Today vessels can sail long distances without problems. Today makes sense in the south Europe, Iberia, maybe Sines. I am sure this is not happening now because there are no infrastructures in the south to serve these operations for grains"_11:50

In an analysis discussion, projecting the idea of a southern port in Europe, having Sines as a potential landmark for this purpose, the interviewee showed complete faithfulness to the idea of concession the opportunity of a grains terminal in the port. This mechanism would let the market operators to come to the tender and show the potential interest in the infrastructure. Whether or not it would be economical interesting, the Port authority would not take the risk; either would engage its role in an activity that is today very specific, technically very complex and developed, were investments are also substantial. Convinced that the opportunity will make a business case, it has the potential to interest eventual private operators, the launch of a scenario concession being the most practical way to redeem the doubts of the problem.

> "(…) it makes all the sense to consider a distribution, making the transshipment of protein in the south Europe and Mediterranean. In fact, I wonder why this did not occur so far? Makes all the sense. Probably because that the countries that could be potentially more positioned geographically to make this transshipment of grains in the south of the continent, are Portugal or Spain, and their strategies

are not focused in food commodities as the norther ports are from long time, with strong tradition. "_6:10

From Source D, we can resume the subsequent table of variables and identify important structural places and ideas as follows:

Variable	Level 1	Level 2	Level 3	C	SP
1.0.0	***Grain facts***	***Grain facts***			
1.1.0		Grains moving south		1	X
1.2.0		Corn & Soya complex change		1	X
1.3.0		Protein consumption raise		0	
1.4.0		Soya protein source		0	
1.5.0		Seaborne trade evolution		0	
1.6.0		Port Systems evolution		0	
2.0.0	***EU Infrastructure***	***EU Infrastructure***			
2.1.0		ARA traditional ports		0	
2.2.0		New EU south hub		1	X
3.0.0	***Efficiency Drivers***	***Efficiency Drivers***			
3.1.0		Logistics Cost		1	X
3.2.0		Time to market		1	
3.3.0		Environment		0	
4.0.0	***Constrains***	***Constrains***			
4.1.0		Geopositioning			
4.1.1			Atlantic coast	1	X
4.1.2			Mediterranean	1	X
4.1.3			MENA	0	
4.1.4			Panama channel	0	
4.2.0		Port system			
4.2.1			Deep water	1	X
4.2.2			Port efficiency	1	
4.2.3			Services	1	X
4.2.4			Intermodality	1	
4.2.5			Inland capacities	1	
5.0.0	***Value Model***	***Value Model***			
5.1.0		Infrastructures			
5.1.1			Deep water port	1	X
5.1.2			Grains transshipment	1	X
5.1.3			Grains services	1	X
5.1.4			Port Efficiency	1	
5.1.5			Train, Roads, others	0	
5.1.6			Crushing Hub	2	X
5.2.0		Strategy			
5.2.1			Eur South Atlantic Port	2	X
5.2.2			Portugal HUB	1	
5.2.3			Transshipment	1	X

5.2.4		Geocentrality	0	
5.2.5		Med and MENA	0	
5.2.6		Hinterland Grains Industry	0	
5.2.7		Commodities Port Systems routes	1	
5.2.8		Concession Hypothetical scenario	2	X

Table 32 - Variables count Content Analysis for source D

6.6.5 Case 5 - Source F – Head of trade and global risk manager

Case 5, or Source F, is an international commodities experienced trader and risk exposure manager in the grains, oils and combustibles domains, having experienced markets in several continents, Central Europe, Med, Brazil, Africa, Black Sea region. Worked as market analyst and risk manager in relevant financial institutions. Later for more than 10 years, focused on the international commodities trade, and its risk management. Today he is the head of international commodities purchase in an important energy group.

Contacts and phone conversations where initiated along the first weeks June 2020, preparing the interview, that took place in 21th June 2020. The preparation of the interview gave the information about objectives, the scope of the study, and the clear information of use and consent of the interview content gathered during the informal conversation, that also would be recorded for later processing in the study.

The table below resumes the information CV, the regional range of experience considered, and classification of the source F from the panel of interviews:

			Professional EXPERIENCES along it's carrier Classified - 1 to 10				
Interv	**Position / Organization / CV**	**Location**	Regional experience	Logistic	Port	Trade	Agro
F	Prio Foods - Head of the Global Trading & Risk Management Desk with the responsibility for Commodity and Foreign Currency Exposures of the company worldwide. Graduated in Economics	Portugal	World, Europe, Black Sea	8	10	10	10

Table 33 - Description, region and experiences considered for source F

The conversation interview with the source F was taken in a welcoming, quiet moment and environment, allowed discussing and exchanging ideas about the main topics. The source is by professional formation very engaged with research subjects and markets knowledge and intelligence. The theme proposed in discussion motivated a more profound reading of the

interview, even after the interview concluded, in the following days, the exchange of information and phone discussions showed the deep interest that the conversion opened to this source, being a professional in commodities market with long years of analysis and experience of trade knowledge. Several interviewees came in contact for later information's and follow-ups, but interview source F was a singular case among all other interviews.

The initial part of the conversation, dedicated in the grains production findings of this research project, intended to initial center the discussion around the agriculture production and its overall evolution in the past decades. Source F also shared his thoughts and convictions about the movement to south of the agriculture production worldwide. The agriculture development the south countries of the global is a recognized fact, sustained by the introduction of technology in the agriculture processes and the overture of new farmland areas. The interview reinforced the importance of this production raise to sustain the food demand observed in the global, demanded by population raise and higher demand in food and especial in meat protein.

> "In the past decades, we all know how food consumption raised in the world. The northern traditional economies, hold countries, could no expand its agriculture areas. Therefore, two main drivers supported this consumption raise: the escalation in the yields, meaning the production increase per hectare; also the new geographies for agriculture, mainly the southern hemisphere countries, where land was not so much used in agriculture production and technologies were basic. In these past decades, industrial agriculture entered in many southern countries, leaded by northern farmers, creating what is today an endogenous developed agriculture industry in these countries. So, the consumption pulled by the northern countries was prompt replied by the development of the agriculture in the southern countries. This scenario strongly contributed to developed the trade an increasing seaborne grain movements south-north as much as far as we know in these past decades. Moreover, we are glad that in deed happened, otherwise the world would starve"_t_4:29

Population rise and in forty years doubled. This made the demand for food, which rapidly increase of the agriculture production quantities influenced. To reply to bigger volumes demand, the industry observed the volume raise of many factors in all the activities. High demand required bigger volumes traded, lead to big vessels, more efficient logistics operations developed to respond to the demand.

"(…) today Brazil is exporting a lot of soybeans to Europe, but the main destination market is China. To move huge quantities makes sense to enlarge the vessels and take it more efficient. In the end, is always the market leading the operational choice. In the recent decades, we observed the progressively enlargement of the cargos, also bigger trade leads made this increase, sometimes joining farmers that are competitors to complete a cargo for this world market. Size became huge in relation to food commodities cargos. I imagine in the 70´s no one would think of buying a 200.000 M tons vessel of corn, when bulk vessels were 10 or 20.000 tons cargo capacity. Today is just normal"_t_19:11

The conversation with source F diverted along many themes of the food commodities trade world, the interviewee beign very experienced and knowing well the grains and seeds trade industry, due to the fact he worked closely with many of the world companies leaders in food commodities like Bunge, Cargill, ADM, Dreyfus, COFCO, and others. Many aspects already focused on discussion about the agriculture evolution facts, the trade infrastructures and logistics evolution phenomena were reinforced by his vision and experience of the professional activity.

The opportunity to make in Portugal a southern terminal for Europe makes sense, Sines having good natural conditions, and the geoposicioning of the port seeming excellent, as an entrance door of Europe for cargos originated in the southern hemisphere. Cargos that need to be spited in bulk for Mediterranean ports, or brake-bulk for other destinations like Africa, the port can easily provide services to international trade operations with advantage of the northern ports due to its proximity. Saves time, many resources, money.

At the moment Sines has no attraction for grains and seeds. There is nothing to attract operations to discharge. There is no consumption, no industry to use grains and seeds. To start just the transshipment operations could be considered in Sines. Having grains and seeds on the port, the natural use of the raw materials in preferred conditions would make later the transformation industry to come. Most probably, facilities to make transshipment of cargos would develop the industry later.

"Sines inland does not work by now; there is not consumption in the next future. Receiving a big vessel of grains would have to be predestined to split and make transshipment of the load in smaller vessels, to be distributed along the Mediterranean markets. Some cargo, a smaller part, by road for proximity consumption, or train for Spain or France"_t_17:41

From his experience, there are context costs that make Portugal not a preferred destination by now. This would have to change and is always expected that services improve and become more efficient and competitive with large volume of operations.

Port services, costs and efficiencies are very important factors to attract logistics operations in such international competitive market. Sines has a very strong argument of its geographical position, moreover, an envious deep-water collection of quays, beign by now a port with good availability, without accumulations.

> "(…) there are cost of fees were Portuguese ports are not at all competitive, but also there are context costs very important to consider. Services are scarce and limited. Example, recently we brought an operation of 100.000 M tons, were we proposed to make an operation ship-to-ship, in a Portuguese port was not possible, no technology available you had to make two transfers between land terminals, but in ARA we could easily do it, just booking a floating terminal in the internet."_t_20:21

Services, both from Port and specialized operators and services in the Port are critical to seaborne trade operations. Any delay in a vessel cargo or discharge operation implicates high costs of context that are many times are not reflected on the cargo price and have to be taken in loss by the trader or logistics operator. Choosing a port to operate is also a consequence of the attraction by modern and efficient services to the trading companies and ship owners.

> "(…) recently we have had an oil vessel waiting two weeks for a veterinary inspection, with very high costs. This is not reasonable and never happened in the ARA region. Today we compare the economic environment and services of the Portuguese ports and ARA with an image like the football district local league and the champions league"_t_30:24

For the attraction of a destination, the Port and its operations must be able to serve the operations with competitive and efficient services. It is true that operation get more diverse and efficient when big operating scenarios exist to sustain them. Opening a new

terminal in a new geographical place in Europe will cost to obtain traffic and convenient volume of operation to pay the investments and bring the maneuvers to a good efficiency level.

> "The traders will prefer always a flexible port environment, were you can get services to any problem occurred in operations, also you have liquidity in the spot market for the cargo, this is important and a new port in the south has to fight against this desadvantages"_t_22:27

The option for an alternative port in the south of Europe is a position of comfort to cargos that may avoid to go in the north region to be diverted.

Especially in food commodities trade, time is critical. Not only because of financial reasons, carry cost and exposures risk that is critical in period of volatility of the commodities quotes, cargo conditions being particular critical in cereals and oil seeds. The grains and seeds are living organic elements, which keep alive during the transfers operations, keep transforming them self and are very sensible. Initial characteristics degrade along the trips, caused by consummation to sustain their lives, notably protein content reduces along time. Not less important, in the presence of humidity severe damages may be caused to the cargo, producing losses and value degradation, sometimes even total loss may be considered.

> "time to market is very important in cargos like commodities, due to the perishability of the commodities also due to financial resasons"_t_32:30

But the eventual terminal for handling grains and seeds cargos in Sines is seen as excellent opportunity, considered by its natural conditions.

> "the port of Sines is an asset of excellency, the geo position, and the natural deep water berths are excelent"_t_30:17

In addition, the opportunity to explore the quick response to Mediterranean, North Africa and its Occidental coast, Black Sea and MENA markets, is a niche opportunity. In some cases, ARA is already a long distance market place. For some especial “trade leads” in spot

markets, being a southern port with storage facilities, it could give quick response and shorter sailing time to destination, being a strong competitive advantage and value gain.

> "On the physics trade commodities market, the importance of the connections is very strong. Be able for rapidly bring to the port the cargo after commodities are traded. The liquidity of the trading operations, especially in spot markets are depending of the quick dispatch of the merchandize"_t_35:20

In a pure trade vision, the natural condition of Sines can bring value to the logistics operation, making the overall operation to become more competitive. The possible scenario can make sense. In his opinion, the model should follow a tender to choose the best operators, allowing two or more operators in competitive environment to generate efficiency and market competition. In his opinion, the possible scenario could interest, among others, the big traders and operators well known in the commodities world.

> "(…) if the new terminal of grains may be operated by some private concessionaires, in competition, for transshipment of bulk commodities, especially for the Mediterranean zone, also North Africa, this could be very interesting due to the geopositioning of the terminal in the south of Europe. A concession may be the way to accelerate this project; for sure, the big traders are interested if they are challenged to study the opportunity. For sure, any of the big world traders ABCD, maybe others also, are interested to evaluate this opportunity"_t_42:12

The competition scenario is ideal for the trading business. It opens opportunities, gives more efficiency and liquidity to the market.

> "ideally it would be interesting to have 2 or 3 independent silo facilities, that the trader could use to break bulk cargos in Sines to divert to euro Mediterranean region, north Africa, middle east and black Sea"_t_34:10

The positioning of a South port in Europe in the perspective of the trade is a relevant opportunity. The dimension and the time to ensure its operation break-even may be the cause of hesitation of possible investors. How much time it takes to start to have liquidity on such market. Maybe is just to transfer part of the north cargos, and that is it.

"Sines may serve very well the Mediterranean markets and MENA. It might be a good advantage in time to market and reduce financial costs"_t_23:53

Not knowing and assuming long time for the development of feed and food industry to justify a grains terminal in Sines, the interviewee considers that in a first stage, the terminal would have to be justified only by transshipment operations of breaking the big cargo vessels in smaller vessels. Again, the cost of the overall operation is the trigger to decide whether to do it, and related to the option of the north terminal in ARA. For the protein coming from South America, it is very obvious the gains for bringing the Soybeans or the Soymeal in Europe with large vessels and after to make the transshipment for smaller cargos with destinations to several proximity ports in Mediterranean, North Africa, MENA, Back Sea end points. However, the overall costs would have to pay the choice with advantage. Which seems feasible.

"(..) the privilege geo position of Sine to make the split of bulk commodities cargo, transshipment smaller cargos, seems to be of a great potential. It is important to get the terminals and the services to support the operations with modern and robust equipment"_t_30:40

There are other alternatives that can make this strategic approach also, in the entrance of the Mediterranean zone, South Spain or Italy, North Africa, are natural competitors to dispute this role in the commodities port services in south region of Europe Mediterranean, for grains services and distribution platform.

"I wonder if Sines is better than a middle center in Mediterranean zone, like Italy, Algeria, Malta, or Tunisia among others"_t_25:15

From his experience and vision, once a terminal of grains will exist, naturally the industrial activities on the down-stream will develop eventually. The advantage of the port proximity will trigger the industry leaders to place the transformation units. Whether to increase capacity in Europe, or just in periodical renovation of factories, locating or relocating closer to a port grains terminal, it makes a big advantage for the logistics of grains. Industry may just connect conveyors and trucks are no more needed. Again the port is an important asset for the industry, once products need to flow for inland markets, for which Sines is a far

origin, touching the Iberian and south Europe markets by road or train. Trough other type of cargos, container vessels or break-bulk cargos, international markets are on the door of the port.

> "(…) all the downstream activities related to food commodities may be developed. The activities may be developed but the hinterland market is poorer than ARA, very close to central Europe big market"_t_29:28

From Source F, we can resume the subsequent table of variables and identify important structural places and ideas as follows:

Variable	Level 1	Level 2	Level 3	F	SP
1.0.0	***Grain facts***	***Grain facts***			
1.1.0		Grains moving south		2	X
1.2.0		Corn & Soya complex change		1	X
1.3.0		Protein consumption raise		2	
1.4.0		Soya protein source		2	X
1.5.0		Seaborne trade evolution		0	
1.6.0		Port Systems evolution		0	
2.0.0	***EU Infrastructure***	***EU Infrastructure***			
2.1.0		ARA traditional ports		1	X
2.2.0		New EU south hub		1	
3.0.0	***Efficiency Drivers***	***Efficiency Drivers***			
3.1.0		Logistics Cost		2	X
3.2.0		Time to market		1	X
3.3.0		Environment		0	
4.0.0	***Constrains***	***Constrains***			
4.1.0		Geopositioning			
4.1.1			Atlantic coast	1	X
4.1.2			Mediterranean	1	
4.1.3			MENA	0	
4.1.4			Panama channel	0	
4.2.0		Port system			
4.2.1			Deep water	1	X
4.2.2			Port efficiency	2	
4.2.3			Services	3	X
4.2.4			Intermodality	1	
4.2.5			Inland capacities	2	
5.0.0	***Value Model***	***Value Model***			
5.1.0		Infrastructures			
5.1.1			Deep water port	2	
5.1.2			Grains transshipment	1	X
5.1.3			Grains services	2	

5.1.4		Port Efficiency	2	
5.1.5		Train, Roads, others	1	
5.1.6		Crushing Hub	1	
5.2.0	Strategy			
5.2.1		Eur South Atlantic Port	1	X
5.2.2		Portugal HUB	2	
5.2.3		Transshipment	3	
5.2.4		Geocentrality	1	
5.2.5		Med and MENA	2	
5.2.6		Hinterland Grains Industry	2	
5.2.7		Commodities Port Systems routes	3	X
5.2.8		Concession Hypothetical scenario	1	X

Table 34 - Variables count Content Analysis for source F

6.6.6 Case 6 – Source H – International trader, agri-business

Case 6, or Source H, is an international commodities experienced trader in varied sectors of the agribusiness. Master in Agriculture Production Engineering, he was a senior commodities trader at Prio Foods, Prio Extractie, Nutre Groupe, Bunge, today country manager of Ascenza for Romania, Bulgaria and Greece. In the different domains of activity, always in Agribusiness sector, the source H was in the last years located in Romania, having strong experience in several continents and markets like Central Europe, Med, North Africa, Middle East and Black Sea region.

Contacts and phone conversations where initiated along the first weeks February 2020, preparing the interview, that took place in 18th February 2020. The preparation of the interview gave the information about objectives, the scope of the study, and the clear information of use and consent of the interview content gathered during the informal conversation, that also would be recorded for later processing in the study.

The table below resumes the information CV, the regional range of experience considered, and classification of the source F from the panel of interviews:

			Professional EXPERIENCES along it's carrier Classified - 1 to 10				
Interv	**Position / Organization / CV**	**Location**	Regional experience	Logistic	Port	Trade	Agro
H	Actual CEO of Ascenza Romania, Agriculture chemicals supplier, Former Commodities trader of	Romania Bulgaria Greece	Portugal, BlackSea, MENA	6	6	10	10

	Prio Foods, Prio Extractie, Bunge. Graduated in Agriculture Engineering.						

Table 35 - Description, region and experiences considered for source H

The conversation interview with the source F was taken in a welcoming, quiet moment and environment, allowed discussing and exchanging ideas about the main topics. The interviewee started with the discussion of the geographical center of agriculture production tendency to south, in the past decades. The source H has large knowledge about this phenomena, so the organizations where he had direction responsibilities were deeply involved in agriculture production and trading operations in South America, providing assistance to operations and trading intensively with the filial companies in the region.

Several reasons explained the strong growth of the agriculture production in South America, also formulated by other interviewees, like the introduction of agro technology and the availability of land for extending new crop areas.

> "(…) definitely, the agriculture countries in the south, due the introduction and development of technology, even specific technology for their countries, I'm now working in the specialized sector of the fertilizers where specific compositions are adapted for the particular characteristics of the soils and cultures in the regions. The growth of the southern countries, especially in the last generation is higher than the global medium as on the north of the globe, where all the soils are taken, no more areas do expand agriculture"_t_7:37

However, he introduces another factor explaining the growth of the agriculture land in the South America. Europe region, like other countries, does not allow the use of transgenic seed for agriculture plantations. Soybeans are the explanation, becoming the most effective source of protein for meat production, having the highest conversion rate feed per kilo of meat, they are not so much productive in non-GMO varieties. American continents allow the use of GMO seeds, conformed by regulations farmers can use GOM and obtain far higher yields of production in their crops when compared with European farmers. In the past decades, meat demand raised in Europe, accordingly soya demanded also raised, market price triggered the America agriculture origins. They were the solution to sustain the meat feed industry and respond to the demand growth of vegetable protein.

"We have assisted of the South America growth in soya crops, due the opportunity to supply other countries and regions like in Europe, where meat consumption raised, and soya was not favorable to farm."_ t_05.47

The non-OGM regulation impediments in Europe also pushed the South America agriculture development, soya the protein base for feed became valuable, creating the opportunity for a lucrative crop development, sustaining the massive investments in deforesting and opening new crop areas in South America.

"Soya has the best conversion ratio for protein meet production; you need less grain to produce the same kilo of meet. Europe today is almost not producing soya, due to the OGM regulations in EU, which brings soya production to high costs, high incertitude in production, moving out the farmers from this production variety, making other type of field crops, like maize, other cereals or oils seeds." _ t_04.50

The population growth and at the same time the tendency for meat consumption increase were the base line for this trend. South America was a natural extension of soils from North America. Their farmers took the first move.

"We have faced in the past years, of a strong population growth, that have higher incomes to by special meat. Moreover, it is expected to grow much more in the next years to come, the tendency is bullish. To produce more meat, we need the protein source. " - t_01.20

Source H knows from extensive experience the international commodities trade logistics. Supported by seaborne traffic, in the last decades he observed an unequivocal escalation in the size of the vessels. Size and unit cost link together, as a rule, the size of the vessel grows, and the cots per carried ton diminishes.

"As bigger the size, less cost per ton of commodity trade cost. Size matters of course"_t_09.45

The topic discussion about ARA tradition as an entry port of protein in Europe had some new perspective. For source H, ARA has a very strong tradition in commodities trade. It is very attached to the hold “Matiff”, today Life CMA stock exchange of the main food commodities, reference of all trading activities in the world. ARA keeps the status of house of

the physical trades “delivered to ARA” or “at ARA ports”, expression of the day-to-day of any commodities trader. Of course, today, the electronic trading made the business goes global, and ARA is just a reference point to discount logistics, never the less its infrastructures for grains, and the existing industry in the surroundings of the ports, makes high concentration of cargos and trade in the region. To move and split part of this cargo, it has to be founded in cost advantage. This might be the case in a southern port in Europe.

> "The business is still based in this region by tradition links. Dutch traders had a strong presence in the world, this made ARA ports very strong destinations and trading origins of merchandizes, very appropriate to establish the business home. Today this origin has a global links in port systems due to trade tradition. Efficiency may be the driver to change the tradition"_t_13.05

No other strong arguments as the cost savings of the operations could justify other alternative ports to ARA. If it is less expensive, more competitive cargo, this makes the sense to evaluate and change the position.

> "(…) definitely is the overall cost that will determine the will of operators to invest in a new terminal facility no matter where."_t_21:05

Although the overall cost will be always the key issue to make decision change, other arguments can be present to justify another port, that comes with the merchandize to market sooner. Time to market is an important matter when we consider live cargo, like grains and seeds. Long time cruising in vessels, with high humidity and eventual heat exposer, is not good for grains cargos.

> "(…) soya gets hot in two senses, because it can in fact easily ferment and get rotten becoming a total loss, also soybeans quotations in stock exchange are very volatile especially after the crop seasons. Time to market is crucial to reduce risk and eventual losses, farmers and trade operators prefer to play safe and not speculate."_t_32:44

Getting “hot” was used in the sense of deterioration, by a fermentation process that can easily occur especial when humidity levels are above 13-14% becomes critical, conjugated with temperature levels. An ignition of fermentation might lead to deteriorate the cargo, and if not controlled in short time, in some cases might even get on fire.

In addition, getting “hot” is also an expression also used by traders, when a cargo is not sold, either “hedged” to cover the exposure risk, and if during the cargo displacement the market quotations are volatile, causing differential margins that might cause enormous profits or losses depending of the market movements.

Not only financial cost. Other factors can benefit from short sailing time of vessels delivering their cargos. It is an increasing concern, by operators and public opinion, also every day more regulated the emissions of transportation. Public opinion, politicians, institutions are regulating more and more. The concern is “How much carbon emission are in my lunch sandwich?”. The search to reduce emissions is feverous everywhere. If a southern port could discharge bigger vessels, earlier transship its cargo to smaller ports, also transfer part of the cargo to trains, and the final balance of emissions is reduced, this is important concern and counts in public opinion and institutions. Today emissions concerns are not only on carbon dioxide, but also on Sulphur affecting the sea life. SO2 characteristically emissions from vessels are pointed as a cause of seawater acidification, disturbing and damaging sea life. The subject is today strongly regulated international authorities, and up to year 2020 obliged ship-owners to make huge investments to reduce Sulphur emissions of the vessels, changing propellers from diesel to GNL or introducing scrubbers on the exhaustion lines of the vessel engines, one or the other, anyway heavy investments.

"Emissions concerns are not only focused in the CO2, but also the sulphur is now very trendy worry to sea life"_14.01

Looking for trade competitiveness, the logistics costs must be squeezed to the limits. Trade commodities markets work with very high volumes and very low margins. This means that if a south port in Europe can be operational and give advantage costs to the trading business, for sure, it will succeed. The overall cost of the operations is driving the preference in the end.

"The logistic efficiency is determinant in the commodities trade business. Those who do not care, will not survive, in commodities trade, we are talking of very narrows margins in very high volumes."_t_08.05

All citizen in Europe are paying the chicken meat more expensive if the logistics cost of the soya from Brazil is higher that it can be. These prices are clearly “indexed”. Chicken meat floats with soya price, that floats with logistics cost.

> "The impact in the cost of raw material commodities is determinant for the food industry chain in europe"_t_08.20

> "Here we are in face the logistics efficiency arithmetic’s, just that argument prevails, the driver is how much is the global cost per ton, this is obvious for the choice of the logistics solution"_t_09.19

The meat protein is breaded essentially from soymeal compounds, for Europe today mainly originated in America and especial South America. Moving the transshipment of this protein to south or simply discharging to southern industry earlier will bring cost savings to the logistic operation at least of part of the feed and food industry in southern Europe.

> "As a basic principal, as many miles the commodities travel, more expensive will be the operations. The Portuguese positioning difference to the north ports is not 5 days, is 10, because is going up and returning down with the same merchandize. The EU must think as a whole, the decisions must be technical, considering all factors costs, environment, time to market, hinterland impacts. It makes all the sense to evaluate, I would say, it should have already been evaluated, we are delayed. "_t_09.35_13.56_14.36

The efficiency of transshipment, to join or split cargos, make bigger vessels use for more efficiency, use ports installations more efficient. The efficiency of “port systems” conjugated with liners and specialized cargos, destinations, makes a complex offer of options that match a particular specialized cargo in a certain “logistics carrousel”.

> "Today transshipment, in port systems, makes routes more efficient. I can give real examples, where I am sending a container from Setubal to Rotterdam, and from Rotterdam to Constanta, being quicker and less expensive than moving it directly with a costal liner"_t_11.25

"(…) it is essential, to have lines connecting the destinations. I can give examples, where the interconnections with longer and distant ports might be more efficient than other alternatives"_t_12.10

Not anticipating any scenario, but convinced of the choice for better efficiency cost of the operations, source H considers that the concession of the opportunity to develop a grains terminal in Sines might be interesting for international trade operators.

"It is necessary to study (…) but foreseeing that with a more efficient logistics system I would better positioned for the success of the trade operations. Yes, I would candidate to the concession of a new terminal in the South of Europe. "_t_15.29

Transshipment in Portugal has historical routes. The source H referred to Lisbon commercial activity as a transshipment trade point from far destinations, splitting cargos, to various closer destinations, by land or short sea.

"For long time in history Lisbon port was one of the European most important ports, due to its geopositioning regarding especially the South American and Asia origins of the merchandizes. Moreover, from there the distribution was made to other countries. Wood, silk, pepper were some examples well known, the commodities by then. (...) from Portugal, you are close to South America, MENA by Mediterranean Sea, you can easily access India/China trough Suez channel, you are in front of Panama channel for the Pacific/Indic sea"_t_12.50_16.26

From Source H, we can resume the subsequent table of variables and identify important structural places and ideas as follows:

Variable	Level 1	Level 2	Level 3	H	SP
1.0.0	***Grain facts***	***Grain facts***			
1.1.0		Grains moving south		3	X
1.2.0		Corn & Soya complex change		2	
1.3.0		Protein consumption raise		3	
1.4.0		Soya protein source		2	X
1.5.0		Seaborne trade evolution		1	
1.6.0		Port Systems evolution		1	X
2.0.0	***EU Infrastructure***	***EU Infrastructure***			
2.1.0		ARA traditional ports		2	X
2.2.0		New EU south hub		1	

3.0.0	***Efficiency Drivers***	***Efficiency Drivers***			
3.1.0		Logistics Cost		0	
3.2.0		Time to market		1	X
3.3.0		Environment		3	
4.0.0	***Constrains***	***Constrains***			
64.1.0		Geopositioning			
4.1.1			Atlantic coast	1	
4.1.2			Mediterranean	2	
4.1.3			MENA	1	
4.1.4			Panama channel	1	
4.2.0		Port system			
4.2.1			Deep water	1	X
4.2.2			Port efficiency	1	
4.2.3			Services	0	
4.2.4			Intermodality	1	X
4.2.5			Inland capacities	1	
5.0.0	***Value Model***	***Value Model***			
5.1.0		Infrastructures			
5.1.1			Deep water port	1	X
5.1.2			Grains transshipment	1	
5.1.3			Grains services	1	
5.1.4			Port Efficiency	2	
5.1.5			Train, Roads, others	0	
5.1.6			Crushing Hub	1	
5.2.0		Strategy			
5.2.1			Eur South Atlantic Port	1	X
5.2.2			Portugal HUB	2	
5.2.3			Transshipment	1	X
5.2.4			Geocentrality	1	
5.2.5			Med and MENA	0	
5.2.6			Hinterland Grains Industry	1	
5.2.7			Commodities Port Systems routes	1	X
5.2.8			Concession Hypothetical scenario	1	X

Table 36 - Variables count Content Analysis for source H

6.6.7 Case 7 – Source I - International Senior Manager Agro-Industry

Case 7, or Source I, is an international Senior Manger working for long years in one of the biggest European agriculture and food groups. Experienced trader, industrial manager, CEO and General Manager in several agroindustry units of the group worldwide, taking decision and leading roles in different countries and regions in the world. Source I is an unique senior professional, with high level of experience and expertise in the agro business world. He

has many cumulative experiences in a long time career in the sector with the top world players. His experience covers markets in several continents, Central Europe, Med, Brazil, Africa, Black Sea region.

Contacts and phone conversations were initiated along the first weeks May 2020, preparing the interview, that took place in 21 May 2020. The preparation of the interview gave the information about objectives, the scope of the study, and the clear information of use and consent of the interview content gathered during the informal conversation, that also would be recorded for later processing in the study.

The table below resumes the information CV, the regional range of experience considered, and classification of the source F from the panel of interviews:

			Professional EXPERIENCES along it's carrier Classified - 1 to 10				
Interv	**Position / Organization / CV**	**Location**	Regional experience	Logistic	Port	Trade	Agro
I	CEO of Group Avril in North Africa and Maghreb region, former CEO responsible for EXPUR seeds extraction oils and Biodiesel, east Europe. Graduated in Engineering and Economics	Boston USA	USA, Europe, ME, North Africa, Med	10	8	10	10

Table 37 - Description, region and experiences considered for source I

The conversation interview with the source I was taken in a welcoming, quiet moment and environment, that allowed discussing and exchanging ideas about the main topics. The interview started with an explanatory introduction and vision of the prospective future of worldwide logistics, in a future scenario, using green technologies propelling, no crew, automated guided vessels by satellite. Although it might seem poetry, this might be not so far in the end. In any case, the base of this discussions problem, the grains and seeds, remains the same if humans keep eating bread and meat.

The introductory discussion also led us to the topic of the southern tendency of the agriculture production in the last decades. The source focused in Brazil geography, based on his life experience but the arguments are valid for the overall geography of the South America. Following the public opinion discussions on the globalization of food trade, industrialization of Agriculture, land grabbing, and other political topics on the public discussions trend, the interviewee got to practical terms "whether you like it or not… you have to eat… and otherwise food would not be enough"

> "Brazil and other south hemisphere countries developed their agriculture in the last 40 years. The introduction of technology was determinant, whether or not the message is friendly to public, it is the mechanization, chemicals and transgenic seeds that made the burst in Brazil and other south America countries"_t_10:09

The Soybean culture today largely spread in South America, got its roots in USA, the technological development of seeds, transgenic OGM seeds, more productive and resistant, are product of the North American technology research of institutes and companies. World leaders in OGM seeds supply are American companies well known. Public opinion and even many farmers may be “against” the power of these agro industrial mega companies, governing the seeds production all around the world. The question is that farmers look for productivity, to get more tons, and higher profits from their harvest. So today farmers also have no other alternatives unless using the technology available, otherwise, production will narrow, profits will fall. Again, the option follows the efficiency of the operation looking to maximize profit for the farmer.

> "Soybeans were introduced by Americans in Brazil, due to its water and hours of sun, this is important for the soybeans culture, and as it is the richest commodities known in protein content, it has the best conversion ration known, so the value raised as the meat consumption grew, in all the world demand soya to make meat"_t_13:22

Reflecting the size of seaborne trade vessels, the interviewee I diverted his reflection into a prospective futuristic scenario of redesigning the logistics technology based on new concept vessels, new technology, and ecofriendly. Size might be less important in these kind of scenarios.

> "Big cargos are cheaper per unite, this is the reality today with the technologies today. But does size still matter in a near future? Smaller, more flexible commodity handling capabilities and transformation of commodities into easily distributed consumer or wholesale channels may become more prevalent and desired by customers. In the future bulk vessel sizes, over time probably it is two converging lines and especially as electric driving force, hydrogen or wind power is incorporated into vessels propulsion technology, size becomes less important. In addition, there is the subject of, reduction of financial risk. Perhaps we can see a trend back to smaller vessels, smaller investments, smaller and more

> flexible handling. I believe Covid 19 will shift thinking back to a more conservative posture, and that will mean lowering capital immobility in commodity transactions."_t_10:13

But after this exploratory introduction about the world maritime logistics the interviewee I came to the reality with the expression “but let’s discuss the reality, and talk about seaborne trade as it is today, business as usual”. In any case, the source considers that the Covid pandemic we faced in 2020/21 will have strong effect in international business models and change the way logistics operates worldwide.

> "In post COVID19 world, shipping patterns, commodity flows, are likely to change dramatically. Food sourcing [raw materials] will shift from raw materials handling efficiencies, to access the agile food processing efficiencies. We are facing dramatic problems today with this pandemic. We are all learning for the future."_t_5:14

The southern movement of the agriculture is a recognized fact. Choosing new port for the food commodities logistics makes sense. Efficiency on the logistics is necessary. No doubt, the south port will be chosen if the efficiency of the operation is higher and costs are lower.

> "(…) makes all the sense to divert the cargos earlier than ARA, if there would be a transshipment port in the Atlantic, especially for the soya complex raw materials"_t_28:15

Nevertheless, the source I focused on the processing site. The efficiency must also be between the port and the transformation units make an “eco-system” that is making also a big part of the efficient system of food production.

> "The question will become, not just what port to use, or where to bring in commodities, but where will those commodities get processed. The idea is shrink the gap between commodity discharge, and commodity processing. Creating port handling and commodity processing eco-system is a potential development path"_t_35:10

A south hub in Portugal might be a great opportunity. It is not only a question of the logistics gains. There is more to consider, also the opportunity for the food industry that gets

the chain of the commodities processing. Portugal has a good safety and quality stand image, to attract major players in food industry to come to the port food cluster.

> "Trust in food processing safety, the competency of food processors, and “legitimizing” semi or fully prepared food items, becomes as important as source of the commodity itself. Portugal enjoys a high level of trust and competency, to serve as a gateway, in this respect, and is cost efficient vs ARA zone. Food processors will move closer to flexible ports. This means reducing inland movement of bulk items. Reducing the time that the commodity travels up the value chain will be emphasized."_t_22:55

The extracting (crushing) industry is a noticeable example of the immediate down-stream industry to complement the port food commodities terminal.

> "If there are soybeans in the port, then naturally the crushing units will come to convert the meal, use the oil to refine for Biodiesel or food grade, this will come naturally"_t_12:15

In the scenario of having a grains terminal in the south of Portugal, the food industry would then be attracted to place. The interviewee I focused on a particular strategy for Portugal to differentiate from ARA region. The inland industry should specialize and should be tailored to distinguish and bring value higher than from quantities, like ARA does.

> "Positioning Portugal as a high-quality, detail-orientated, safe, food processor or location to set up a food processing facility. This is a theme that goes with a standardized port intake, commodity-handling facility. I think Portugal can differentiate itself by pitching itself as sophisticated enough to handle complex food transformation missions, but small enough to be accessible to everyone, as a gateway into Europe. The idea is to receive a tailored service, from Portugal, as opposed to be just another customer, like in ARA, where you get lost in the crowd. "_t_42:50

The opportunity seams feasible, makes all the sense to study it deeper. Big trader houses will look for the grains terminal, big food industrial groups will look for the opportunity to be placed to the terminal in Portugal.

> "Makes all the sense to evaluate this opportunity to study alternative ports to ARA in the south"_t_15:15

From Source I, we can resume the subsequent table of variables and identify significant structural places and ideas as follows:

Variable	Level 1	Level 2	Level 3	I	SP
1.0.0	***Grain facts***	***Grain facts***			
1.1.0		Grains moving south		3	X
1.2.0		Corn & Soya complex change		4	
1.3.0		Protein consumption raise		3	
1.4.0		Soya protein source		5	
1.5.0		Seaborne trade evolution		3	X
1.6.0		Port Systems evolution		2	
2.0.0	***EU Infrastructure***	***EU Infrastructure***			
2.1.0		ARA traditional ports		5	
2.2.0		New EU south hub		3	
3.0.0	***Efficiency Drivers***	***Efficiency Drivers***			
3.1.0		Logistics Cost		4	
3.2.0		Time to market		6	
3.3.0		Environment		5	
4.0.0	***Constrains***	***Constrains***			
64.1.0		Geopositioning			
4.1.1			Atlantic coast	2	
4.1.2			Mediterranean	3	
4.1.3			MENA	1	
4.1.4			Panama channel	0	
4.2.0		Port system			
4.2.1			Deep water	4	
4.2.2			Port efficiency	6	
4.2.3			Services	4	
4.2.4			Intermodality	0	
4.2.5			Inland capacities	3	X
5.0.0	***Value Model***	***Value Model***			
5.1.0		Infrastructures			
5.1.1			Deep water port	0	
5.1.2			Grains transshipment	4	X
5.1.3			Grains services	2	
5.1.4			Port Efficiency	4	
5.1.5			Train, Roads, others	0	
5.1.6			Crushing Hub	2	X
5.2.0		Strategy			
5.2.1			Eur South Atlantic Port	2	X
5.2.2			Portugal HUB	3	X
5.2.3			Transshipment	2	
5.2.4			Geocentrality	1	
5.2.5			Med and MENA	1	

5.2.6		Hinterland Grains Industry	3	X
5.2.7		Commodities Port Systems routes	1	
5.2.8		Concession Hypothetical scenario	1	X

Table 38 - Variables count Content Analysis for source I

6.6.8 Case 8 – Source J - Senior International commodities trader

The case 8, or Source J, is a senior international trader, leading one of the Portuguese commodities trading houses in Lisbon. He is an experienced food commodity trader, knows very well the south and north Atlantic ports logistics for grains. Engineering base formation, multinational experiences, he is a leading trader in Portugal for commodities business. The company where source J is working is in close cooperation with major world commodities traders, experiencing cargo movements from different countries in the world to Portugal especially to the port of Lisbon, to the Trafaria grains terminal. He is experienced in zones like South America origination, Atlantic coast ports, Mediterranean and all the connecting ports and zones with that trade with the region. This professional knows and visits many ports installations around the world, in the scope of his professional functions, duty calls and displacements. He has a strong experience in bulk logistics of food grains, upcoming from his extensive professional career with the major trading houses of the world.

Preparatory contacts and phone conversations took place along the first weeks of February and March 2020, preparing the interview, that took place in 14th April 2020. The preparation of the interview gave the information about objectives, the scope of the study, and the clear information of use and consent of the interview content gathered during the informal conversation, that also would be recorded for later processing in the study.

The table below resumes the information CV, the regional range of experience considered, and classification of the source J from the panel of interviews:

			Professional EXPERIENCES along it's carrier Classified - 1 to 10				
Interv	**Position / Organization / CV**	**Location**	Regional experience	Logistic	Port	Trade	Agro
J	Key Account Manager of REAGRO, senior trader in food commodities in Portugal. Graduated in Economics and Engineering	Lisbon Portugal	Europe, Brazil, Med	9	10	10	10

Table 39 - Description, region and experiences considered for source J

The discussion with the source J took place in the main company office in Lisbon, in one of the city central avenues. A welcoming, quiet moment and environment, allowed discussing and exchanging ideas about the main topics and entering in details with some of the closer subjects to him. As expected, deeper insights were naturally exploited in subjects matching the professional profile of the interviewed source.

The discussion started with a general introduction and discussion about the foods commodities agriculture production evolution in the past decades, being the motivation trigger of the research and the initial elements to conduct the interview.

The source J has a long experience in agriculture commodities international trading, for more than one decade assisted to its evolution and movements, especially focused in the Portuguese and Atlantic trading of the protein. Protein is every day growing and more concentrated in the soya complex, both the beans and the meals, together with strong rise in the production and trade from South America countries.

> "Since I'm on the trading business, for more than 12 years, I could observe the significate growth and importance of the south America origins in the commodities business. Moreover, it keeps growing, in my opinion there is still a lot of potential for the Agriculture to grow in the south regions. Buy opposition, this is not possible in the north countries. So we are every day more dependent of trading and logistics of grains between countinents."_t_1:20

From his knowledge about international markets, source J observed that the calculation made to determine the moving average of the medium weighted latitude of the food commodities agriculture production, would be more expressive, meaning this latitude displacement value would represent more grades in its position to south. China in the last decade became a very strong producer, but also a very strong importer of soya. Meat consumption in China raised to sustain the growing demand for human food meat, raising the demand for animal feed of the livestock. The increasing household incomes of the Chinese population were largely contributing to this growing demand for meat and other animal based dairy products. Chine became in the last few decades a top producer of soya, but not being sufficient for internal consume, demand requests soybeans protein import in large volumes.

The latitude of China was considered in this research work, in chapter “5 - Southern evolution of world agriculture production latitude” as explained in the methodology previous chapter, as a concentration of the production in the latitude of the capital of country. This means in this case, Pequim (Beijing) latitude is 39 grades north. Being a north latitude and having a strong growth in the world context, this made the north hemisphere weighted more for this particular but very heavy country in the global perspective. The following research analyses the movements in the European Atlantic coast, Mediterranean areas, so the southern displacement along the year’s phenomena will be more emphasized if China would be retrieved from the global analysis of the agriculture production evolution for the area in focus Europe. The extraction of China figures would have a strong impact, bringing results that are more significant for the southern movement of agriculture grains production.

> "(…) for sure your results would be even more notorious if China would be excluded from your calculations. Because their production is for internal consumption, and is not sufficient, and their weight on production would bring the medium even more on south for the tradable production of the other countries. So I believe the real impact of this figures might be even more expressive in the movements of grains around the world"_t_3:15

The I interviewee also reflected on meat evolution in Europe. He is in strong relations with the animal feed industry, for which he daily trades protein, especially soya-based products, meals and beans, using the Lisbon gains terminal. It is true that in the past decades, traders houses could make the confirmation that the feed industry started to incorporate soya protein in the feed compound for meat, due to its high conversion ratio for the meat production efficiency. More meat, more kilos, and fewer costs per ton.

> "(…) one generation before the animal feed was conventional cereals. Today soya is ruling the feed for meat.” T_4:22

With strong relations to the feed compound producer’s purchasers, the interviewee testified that the industry knew strong evaluation, from a sector dominated by domestic small producers, towards a very modernized and industrial meat production sector. Large and international groups take care of the meat production and supply to the modern markets, due the high increasing demand. As we saw in the previous chapter “2.3 - Soybeans became the

source of protein for meat production", the source interviewed reinforced this finding from his trade experience.

> "Meat consumption raised in the last generations, this is for sure connected with the richness of the populations along with the economic growth, and this is a driver also for the search of better protein source to produce meat more efficient and cheaper"_t_5:56

The soya complex is composed by soybeans, soya meals, and soya oil, beign together interconnected in the international trading operations. Traders take care of the protein complex with a global view of solutions. The soybean weight incorporates less than 20% of oil, this means the business is focused in the meal, and it is the protein of the meal that makes the soybeans value economy driving the strategies of this commodity. In the crushing and extraction operation of the soybean, the meal is leading the operation and conducting the trade business. Soyameal market is oriented for animal feed, meat production. Meat production includes dairy products like milk, yogurt or cheese; similarly, fish farming feeding compounds are based in soya meal protein.

> "(…) there is a big capacity of extraction of protein from the gains is in ARA/Hamburg region. So currently feeding with soya is not the beans but the soya meal, which is coming from the north essentially. This is true with the beans coming from Brazil or EUA, but Argentina is exporting meal and not beans, due to the internal tax system."_t_7:00

Being the biggest producers of soybeans, the South American origin countries are leading the sources of soya complex products. Along with Brazil, this trader is experiencing growth opportunities with other South America continent countries, like Paraguay and Argentina. The big agriculture countries producing grains in South America continent represent a growing tendency in the protein origin for the trading international markets. The interviewee reinforced the awareness of this growing trend on its particular market origination sources.

> "South America is the important new source of protein for us. We in our company are mostly buying from Brazil, Paraguay, Argentina, only a part form New Orleans, EUA. This tendency is increasing as these countries are becoming more productive and trading is getting competitive"_t_31:36

The discussion took several themes in considerations around the efficiency of the logistics of the protein grains, from South America Ports, to European Ports. Always a consideration was present in the speech, in favor of the entrance in a south European port, traveling less time, reducing the trade operation interval, minimizing the risks of the operation, among others. The risks taken by several factors, exposure to markets, financial costs, trade opportunities, and grains conservation are immense. Special experiences with Brazil origin soya emphasize and remain a strong alert about the humidity levels of the grains, which have characteristically more high values than other countries. This particular characteristic poses conservation challenges to the trade and logistics operation that would risk losing its cargo, if not properly controlled. Commodities with high value of humidity could rapidly become deteriorated and irremediable lost, generating high losses. So it is very relevant to shorten as possible the period of transportation, and particularly the sea transportation, reducing risks of partial or loss of cargo.

> "(…) especially the Brazilian soya is harvested with high humidity. Drying is expensive, so the beans are traded in the limits high of the parameters; this is a risk for long time shipping operations."_t_13:15

In the vision of the source J, the idea of managing the complex of the protein in an integrated way is reinforced. It is true that the trading experience of this interviewee is very strong with the operators in the Lisbon Trafaria vegetable oils, refining and crushing, where all these operations are interconnected with the terminal. Here is where is a crushing capacity close by the port, the Trafaria edible oils complex of Sovena. Trading the complex altogether is a commercial advantage in his experience.

> "(…) crushing is essential in the protein trading transfers. You may trade the soya complex all together, so having the crushing ability in the operation is very important to create value, you buy beans, sell beans, meal or oil. We have advantage dealing the all complex together."_t_22:15

The role of the crushing unit in the protein complex international trading is very important. It would be a natural consequence. Whether planned from initial by the port authorities in the concession, or after, authorized by the pressure of the economical

operators using the terminal for protein. Traders would rapidly impose this need, as in his experience on the international protein trade operations.

> "Having the crushing capabilities in the Port is essential. The traders would take care of that immediately after"_t_22:30

Likewise, Trafira terminal, although limited to drafts of 12 to 14 mts depth, receiving up to 80.000, has today a micro regional role in transshipment of grains, intended to serve the industrial transformation units along the Tagus river, using grains and seeds. Milling industry, along Tagus, for example the well-known “Lisbon Beato” milling factories, these are inter-connected with the downstream food biscuits factories.

These transshipment operations, from Atlantic big vessels, Panamax or similar, to barges operation along the river, are efficient on the regional scale, showing the opportunity to develop further the model of these operations in the trade business of grains. Rarely, but demonstrating the efficiency of the operation, from this silo, some other Handy, smaller 12 to 20 K MT bulk vessel, carriers for distribution to other ports are being done from Trafaria SiloPor silo terminal. The limiting draft of 12 to 13 meters in the Tagus entrance, subject to the tide schedules and weather conditions is very limiting for this kind of operations.

> "(…) Europe, especially in the south ports is very limited to the allowed deep drafts in the ports. This is a big limitation for big vessels in the south ports in Europe in general. Trafaria in Lisbon, the Silopor project was a port terminal made for transshipment and not storage. Today the size and the draft is very limitative for this kind of international operations. Yes, vessels got bigger. If we would have more capacity of crushing and more storage, we could operate this role in Lisbon were we can receive only up to 80 or 90 thousand MT."_t_9:08

The possibility to grow the capacity in Portugal is seen as a great opportunity in this business. The interviewee having strong knowledge of the grains market, especially in the protein sector, identifies the role of Sines, as a potential alternative of Trafaria, but in large scale, allowing to operate international trade leads, large size vessels and large trades, what is today a limitation in Trafaria infrastructures.

> "Sines would be the great alternative today. Has capacity, draft, a geolocation of excellence, for shifting cargos would be ideal if there would be port storage capacity. However, now for the time being, just for transshipment, there is no

> crushing capacity. Having the hinterland space for industrial expansion, this is a clear opportunity for the port strategy. I agree, also looking for export of the cargos. Not for internal consumption, domestic sales would be minimal to justify these new investments, but for shifting cargos, especially to destinations along the Mediterranean and north Africa countries makes all the sense"_t_9:37

The vision of the interviewee appoints the industrial development opportunity in the downstream operation of the protein business. In his opinion, the economy of the operations will make the opportunity to bring the crushing operation of the soybean, producing meal and crude vegetable oil. The oil will attract the refining operations for edible oil, also subsequently the grease transformation sector like mayonnaise, ketchup, and other sauces, as well as soaps business, eventually mixing detergents, shampoos, and others once the port already have chemicals ingredients available. The Biodiesel has similarly opportunity, although today very regulated and focused on the recycling used oils. Nonetheless, is the feeding industry, that produces the animal feed for breading poultry, pork, cows and fish farming, and could benefit from the proximity of the port, as well as the meat industry together.

> "The transshipment of the protein is not only the soybeans, big part of it is the crushed beans, especially the meal for the feeding industry, the oils go for edible oils for food and part goes to biodiesel, but we always need the meal solid part from the beans, this is the main business of soya. So, in my opinion, if a terminal for transshipment of soybeans would make sense in Sines, immediately a crushing unit would be demanded by the feed industry"_t_11:11

The crushing industry converting the seeds into oils and meals seems a clear advantage for all the downstream trade business. Today this could be also one of the big attractions of the ARA and Hamburg ports for the protein, the soybeans industry transformation. The feed industry, making feeding compounds for cattle, is the major destination of the meals, which is at its turn the main sub product of the soybean. The protein chain is today very specialized, and industry is in clear value chain succession.

> "For feeding meat production, we need to receive from the north countries where the oil extraction is made today, there is a very strong crushing capacity installed in the north region of ARA and Hamburg that is crushing the seeds and producing the oils and meals that are serving the meat industry later. To bring this down to the south, also this crushing capacity should come to south to bring the meal and not the beans, for feeding compounds"_t_7:15

Knowing very well by professional experience the operations in ARA and Hamburg zones, the interviewee expresses his positive opinion about an alternative zone to make transship and process the grains and seeds complex. The ARA region is permanent congestioned, but an alternative zone with the advantage of being in the south could outclass the advantage of the north European facilities and compete with them. Especially when targeting the Mediterranean and North Africa markets, which are in a closest line distance, gaining critical time to market in the protein trading business.

> "This terminal should not be focused just in soybeans. In addition, the rapeseed or sunflower coming from the north, with destination to Mediterranean south countries, or North Africa destinations. This seeds have the opportunity to be crushed and sent for meat production in the south region of the Mediterranean countries, and North Africa. In direct competition with the role of the units in ARA ports region. This operation could bring more efficiency in many cases. I'm positive, in this case is the competitiveness of the industry and the ports that will rule, those should be efficient and gain the markets. Nevertheless, ARA ports and industry, although very efficient, are today very jamming in traffic and operations, there are bottlenecks everywhere we know. It is truth, this is an opportunity to take, complementing and offering an alternative processing zone for grains and seeds"_t_11:18

The source also sees the potential competition for this opportunity in the entrance of the Mediterranean Sea. The fastest mover would take the place and discourage any other investments in the region. The North Africa market represents important volumes in import of grains. It is an opportunity to share and divert big cargos that might be oversized for Europe market, in a certain time window period. This opportunity can be an advantage especially for a southern European Port, due to its proximity, splitting and diverting grains in short-see-shipping operations. In addition, we can look from Sines perspective, a cargo transshipment from Brazil, diverting partially to north of Spain and to north of Africa, would bring to Sines the advantage of its position. In any case, we have to look to North Africa as a relevant market today and in the future. It is an important market already today, still very centralized in the state control. Bu it is increasing in size and competitiveness, opening the state control of the Arab countries to private dynamic operators sharing a part of the population food demands.

" (…) a location between Spain/Italy might be strategic for the excess market quantities be diverted to north Africa"_t_8:30

Identifying the opportunity, the source J could immediately identify competitors to face in this challenge. Already some local and international players and operators, like in Trafaria Lisbon, are on the market. They will look for an alternative scenario for trading grains facilities, and particularly for transforming seeds into meals and oils, as an alternative and competitor installation site. Although market should be competitive and open, the players in the international commodities business are a few very big companies operation worldwide that might block such a project, using their powerful abilities and commercial liaisons between one and other.

"The opportunity exists, but it will face the competition of the big operators already installed in different parts. Might take some years. Bunge and Cargill have their extractors in Barcelona, and Bunge another extraction in Bilbao, but other players like ADM or Dreyfous could be very interested to mobilize their crushing capacity to south Europe also."_t_12:49

An oil extraction, crushing unit, is usually operating multigrain varieties, not staying dependent of seasonal activity, prices quotations, or episodically shortages for agriculture or natural reasons. The units usually are equipped for the oil extraction of the tow or more varieties of oils seeds, like soybeans, rapeseed, sunflower or others.

"(…) the opportunity of crushing in the south would also suffer the proximity of the north crusher to access the origination of sunflower and rapeseed in the central Europe, where France, Germany and others are delivering their seeds in ARA region for crushing. It is true part of the agriculture production is also close to south Europe, including Spain and Portugal, Iberia is also a big farming zone, although already partially served by these crushing plants in Bilbao and Barcelona, or Sovena in Lisbon, among others"_t_12:55

Sunflower, and particularly rapeseed, have north origins due to their better adaptation to north climate, and rain seasons. North region of the globe is strongly producing rapeseed and sunflower. Hypothetically, these commodities would be coming from north to be crushed in Sines. Especially for the destination of the meals, the sunflower meal, very appropriate for caprine cattle, lamb and goats, with high demand in the North African markets, could also position south Portugal units in advantage to other locations.

"In Portugal, a new investment could be focused just on the import of Soybeans coming from Brazil or Argentina, but this could be very exposed, depending on market quotations, there are moments were the crushing might be more interesting in other commodities like rapeseed or sunflower, and these are commodities from the north geographies. No limits to use them also in Sines, but here logic inverts from the original thought. There is a great source for this, today Europe is importing sunflower and rapeseed from Ukraine, and this is coming through Black Sea and Mediterranean Sea. It would have to fight against Italian and Spanish crushers before reaching Sines, but it is possible, Ukraine is a huge origin of seeds today, and other east ex-Ussr countries will come to it also"_t_13:21

The vegetable crude oils destination to Biodiesel could also benefit in Sine by the proximity of the petrochemical refining existing units. Producing combustibles, today demands mixing a Biodiesel incorporation percentage. The proximity to the petrochemical refinery is a clear advantage to the operations.

"Imagining also that a significate part of the vegetable oils market are intended to make biodiesel, having a strategic Bio oil refinery in Sines, it would make sense, very economical, to introduce and displace the Biodiesel refining production in the complex"_t_14:09

Potentially the Portuguese meat industry could benefit from this eventual opportunity to create in Sines a protein origin complex. Having the oils seeds earlier and closer to origin, especially in the cases where origin is South America. This would allow having seeds more competitive for the crushing operations. Having the extraction operation in the value chain, operating in the zone, immediately the feed industry would come to exploit the opportunity to the proximity of the grains and seeds terminal together with a crushing facility, producing feed more inexpensive. This would implement by far the meat industry that needs to reduce transportation costs to be competitive. Therefore, we could expect that in close Alentejo region, the farming and breading animal industry could rapidly develop having competitive factors to enable quick development in the hinterland of the region.

"Furthermore, the production of meat in Portugal would be beneficiary of stronger competitiveness. There is a lot of space to grow in the south region of Portugal, Alentejo, Portugal is crowded with meat production units in the central region, but we would gain strong advantage to explore new facilities or displace

the existing, in the Alentejo region. In the proximity with the extractor factories and the feed industry that rapidly would be installed around, if there were a serious grains terminal. This would make the meat producers more competitive. Portugal is today like 10% more expensive on the feed price due to road transports to center of the country, this makes no sense in modern industry. Alentejo would have than a very good opportunity also to produce meat"_t_15:20

From Source J, we can resume the subsequent table of variables and identify significant structural places and ideas as follows:

Variable	Level 1	Level 2	Level 3	J	SP
1.0.0	***Grain facts***	***Grain facts***			
1.1.0		Grains moving south		4	X
1.2.0		Corn & Soya complex change		3	X
1.3.0		Protein consumption raise		0	
1.4.0		Soya protein source		6	X
1.5.0		Seaborne trade evolution		3	X
1.6.0		Port Systems evolution		2	
2.0.0	***EU Infrastructure***	***EU Infrastructure***			
2.1.0		ARA traditional ports		6	X
2.2.0		New EU south hub		3	
3.0.0	***Efficiency Drivers***	***Efficiency Drivers***			
3.1.0		Logistics Cost		4	
3.2.0		Time to market		6	X
3.3.0		Environment		1	
4.0.0	***Constrains***	***Constrains***			
64.1.0		Geopositioning			
4.1.1			Atlantic coast	2	X
4.1.2			Mediterranean	3	
4.1.3			MENA	1	
4.1.4			Panama channel	3	
4.2.0		Port system			
4.2.1			Deep water	4	X
4.2.2			Port efficiency	1	X
4.2.3			Services	1	
4.2.4			Intermodality	2	
4.2.5			Inland capacities	5	X
5.0.0	***Value Model***	***Value Model***			
5.1.0		Infrastructures			
5.1.1			Deep water port	2	X
5.1.2			Grains transshipment	5	X
5.1.3			Grains services	5	

5.1.4		Port Efficiency	3	
5.1.5		Train, Roads, others	4	
5.1.6		Crushing Hub	5	X
5.2.0	Strategy			
5.2.1		Eur South Atlantic Port	5	
5.2.2		Portugal HUB	4	
5.2.3		Transshipment	3	X
5.2.4		Geocentrality	1	X
5.2.5		Med and MENA	1	
5.2.6		Hinterland Grains Industry	6	X
5.2.7		Commodities Port Systems routes	1	
5.2.8		Concession Hypothetical scenario	0	

Table 40 - Variables count Content Analysis for source j

6.6.9 Case 9 – Source K - Secretary of State of Maranhao Brazil, for Agriculture

The case 9, or Source K, is an Agriculture member in charge in the Government of the State of Maranhao, in Brazil. He is a high experienced farming engineer, with the first-hand experience of managing international agribusiness farming units, producing high volume of grains, soybeans and corn. During some years, also took in charge as Secretary General of the Association of Soya producers of the state of Maranhao, before being appointed as Vice Secretary of State for Agriculture, later on nominated Secretary of State of Agriculture.

A few preliminary contacts and phone conversations took place along the first two weeks of April 2020, preparing the interview, that took place in 24th April 2020. The preparation of the interview gave the information about objectives, the scope of the study, and the clear information of use and consent of the interview content gathered during the informal conversation, that also would be recorded for later processing in the study.

The table below resumes the information CV, the regional range of experience considered, and classification of the source B from the panel of interviews:

			Professional EXPERIENCES along it's carrier Classified - 1 to 10				
Interv	**Position / Organization / CV**	**Location**	Regional experience	Logistic	Port	Trade	Agro
K			Brazil	9	10	9	10

	Secretary of Agriculture in Governo Estadual of Maranhao – Brazil ; Former General Manager of the Soya Farmers Association; Agro Engineer; Others	Sao Luis Brazil					

Table 41 - Description, region and experiences considered for source K

The conversation with the source K was taken in friendly, peaceful moment and environment, allowed to discuss and exchange ideas about the main topics and enter in details with some of the closer subjects. The participant chose to discuss deeper some of the aspects, in particular the special role of the port of Itaqui in the exports of Brazil Soyabeans agriculture production business.

A general introduction to the initial findings about the growing trend of the agriculture in world were in total knowledge and inline, of the interviewee from his past and present experience in the Agriculture world.

To apprehend the especial interest of the source K, it is necessary to explain the importance of the region of Maranhao in the soya business in Brazil and consequently in South America.

The state of Maranhao, leaders an agriculture region called MAPITO, within the northeast Brazil country, the central zone. It is a terroir full of diversity and natural zones, rivers and agriculture is developing fast as the technology is adapting the seeds varieties to the specificity of the Maranhao climate. The agribusiness base is the soybean culture in all agriculture territories, balanced with a few corn, especially in the small second crop season “safrinha”, rarely others cereals. Mapito is grouping the sates of Maranhao, Piaui, and Tocantins having similar characteristics in forestation, soil and climate. Sometimes is called the north center region. The territory is particular important in the soya business export discussion, hence it is in Maranhao state, that one of the most modern facilities for soya export was established in 2013, the Tegran, the “terminal de grãos”, in Itaqui, the Port of Maranhao. Tegran is an important project, not only for the region of Mapito, but also for other states where the soya harvest has its highest volumes, the sates of Mato-grosso, Para, Goias, through the project “corredor centro norte” that interconnects these regions with the “VALE iron road” the railway corridor until the port of Itaqui, in Sao Luiz do Maranhao. We can see the main areas of the soya production and the interconnection with the Itaqui Port (Salin, 2020).

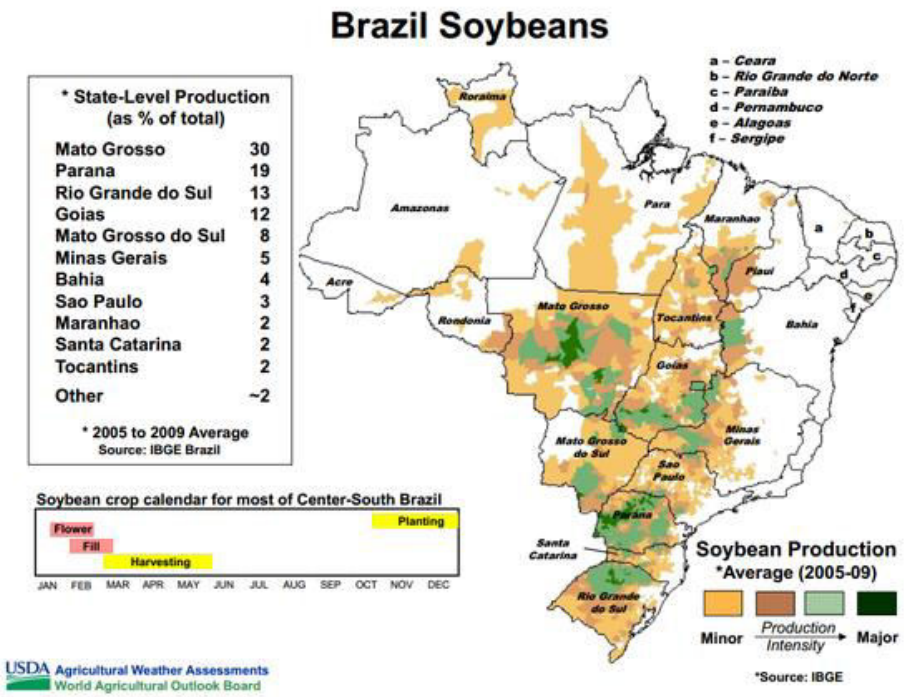


Figure 108 - Brazil soya culture regional distribution – source USDA

And the interconnection of these areas with the port of Itaqui using the existing infrastructure of the iron mining zone in north Maranhao and Para, the railway “Carajas” complementing the “north-south Ferrovia” recently completed to connect and in extension for south areas. These lines, allow the soybeans to reach the port more efficiently using the railway infrastructure, avoiding road transportation to reach the port.

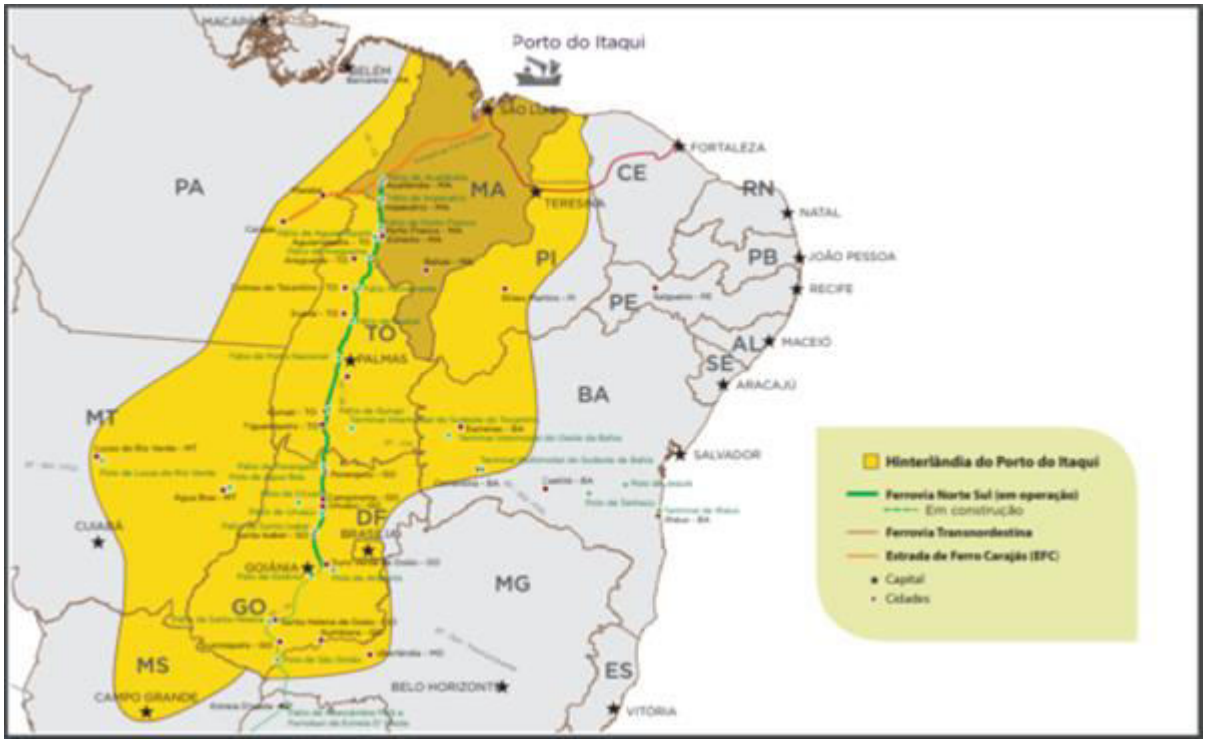


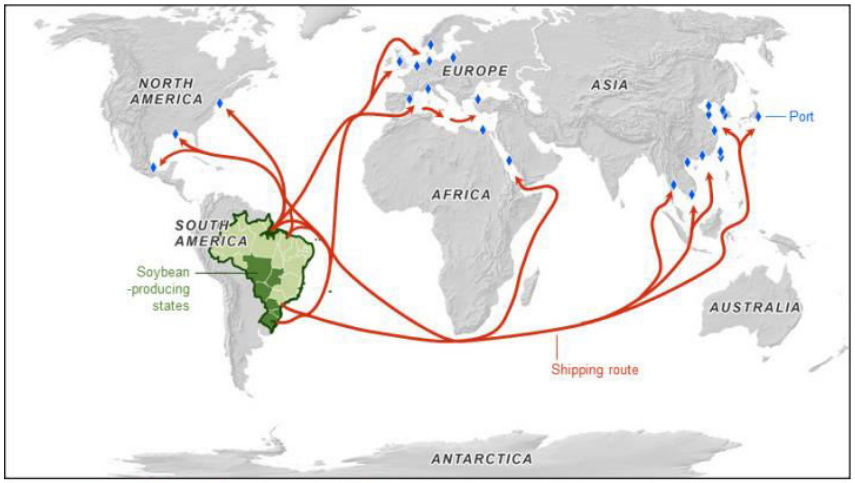
Figure 109 - Interland of Port of Itaqui, the iron road

Source: USDA Brazil transportation guide (Salin, 2020)

After the Tegran project started in 2013, the rail infrastructure is the strategic way to bring the soya from the interior of Brazil to export markets. Origins like Mato Grasso the highest producer, but also Goias, Tocantins, Maranhao and Piaui, can now bring to the Itaqui port, using rail connections and discharge directly to the terminal warehouses.

Itaqui Port is the main door for exports of the Brazil's iron mining north region, originated from the borders of the Amazon state. The operators Alumar and VALE are metallurgical world giant companies. Port of Itaqui is a gateway for iron ore arriving from the Carajas Railway, operated by Companhia Vale do Rio Doce, but now also exports soybeans grown in southern Mapito and central Brazil region, especially Mato Grosso, Goias and Para, transported by the Carajas Railway and North South main Railway. The port is in proximity to strategic markets in Europe and North America has led it to become an attractive option for exporting Soybeans. Ex-President Dilma Youssef inaugurated the TEGRAM in 2015, built by a consortium of grain exporters with the major idea of exporting big volumes constantly and in fastest way, serving primarily Far-Eastern and European clients. Total terminal storage capacity is 500,000 MTons, which are divided into 4 warehouses with 125,000 MTons static

capacity each. TEGRAM oversees terminal management and warehouse owners are in charge of what goes on inside of their warehouses. Consortium Partners are world leaders in commodities trading, in Warehouse 1 is Terminal Corridor Norte (75% NOVAAGRI + 25% CHS), in warehouse 2 is GLENCORE, in Warehouse 3 is CGG Trading (60% COTEMINAS + 40% SOJITZ) and in Warehouse 4 are in consortium AMAGGI, LOUIS DREYFUS, ZEN-NOH. These horizontal V silos have ability to store two different kind of grains simultaneously with a wall separation, currently the only grains they are working with are soybeans and maize. Today like 98% of the exports are bound for China where they are processed as meal and oil for further consumption. There is no milling capacity in Tegram. In 2018, terminal loaded 6,3 million Mtons of grains on 99 ships. Terminal capacity is 5 million Mtons yet technically 7 million MT per year is possible to achieve. Tegram is initiating the 2nd phase of investment in 02/2019 with the aim to increase terminal capacity to 10 million MT per year. Technically 14 million MT per year will become a possibility for them once investment is completed. Currently they have only one assigned berthing position; EMAP Berth 103 where they are connected with one conveyor belt to a massive ship loader that can move sideways on rails and perform 2,500 MT/H loading rate. EMAP and Tegram agreed on assignment of a second Berth: EMAP Berth 100 where Tegram will be investing for a second conveyor belt connection and a new ship loader. Once investment will be completed, Tegram will be able to load two ships simultaneously. Of 6,3 million Mtons loaded in 2018, 81% were soybeans, 16.5% were maize and 2.5% were soybean meals. 56% of this total volume arrived in Tegram with trucks and remaining 44% arrived with railway. Only railway operator providing this connection is VLI (VALE) which is the other grain terminal operator at Itaqui as well. Upon completion of capacity increase, they will also be able to unload 8 wagons simultaneously in comparison to 4 wagons now. Then they expect to receive 80% of grain via railways. All volumes are arriving via land. Origin of the grains are following Brazilian States: Maranhao, Tocantins, Piaui, Bahia, and Mato Grosso. PANAMAX is the most common choice for export shipments loaded from Tegram. Biggest loading operation so far was for 76,000 tons which with their 52,000 tons per production rate, they can fulfil in around 1.5 days (André Lamelas, G.Ferran, 2013).



Source:USDA/Agricultural Marketing Service and USDA/Foreign Agricultural Service.

Figure 110 - Brazil soya maritime main export routes, source USDA

Brazil takes a leading position in Soybean production as we saw before, slightly overpassing USA, but the rank shows more distance in the figures of the international exports market of soybeans between both.

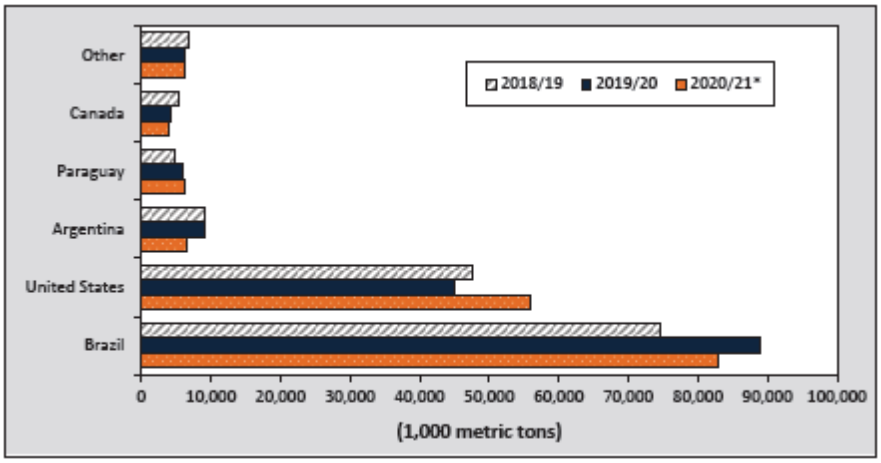


Figure 111 - Soybean world top exports 2018-2020, source Usda

The main export market of the Brazilian agriculture grains is by far, China market. The protein consumption raise focused in the soybean Brazilian origin.

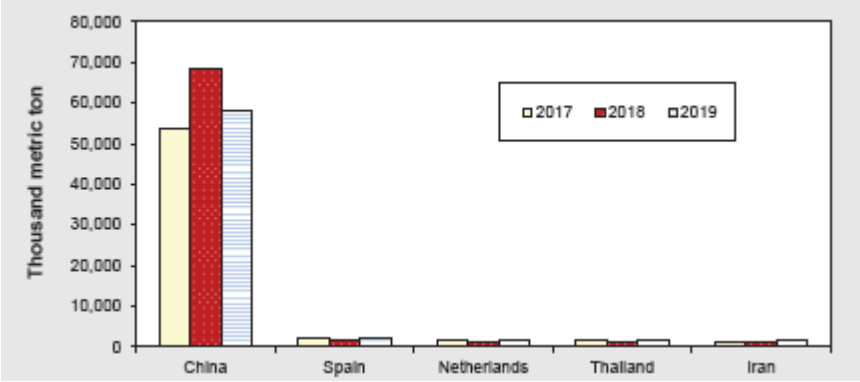


Figure 112 - Top soybean export destinations from Brazil, source Min Econ Brazil

We may observe a growing tendency of the Brazilian soya exports to Europe. This origin of soya protein is becoming relevant for the European supply. As we saw in early chapter, soya complex origins are also essentially distributeed by USA and Argentina also.

Regarding figures, specifically focusing Europe, Brazil is increasing the exports and especially the soya complex products, the soybean growing 61.6% last year 2019-2020 (DG Agriculture, 2021).

		Imports						
		Value (million EUR)					%	
		2016	2017	2018	2019	2020	Share in all Agri 2020	Change 2019-2020
1	Soyabeans	1 877	1 610	1 718	1 567	2 532	22.3	61.6
2	Oilcakes	2 362	2 302	2 624	2 579	2 482	21.9	-3.8
3	Unroasted coffee, tea in bulk & mate	2 128	2 079	1 814	1 852	1 886	16.6	1.8
4	Fruit juices	1 148	1 132	1 121	1 072	984	8.7	-8.2
5	Cereals, other than wheat and rice	196	613	723	803	651	5.7	-18.9
6	Raw tobacco	500	531	510	529	479	4.2	-9.5
7	Meat preparations	705	600	366	368	332	2.9	-9.8
8	Tropical fruit, fresh or dried, nuts and spices	308	307	283	332	321	2.8	-3.3
9	Bovine meat, fresh, chilled and frozen	425	380	400	360	305	2.7	-15.3
10	Fruit, fresh or dried, excl. citrus & tropical fruit	250	291	302	278	265	2.3	-4.7
11	Ethanol	12	10	36	9	125	1.1	1288.9
12	Beet and cane sugar	202	147	81	113	120	1.1	6.2
13	Poultry meat, fresh, chilled and frozen	142	123	179	129	92	0.8	-28.7
14	Casein, other albuminoidal substances and modified starches	54	69	62	72	83	0.7	15.3
15	Citrus fruit	90	84	83	81	82	0.7	1.2
16	Essential oils	90	109	114	78	64	0.6	-17.9
17	Oilseeds, other than soyabeans	30	57	65	61	59	0.5	-3.3
18	Other feed and feed ingredients	22	30	52	48	54	0.5	12.5
19	Coffee and tea extracts	58	51	39	47	48	0.4	2.1
20	Pet food	48	40	52	46	42	0.4	-8.7
	Remaining Agri-Food products	341	366	380	338	335	3.0	-0.9

Table 42 - EU Agrifood imports from Brazil 2016-20, source Eurostat

The soya complex products are leading the exports from Brazil today, in 2020 soybeans and oilcake, the meals for feed animals and production of meat beign on the top of the exports from Brazil to EU according Eurostat figures.

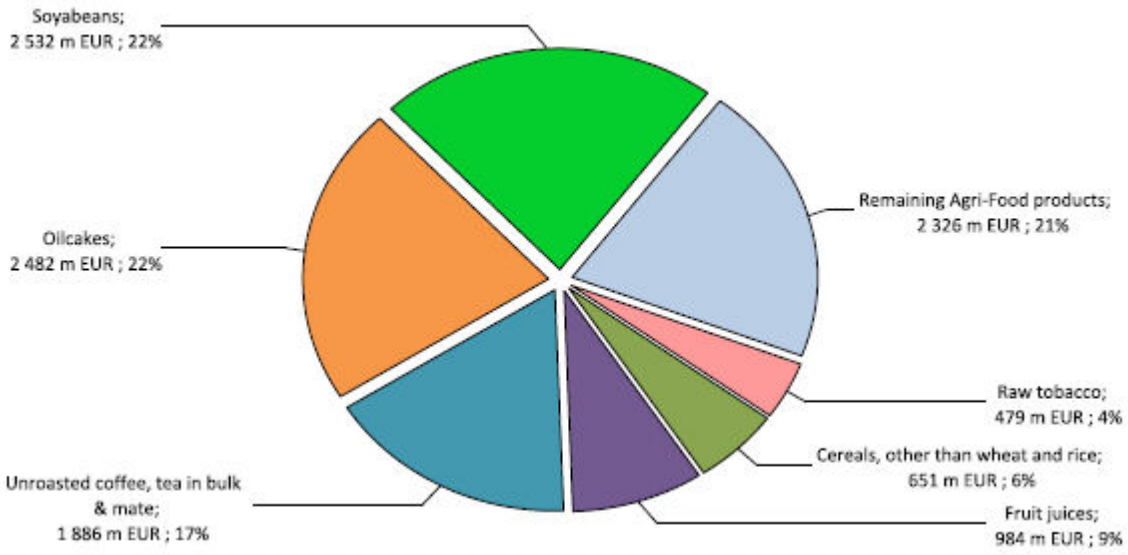
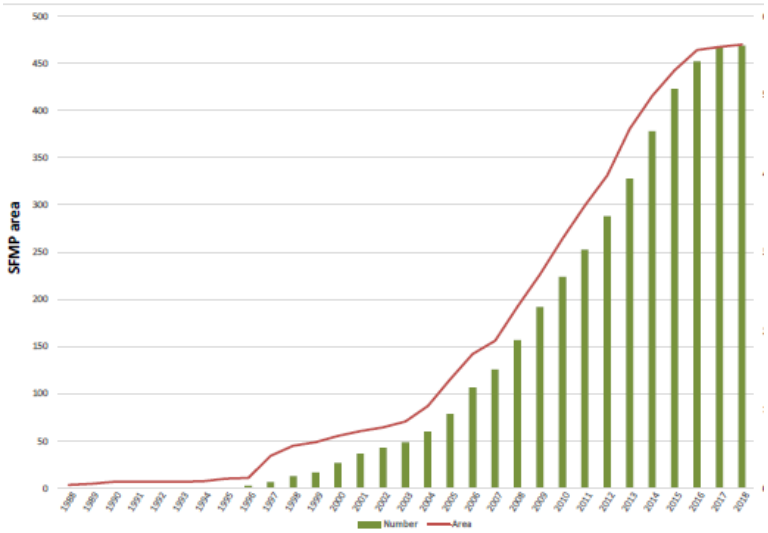


Figure 113 - Top EU imports from Brazil share, in 2020, source Eurostat

The conversation with Source K initiated with a long conversation around the development and opportunities of the agribusiness in the Maranhao region. The interviewee considered that region of Maranhao has still many surface to become arable, one of the states where growth area potential is bigger. The operations of clearing farming areas for agriculture production today, are especially supervised and in total compliance with the zone planning of the state, in strict respect of the reserves and natural endogenous habitats of the region. The opportunity to grow seeding areas with the improvement of the export logistics of the State, takes in high relieve the program for expanding agriculture investments in the region, creating jobs and surging economic development.

The conversation started with the recognition of the phenomena of the south hemisphere quick development of agriculture production. The interviewee rapidly sustained with official figures and static results. As we saw before in previous chapter if this document, in the last years Brazil is toping records of soybean production, also becoming the biggest

exporter of Soybeans in the world. The Secretary of State of Agriculture proudly refered also to the corn production record. The mix for the use of soils in the Brazil for the crops of soya and corn are splited like 80/20, being the soya more profitable, sale of tons produced per hectare, farmers only use Corn to structure the soils, intermediating on every 4 or 5 soybeans crop. Also making the short second season “safrinha” with millet, a derivate variety of corn. In Europe, the rotation of soils between crops, seeding alternative vegetable varieties is compulsory and controlled by state agriculture institutions. In Brazil, biodiversity is preserved by the compulsory reservation of a small percentage of soils for natural and endogens varieties, varying between regions, also controlled by State Agencies. Brazil keeps opening land for agriculture use. The state of Maranhao is a region of “cerrado”, meaning plain forests terraces, where the climate is hot and divided into a wet and a dried season, extremely humid, with lower medium dense vegetation, savanna type. Agriculture areas keep being opened by growing farming activities. Initially clearing the savanna, structuring the soils to prepare the sending during initial year, it might take 3 or 4 crops to reach efficient agriculture production on the land. Deforesting “cerrado” are operations strictly controlled and licensed by the state Agencies, with the submission of agriculture projects for well-structured areas and compensated impact measures. The institutions efforts to oblige the planning to protect and manage the forest areas are implemented in the north region of Brazil, progressively the territory regions being under management are being gathered, under so called “forest management plans” where agriculture areas are included in sustainable development politics (Carolina Clemente & Júnior, 2019).



Source: Projeto Nexus I - CNPq/PNE (2019)

Figure 114 - Total area of approved Sustainable Forest Management Plans (PMFS) in the northeast region

In this State of Maranhao, Mapito region, as well as others sates of Brazil, it is planned to largely grow the agriculture surfaces and subsequently the grains production volumes potential.

> "(…) this year (2020) Brazil once again is beating its record production in soybeans and corn. Brazil will keep growing its areas in agriculture, some states are matured but others still have potential growing areas. Brazil raised this year 8,5% its Soya production. The Amazonia region is now intensely protected and no more agriculture areas can be opened to protect Amazonia. The political pressure is enormous because of environmental protection issues. But in other territories, example the state of Maranhao is planning new agriculture areas around 3 million hectares. And still, only 7% of the territory is agriculture, this state is contributing only 2% of brazil agriculture production, there is still a lot of growing potential, and farmers are looking for it"_t_6:14_20:59_22:09

State research institutions in Brazil, keep working in the improvement of the genetics for varieties more adapted for the clime and soils of the territories. Special emphasis is given by EMBRAPA, the state company created in 1973 dedicated in research and technology to develop the agribusiness sector. This company is continuing improving varieties to adapt the genetics for better resistance and production growth potential, for each one of the territories particularities. Brazil is large like a continent, with rich diversity. Its surface is bigger than west Europe countries altogether, or the EUR-12 countries. An excellent variety for the climate and

soil of Mato Grosso, it might not be a good seed variety for the states of Piaui, or Maranhao. So the potential growth of grains production is based in two main factors, still with great potential to expand: the harvest production area and the genetics improving yields per hectare. Both this causes are time-consuming dynamics, long-term developments and complex activities involved to have result expectations. We may expect Brazil to keep growing the production volumes in agriculture commodities in the next decades.

> "(…) we may observe and expect still a big grow in productivity in Brazilian agriculture, in areas where you are farming with longer time tradition and experience you can see mediums of 80 bags of soya per hectare, other regions with where the production is more recent and young we can observe mediums of 40 or 50 bags[1] per hectare. So there is a genetic work potential to be done to improve production like 20 or 30%, we may expect that thes areas might also reach the productivities of the other experienced areas that also will keep improving their yields, although probably in a lower rate."_t_32:48

According to the interviewee, in the next future, Brazilian agriculture production expects to keep growing figures and leading record world production in soybeans and corn, consistently with results achieved in the last year and with the prospective expectation of growing crop areas in all the territories of the Brazilian States (unless Amazonia). In his expectation, growing rates like 4% in all country and 10% in its region can be matched. This positions Brazil as one the largest agriculture producers in the world and it will allow keeping the top ranking position as soybean leader export in the world for many years.

> "Brazil, continues its great agriculture development, being specially focused in Soya and Corn, according to last numbers of Conab we made 252 M MT of protein, soya around 122 M MT and Corn 101 M MT, also rice and beans are progressing but soya and corn are the main seeds and grains in our territory. Soya raises 2,7% last year, but I believe and expected around 4% per year may be expected in the next decade, some regions less agriculture developed but where expanding investments are foreseen, being licensed new areas and exploitations, like Maranhao may grow like 10%"_t_6:00_33:40

Soya is the large agriculture commodity harvest in Brazil Agriculture, and the trend keeps growing the figures of the protein most preferred crop in the world. The

[1] Note “sacas” bags, is a popular and common measure of quantity for grains in Brazil, representing 1 “saca” = 60 Kg of soybeans, being 50 sacas per hectare, a quantity like 3 MT per hectare of soya grains harvest production.

agribusiness farming sector, also the governmental institutions are driven by the best economical return of the variety, considering the costs and the value of the production obtain per hectare of soil, compared between other crops profitability. Corn comes in second place, looking to economical return but also to soil bio structuration needs.

> "Strategically we are specially focused in the protein production. The main feeding nutrients for meat are soya and corn. In addition, we want to transform in the value chain and increasing produce the food for human consumption, beef meat and chicken meat, are the main protein sources that we are exporting around the world"_t_6:15

Looking ahead to the future, the politician is looking to sustain a vertical value chain on the protein business, from the agriculture grains to the meat production and transformation. Always probing the political sustainment for the development and support given to the integration of the next transformation units.

> "Being Brazil a leader in vegetal protein producer, we want also to export the meat and bring more value for our agriculture"_t_7:15

The mission of the research and development state institutions in Brazil is deeply recognized as an essential partner of the agriculture development and production growth. Raising the production productivity levels is not only extending seeding agriculture area, but complementary is also based in the technological productivity. Apart from machinery, soil fertilizers and plant phytosanitary treatments, the seeds genetics takes essential role.

> "Brazil, trough EMBRAPA[2] is making huge improvements in the genetics of the grains to improve productivity. They work continuously in improving the genetics of Brazilians grains, when we talk about productivity enhancement, EMBRAPA brought a lot of contribution trough new genetics adaptations to the territory and climate in Brazil"_t_35:50

Logistics is of course seen as a main factor on the equation of the value for the farming activities. The price of the commodity is fixed in the ports, and the value of logistics is discounted to the farmer, like everywhere in the commodities worldwide business. So having

[2] Embrapa is the national agency and research center for agriculture, developing and improving seeds genetics

efficient logistics to bring the grains to the ports, and from the ports to the markets is a vital issue for the agriculture economics. Also, economical productivity depends of the logistics efficiency costs per MTon.

The state, together with major private operators of the agribusiness sector, are all investing in the main infrastructures necessary to export the grains in the most efficient way, bringing more significance to the agriculture operation, as well as, maintaining the competitiveness in the international markets. In the recent years the Tegram terminal, as explained before, was the largest investment made, through a model of a mix public private project solution. That new terminal enables an efficient infrastructure to export grains, modern, fast and capable of processing large volumes, interconnected with rail facilities. Although it started operation in 2015 and had a recent inauguration in 2017, its consortium partners are already upgrading the infrastructure. Agreements already made to invest in new systems and piers expansion will allow to duplicating its transfer capacity, doubling the export capacity to serve the strong demand and market opportunities.

> "Itaqui port, through the Tegran terminal, is growing every year its capacity, from star in 2015, is now doing 7 M MTons grains export, and we hope to reach 10 MTons very soon. The terminal is being upgraded with new terminal conveyors to be able to duplicate the loading operation of the terminal, it will be able to reach around 14 to 20 MTons exports capacity very soon, already construction works are ongoing now (y 2020)"_27:05

The Itaqui strategy is in line with the global tendencies of the grains international commodities market. Commodities are every day requiring more efficient transport means, looking for the competitiveness of the prices. Logistics cots are an important factor of competitiveness of the origin market. Brazil is exporting long distance destinations, like Europe or Asia, where the vessel size, takes relevance on the cost of transportation.

Looking for a very modern infrastructure, Tegran was planned to best serve the grains export of central north Brazil. Able to receive large size vessels, Panamax and more, interconnected with the railways infrastructure, serving the quaysides terminal with high speed modern grains ship loaders, minimizing losses and reducing charging days to a minimum. Seaborne trade evolution in the past decades made vessels big to reduce cost transportation per unit, big vessels are costly per day, this obliged the port and their terminals

to be efficient on the services, making operations fats, quickly releasing the vessels. The intermodal connections of these infrastructures in conjunction make the Export Brazil origin more competitive, or not.

> "Seaborne transportation is sustaining the Brazil grains export. Brazil export roads are maritime. Therefore, it was very important to make some specialized terminals for grains. In Port of Santos an important one. Or Itaqui in Sao Luis, where the grains terminal Tegran, is the new terminal for soya in north brazil, the closest to Europe, this is being today interconnected by rail transportation, to the main agriculture production region Mato Grosso, Para, Tocantins, Maranhao making the inefficient and dangerous road transportation obsolete, reduction costs, raising security, and more environmental friendly"_t_26:45

When referring to the traffic of grains to Europe, the interviewee recognized the importance of the main market of this region, which is China / Asia. The attraction and size of the Chinese demand takes the international traders to serve Asia by Brazil, being a southern country in the Atlantic South is in advantage and can more closely cross cape Good Hope in South Africa and contour to the Indian Ocean towards China. Leaving the North American soya to serve Europe in the north Atlantic. They are the same international trading houses. But, it is true that the European market is the closes big market to Tegran, and the volumes of soybeans to Europe, also soya meal, although far from China figures, are rising every year consistently, last year 2019-20 more than 60% growth.

Portugal, having a deep-water port, is the nearest European territory to Brazil maritime routes, making port to port, more efficient traffic allowing more rotation on the use of vessels, reducing seaborne impacts and costs.

> "Portugal is the nearest point between Brazil and Europe, makes all the sense to study a hub in this corner, from Itaqui we are just 3.500 miles away, compared with Ara/Hamburg around 5.000 miles away, this is a long distance difference, this means more one week navigation"_t_28:42

This opportunity must be deeply evaluated, as the indications are very interesting to discuss, as the interviewee recognized. Traders are in the end the final decision makers in the logistics operations point-to-point to deliver the commodities. Trading houses look to be competitive in the international market, searching best to explore the best margin in each trade lead, to grant its success, which depends of the origination price, plus logistics to final

market. This cost of the overall logistics is a combination of factors and parameters where trader can choose for the decision making process. The opportunity of a new entrance door for Europe grains operations, unloading for inland transformation/consumption markets or the transshipping in smaller vessels for local ports, either are to be validated by the traders options. Moreover, their option will be mainly triggered by two factors, the economic cost reduction and time to market.

> "(…) the logistics efficiency is an important contributing factor for the agriculture development. Market trading operators are looking for these opportunities. Brazil is continually investing in new ports, Sao Luiz is making a new port, also another in Alcantara. Protein, soya and corn, are the main drivers of exports for this ports operations. Some of this investments are private concessions. New ports are interconnected with railways; Alcantara is building 200 Km of railway interconnection now._t_39:06

In a destination port, it is very important to sustain the operations with inland operations. In the interviewee perspective if the Port bases its operations just in trade and transshipment, it will exposed to volatile behaviors of the markets, seasons, fluctuations, new competitors, and other events or causes that may disrupt the stable and continuous work of a reception grain terminal. The existence of a certain local consumption will keep a continuous flow of commodities to the port, overcoming market conjunctures and episodically and unpredictable events that might otherwise disrupt the operation of the terminal, breaching the cost structure sustainment of the operations.

> "(..) the inland capacities are determinant for sustaining the port operation"_t_32:38

Intermodal operations, automatic and fast, between sea and land, are very important in the grains logistics today. Interconnecting with modern mechanical systems, for speedy and proficient, multi operational, multi grain, grains and meals, multiuser systems. Operations interconnecting with railway and trucks are indispensable. They must be able to interconnect the transport railcars directly with the terminal unloading or loading with fast and efficient systems. The logistics value added gain, its economies are transferable to the farmer in the end. The grains price in the farm discounts the logistics to the market place quotation. And

quotations are worldwide established by international markets. Commodities prices are purely market driven, the farmer has almost no interference ability.

> "it is determinant the train interconnections to make the transports to feed the port, or discharge. We are reaching the interconnection of Santos with Itaqui. At the same time, building the new rail to Ancantara, making this ports more competitive in their operations, all in all, looking to give more value to the agriculture operation. The farmer is discounting to bring the grains to the port, so being efficient we are getting a bigger prize for its commodity, allowing and pushing the farmer to expand and invest in agriculture production"_t_39:56

From Source K, we can resume the subsequent table of variables and identify significant structural places and ideas as follows:

Variable	Level 1	Level 2	Level 3	K	SP
1.0.0	***Grain facts***	***Grain facts***			
1.1.0		Grains moving south		3	X
1.2.0		Corn & Soya complex change		2	
1.3.0		Protein consumption raise		1	X
1.4.0		Soya protein source		1	X
1.5.0		Seaborne trade evolution		2	X
1.6.0		Port Systems evolution		4	
2.0.0	***EU Infrastructure***	***EU Infrastructure***			
2.1.0		ARA traditional ports		1	X
2.2.0		New EU south hub		1	
3.0.0	***Efficiency Drivers***	***Efficiency Drivers***			
3.1.0		Logistics Cost		1	X
3.2.0		Time to market		1	X
3.3.0		Environment		2	
4.0.0	***Constrains***	***Constrains***			
64.1.0		Geopositioning			
4.1.1			Atlantic coast	1	
4.1.2			Mediterranean	2	
4.1.3			MENA	0	
4.1.4			Panama channel	0	
4.2.0		Port system			
4.2.1			Deep water	2	X
4.2.2			Port efficiency	1	
4.2.3			Services	2	
4.2.4			Intermodality	2	X
4.2.5			Inland capacities	2	
5.0.0	***Value Model***	***Value Model***			
5.1.0		Infrastructures			
5.1.1			Deep water port	2	X

5.1.2		Grains transshipment	1	X
5.1.3		Grains services	2	
5.1.4		Port Efficiency	2	
5.1.5		Train, Roads, others	2	X
5.1.6		Crushing Hub	1	X
5.2.0	Strategy			
5.2.1		Eur South Atlantic Port	1	
5.2.2		Portugal HUB	2	X
5.2.3		Transshipment	1	X
5.2.4		Geocentrality	0	
5.2.5		Med and MENA	0	
5.2.6		Hinterland Grains Industry	1	X
5.2.7		Commodities Port Systems routes	0	
5.2.8		Concession Hypothetical scenario	2	

Table 43 - Variables count Content Analysis for source K

6.6.10 Case 10 – Source L - CEO leader agro commodities Portuguese trading house

The case 10, or Source L, is the CEO, with long deep experience in the agro commodities trading of grains and seeds domains in many world regions. Lifelong carrier in RAR group, a Portuguese historic family based agro industrial group, well-known in the sugar industry, later consolidated a leading position in the agro commodities international trading business, essential in the activity of grains import for the milling and feeding industry in Portugal. This professional knows and visits many marker, ports installations around the world, in the scope of his professional functions, duty calls and displacements. He leads a trading team, working origin international markets, having a strong experience in trading bulk food grains, consequently its logistics flow operations, upcoming from his extensive professional career with this major Portuguese trading house.

Preparatory contacts and phone conversations took place along the first weeks of January 2020, preparing the interview, that took place in 16th January 2020. The preparation of the interview gave the information about objectives, the scope of the study, and the clear information of use and consent of the interview content gathered during the informal conversation, that also would be recorded for later processing in the study.

The table below resumes the information CV, the regional range of experience considered, and classification of the source L from the panel of interviews:

			Professional EXPERIENCES along it's carrier Classified - 1 to 10				
Interv	**Position / Organization / CV**	**Location**	Regional experience	Logistic	Port	Trade	Agro
L	CEO of ACEMBEX, one of the top Portuguese trading houses, integrating RAR Group, commodities leader in Portugal	Porto Portugal	Europe , Brazil, Med	9	10	10	10

Table 44 - Description, region and experiences considered for source L

The discussion with the source L was in RAR modern headquarters in Oporto. Had friendly welcoming visit to installations, being the meeting conversation held in a quiet moment and office environment, after a daily busy period, which allowed a relaxed discussing hour about the subjects under examination.

Knowing in the Portuguese grains market for decades, the interview showed a superb historical knowledge of the market evolution, the players and some episodes of shortage and struggles in its past trading experience. Probably one of or the most senior food commodities trader in Portugal, and keeps in agitated daily major trade leads involving activity.

The trading house takes a share around 50% of the grains import trading of Portugal, awarding a relevant position in the business, forwarding the cargos between continents, ports and their customers industrial units, essentially the milling industry and the feeding compounds business.

Being an experience senior trader with long carrier in the agro commodities world for decades, he could easily testify the phenomena of increase of agriculture production volumes in the south hemisphere countries, consequently theirs growing importance as origination markets for commodities trading worldwide. Especially focus on soybeans and more recently on the corn.

> "Yes, we are assisting the increase of agriculture production in south America for decades. Unfortunately, Africa is decreasing due to its context of instability, wars and political conflicts. Europe is losing the Agriculture production for other countries, and south countries are growing. Europe is dropping capacity. In meat, and protein, Europe is not sufficient, must import. Today, is very easy to move high volumes of grains, world logistics is efficient. Europe, the "old

> continent” shall be every day less competitive in agriculture production, its way of life is expensive, and soil is very high value. Grains can be produce in any geography and moved"_t_24:10

Having a long last experience observing the agriculture markets worldwide, the interviewee showed its vision about the future evolution of the agriculture production in the next decade. Due to soil availability and natural conditions, in the western countries, Ukraine and South America countries are the privileged spots for agriculture production in his opinion.

> "South America and Ukraine in my opinion will dominate the next Agriculture generation, has production geographies. For Europe Atlantic, we must look for this reality. Yes, Portugal could be a very good alternative for the logistics hub for the Atlantic coast"_t_26:10

Identifying in the conversation that the north ex-Soviet Union territories are strongly production wheat and coarse grains, while South America took the leading role in the protein seed production, mainly the soybeans that become a tendency in the past generation years for the meat production industry. Knowing and accompanying the evolution of the protein demand in Europe, the interviewee could observe the imperious increase of the protein market in Europe and the rest of the world, especial focus on general Asian demand, particularly the China market.

Looking the static logistics frame in Europe grains world, the east north Atlantic ARA region together with the Hamburg port in north-sea dominance in the grains business, our interviewee expressed the agreement to the opportunity to challenge this destination with alternative port in the south for the reception of grains and seeds. More affirmative in the protein case, where origination is clear the south hemisphere tendencies, Brazil and Argentina named countries.

> "(…) makes also sense to bring the protein in more efficient ways from South America"_t_27:10

Long time experienced in the international trade, our interviewee also could detail his knowledge about the fleets evolution and the logistics solutions in the food commodities

trading intercontinental operations. During decades the vessels got bigger in size, from common handy and coastal vessels even bellow 10 thousand Mtons, to the actual Panamax and larger, the interviewee testified the evolution of the grains cargo fleet, in size and specialization. Vessels for grains are no longer doing mixed cargos with other materials and brake bulk cargo. Today they are big vessels and specialized for grains and meals. Long time involved in the business, participated and assisted to the discussions and planning of the infrastructures necessary for the food commodities modernized business. Assisted the evolution of the specialized terminals and the construction of the port silos, observing also the evolution of the mechanical transfers systems, and the instruments to control quality and quantities of the bulk cargos, all were evolution experiences of the interviewee L past experience. Seaborne international trade development brought bigger vessels, specialized terminals, and these terminals had to accommodate longer and deeper berths for the rising size vessels. This was forced by the main stimulus-impelling factor, the costs per seeds MTon of logistics, which was the inducing hint to grow the vessels.

> "Seaborne is the most efficient, less expensive and more environmental friendly way of transportation for goods"_t_9:45

Summarizing all considerations around the transportation and movements of cargos between South America Continent and Europe. The cargo break between different destination markets, comprised ports in all along the European west Atlantic coast, crossing the Mediterranean sea to the Black Sea ports, it makes all the sense to evaluate an alternative point to divert and transship the cargos. The proxy Middle East and the North Africa countries are today also very important destination for major trade leads in cereals and vegetable proteins.

> "Ukraine is today a big cereals producer and stock holder of Black Sea, and feeding the MENA and Mediterranean markets"_t_7:50

Egypt, Syria, Iran, Algeria and Morocco are countries with poor agriculture development and important international purchase leads in the markets. The new location for efficient grains transshipment should be somewhere in a middle region of Europe Atlantic /

Mediterranean region. This will be more efficient than in the extreme north tradition zone as it is today.

> "I fully agree that Europe should have a south hub to minimize costs and make more efficient its grains logistics"_t_8:41

The vision of our source L about the capacities available in the Portuguese ports is critical. The opportunity of developing one single large capacity to import/export and make the transshipment operation to smaller ports makes all the sense to appraise the best solution combination. The economy of scale of large cargos from origins like Brazil, Argentina, South Africa, Ukraine, and the Atlantic/Med zones is immense. We shall consider also the increasing importance of the environment impacts of such transports proliferation. So it will be a good mix combination to determine the best efficient cargo per Mtons, in terms of operations cost, time to market, financial cost and exposure, environment impacts.

The interviewee considers that the small capacity ports, like the Portuguese case, will not be efficient in the future to operate in the international business. Otherwise taking a position of local port in communication with the hinterland food and feed industry, receiving smaller vessels from large transshipment hubs, making the long distance cargo transport efficient. With large vessels, requiring long berths, deep drafts, quick operations.

> "(…) the traditional Portuguese ports like Lisbon or Leixoes, are over. Ships arrive and stay in rad long days, with high costs, due to port congestions. Sines would be a great alternative for grains. In addition, yes, for our internal Portuguese market, it would serve than with small ships, in transshipment operations would bring the grains from Sines to Lisbon, Leixoes or Aveiro"_t_13:39

Domestic markets, transformation industry are very affected by the terminal costs. Local companies cannot look to be served by different ports from the one serving the region. When a port facility as just one operators, it competes with other ports, but does not compete for the local region industry that relates to that origin/destination port, having a market powerful dominance. Therefore, it is important that authorities prevail competition and/or regulation in the ports tariffs so the operations may be close fitting in the same frame of ports standard costs. The dilemma is also that the ports administrations themselves, being

small regional operations, the port cannot possible split the operations opportunity between many operators, building competitiveness buy close competition. Rather shall look to market regulation by comparing cost factors for the end users of the port services to be fairly charged and keep feasible their operation in down turn.

> "Also port services must be competitive. The regulators, the government, when making the concession should impose limits to the concessionaires to explore tariffs, and force them to remain competitive (...) I cannot understand why the same operation, but operated by different concessions, may cost in euros per MT like 10 in Leixoes, 3 in Aveiro or 6 in Lisbon. We need to make ours ports competitive and avoid concessions bargain power above reasonable costs, destroying economical operations in the downstream activities"_t_14:08

Being state investments and strategic infrastructures to serve the economic development of the industry, the interviewee focuses the role and responsibility of the port authority on the inland industry development.

> "(…) the port must look for the development of its inland economy, and not just for the income of its operations, it is not the main result for the state investment effort" _t_15:01

Port services and operators tariffs must be controlled to make the port operations competitive and privilege the economic development around in land, where taxes and jobs are really to be created. The port authority must concession in a competition framework, but also impelling the operation for a completion frame; or else, shall regulate the tariffs in accordance to other ports in the world. A local port that has tariffs high above the usual tariffs of other ports, is destroying the competitiveness of the local industry and maybe even closing its possibility to stay in market. Open markets require industries to be competitive at worldwide scale. Ports operators cannot stay out of this framework.

For the interviewee, the eventual concession of a new terminal for grains in a port should pass through a competitive regulation frame, allowing multiple operators to take part and compete in the same space.

> "(…) competitiveness may be achieved by the competition of the operators in the ports. When the port authority gives the concession to just one operator, then it has to regulate its tariffs."_t_15:39

Modernizing the port activities, better efficiency less establishment and paper work, is for the authorities a common place in the discussions between users, operators, regulators and them self's, the authorities. Always the dialogue takes a balance pending the arguments for one or the other part, but altogether, they must find the most efficient ways to bring the cargos to market place, all need each other, in different but complementary roles. The global Port economics are many slices of different players, all stakeholders of the cake. Altogether are interconnected and in time all depend of each other. Authorities need to coordinate and regulate the interchange of services, operations, rules, tariffs, obligations for the best operational environment and as inexpensive as the world competition obliges today.

> "(…) for this strategy we need more competitive services in the ports. And less burocracy"_t_13:50

In a final resume of the discussion, the interviewee L reinforced the opportunity of the possible transshipment port in the south Europe, today would be immediately particular interesting to split and divert the immense cargos coming from South American and Ukrainian regions. Cereals and protein seeds in each case. From a Portuguese Hub, the transshipment of smaller cargos would be efficient for other close ports in south European Atlantic coast, Mediterranean zone. Furthermore, the intermodal capacities of the port infrastructures are important to be able to transfer cargo to railways or truck for short distance destinations.

> "(…) yes, transshipment in south Europe, serving the European Atlantic coast, makes all the sense, we could be more competitive. We could have the South America products more competitive in our coast, from here diverted to the local ports around. By trains or truck to industry also, nevertheless, for Atlantic Europe, seaborne are the more competitive and the less polluting transportation"_t_17:50

From Source L, we can resume the subsequent table of variables and identify significant structural places and ideas as follows:

Variable	Level 1	Level 2	Level 3	L	SP
1.0.0	***Grain facts***	***Grain facts***			
1.1.0		Grains moving south		3	X
1.2.0		Corn & Soya complex change		1	X
1.3.0		Protein consumption raise		3	
1.4.0		Soya protein source		1	
1.5.0		Seaborne trade evolution		2	X
1.6.0		Port Systems evolution		1	
2.0.0	***EU Infrastructure***	***EU Infrastructure***			
2.1.0		ARA traditional ports		2	
2.2.0		New EU south hub		1	X
3.0.0	***Efficiency Drivers***	***Efficiency Drivers***			
3.1.0		Logistics Cost		1	X
3.2.0		Time to market		1	X
3.3.0		Environment		1	X
4.0.0	***Constrains***	***Constrains***			
64.1.0		Geopositioning			
4.1.1			Atlantic coast	1	
4.1.2			Mediterranean	1	
4.1.3			MENA	1	
4.1.4			Panama channel	0	
4.2.0		Port system			
4.2.1			Deep water	1	X
4.2.2			Port efficiency	1	
4.2.3			Services	1	
4.2.4			Intermodality	2	X
4.2.5			Inland capacities	1	
5.0.0	***Value Model***	***Value Model***			
5.1.0		Infrastructures			
5.1.1			Deep water port	1	X
5.1.2			Grains transshipment	1	X
5.1.3			Grains services	1	
5.1.4			Port Efficiency	2	
5.1.5			Train, Roads, others	1	X
5.1.6			Crushing Hub	0	
5.2.0		Strategy			
5.2.1			Eur South Atlantic Port	1	X
5.2.2			Portugal HUB	1	X
5.2.3			Transshipment	1	X
5.2.4			Geocentrality	0	
5.2.5			Med and MENA	0	
5.2.6			Hinterland Grains Industry	0	
5.2.7			Commodities Port Systems routes	1	
5.2.8			Concession Hypothetical scenario	1	X

Table 45 - Variables count Content Analysis for source L

6.6.11 Case 11 – Source M - Senior Commodities Trader of Portuguese trading house

The case 11, or Source M, is an experienced key account trader in agriculture commodities, one of the biggest trading houses of Portugal. The interviewee graduated in Argo engineering, passed in his professional experience by several geographies within international agribusiness groups, like in Brazil, Angola, and several European Countries. Having worked with different international groups in several agroindustry activities, the interview as a broad experience in the food commodities business industry and largely knows the trading problematics in this various perspectives. Since many years now, he is a senior trader, in one of the most respected Portuguese trading houses for food commodities. Responsible for grains and seeds, key account customers in Portugal and Spain. He is daily managing trade leads in the international markets for the demand of its clients. In the grains and seeds international trade domain, he is well experienced, working in close contact with top world trading companies in food commodities global trade. He is experienced in zones like Europe, Brazil, Mediterranean. Also had some experience in sub-Saharan Africa and Black Sea region. This professional knows and visits many ports installations around the world, in the scope of his professional functions, duty calls and displacements. He has a strong experience in bulk logistics of food grains, upcoming from his extensive professional career with the major trading houses of the world.

Preparatory contacts and phone conversations took place along the first weeks of January 2020, preparing the interview, that took place in 16 of January 2020. The preparation of the interview gave the information about objectives, the scope of the study, and the clear information of use and consent of the interview content gathered during the informal conversation, that also would be recorded for later processing in the study.

The table below resumes the information CV, the regional range of experience considered, and classification of the source M from the panel of interviews:

			Professional EXPERIENCES along it's carrier Classified - 1 to 10				
Interv	**Position / Organization / CV**	**Location**	Regional experience	Logistic	Port	Trade	Agro
M	Senior trader in ACEMBEX, former trader in Nutre Groupe, Agro engineer. Actually responsible for several international markets and commodities for Key accounts.	Sofia Bulgaria	Europe, Brail, Med	9	10	10	10

Table 46 - Description, region and experiences considered for source M

The discussion with the source M was in central offices modern headquarters of trading company where he is working in Porto. After a friendly welcoming visit to installations, the meeting conversation was held in a quiet moment and office environment, after a daily busy period, allowing a relaxed discussing hour about the subjects under examination.

From the interviewee experience, the southernization of the grains and seeds agriculture production is a fact well recognized in the trade business. Is a well-known circumstance, assumed without any concern to calculate or demonstrate. In fact, the traders care to discuss the cost of the commodities and its logistics.

The South America experience origin is a trend gaining volumes in the last years the interview recognizes without any doubt. He is experiences in wheat and coarse grains, meaning corn, barley, oats, millet, and others. The demand is modeling along the year with the consumption small variations but it must source a continuous supply of this grains. For this kind of constant and programmed market, the origins depend of the advantage of crop season in each geography. So you may have the corn being cropped in February in Brazil, in September in Europe, so the origination is depending of the market opportunity to buy new crop commodities, sometimes old crop discounted commodities. In between these periods, the trader has to negotiate the carry cost (storage and financial costs) that adds on the grains price on the purchase contract, if long term programmed. Sometimes, contracted on the spot market, but exposed to risk, this means discounted or increased by market volatility. Many traders make a mix of both type of contracts, although covering the essential of the needs, not assuring the total quantity leaving some exposure to future spot opportunity markets. This is in fact the trader strategy, in serious trades, always pre aligned with the client risk exposure will. Nevertheless, the South America origin markets, and Brazil in particular are growing importance in all trade commodities world in the past decades.

"The origins of the grains depends essentially of crop periods, but traders stock and feed markets all year. The carry cost is then to be added, if markets allow on margin. East Europe is an important source of corn for Portugal and Spain. Nevertheless, Brazil became in the last years a big and competitive origin for Corn"_t_9:49_11:30

Seaborne trade increased volumes in agriculture commodities, food demand increased more than world population, the food and feed solution was just some maritime miles away by sea transportation.

Vessels increase sizes, being able to transport larger quantities in the international trade business. Bigger vessels oblige bigger births and deep-water terminals. Big cargo sizes lead the trader to split and re-deliver the cargo to other client. Assuring time to market in the delivery window and most efficient cost per Mton of cargo. The international trade of grains and seeds is a very exigent market, squeezing margins every day, obliging the continuous search o efficiency gains on the total operation, from seeding, to crop, and the logistic to final destinations.

"(…) today the traffic of bulk grains is made in large scale, by bulk vessel, otherwise the grains become outside and not compatible with price targets of the market. Market is every day more price exigent and margins more strict"_t_8:50

To get margins worthwhile, traders manage to get bigger size leads to become efficient gathering economies of scale in the operation. Size and distance matters. Small cargos, in long distances, are not viable today. The efficiency is conquered using big cargos, for the long distance, and after make the transshipment between the local destinations, splitting the big cargos in two, sometimes three or four destinations, using smaller economical vessels for the “last mile” partial quantities. Small cargos are not profitable; traders tend to manage trade leads, to join cargos, to split in the final delivery.

"(…) markets behaviors are difficult. As the volumes have low margins, value per unit is small. You need scale to pay the costs. For example, unless special

> conditions, usually corn is not profitable if you make less than 30.000 MT in a trade movement...usually you move more than 50 or 60.000 MT using large vessels, as minimum, many times over, bigger than a Panamax 80.000 MT or Post-Panamax 120 MT "_11:49

Source M has extensive cereals trading experience, in the last few years working with a Portuguese cereals trader buying large quantities of cereals to direct clients, feeding and milling industry essentially. Strong experience in the north ports of Portugal, operating in Port of Leixões and Port of Aveiro, where capacity to receive grains is in what we may consider today low volumes, like 30 to 40.000 MT in vessels that are strongly limited by port installation but especially by the low water depth up to 8 or 9 meters draft. In international shipping cargos moving intercontinental, like between Brazil in South America and Atlantic Cost of Europe, it is essential to be able to bring large cargos. This will be reducing the cost per ton, as seen before in chapter “2.4 - Intercontinental food Logistics, trade and vessels”, deep-water births are essential for intercontinental grins transfers. A bulk carrier Cap Size, a vessel with Dwt above 120 MT we need like 14 to 15 meters depth. A Valmax Bull Carrier is a modern giant considered the most efficient vessel for cargo transport due to the size; its impacts are divided per many tons of cargo. Not presently used in grains, just for Iron Ore, but this carrier lengths 360 meters has 65 meters width, can transport up to 400.000 MT of cargo and needs like 24 meters draft depth. Used for grains, today in 2021 it is common to make transcontinental Brazil or Argentina to Europe or China, loads of 120 to 200 thousands MT.

> "Port size terminal capacities matters for international Operations, example in Aveiro you cannot make international moves, you have a capacity of only around 34.000 MT and only small vessel, with short draft, can access the terminal. Maximum 8 meters in high tide period. This is for local domestic secondary distribution from transshipment"_t_13:18

Vessel sizes increase along time, driven by one side the raising consumption demand and on the other side efficient transportation. Deep-water ports are essential to make transshipment operations diverting to smaller local ports.

> "(…) for grains trading, big volumes of seeds require big vessels, and these vessels requires a deeper draft. This is a main constrain in some Portuguese ports in the north like Aveiro. Although is very good in terminal availability, draft is a big limitation. In Leixoes, we may bring slightly bigger vessels, up to 45 or

> 50.000 MTs we made already in high tide, but this Port in its operational limits, we lose too much time in Leixoes, today we prefer to operate in Aveiro. For a Panamax we have to use Lisbon, Trafaria terminal, we can make up to 60 max 70.000 MT"_t_16:05

In this interviewee opinion, the ports also compete by their quality of services and for sure in availability. Leixoes, although well serviced in infrastructures for small grains cargos, is very bad in availability of the quays time-slots, always in congestion. Vessels waiting to discharge, during days, generate high costs that can make the trade operation became on negative margin. International trade of seeds and cereals, is a business were absolute values are high, margins are perceptually very tinny, with logistics operations using vessels that may cost 20 or 30.000 USD per day waiting, these operations cannot lose time. Both financial costs and risk exposure, added to ship holding costs, might be very high and disrupt the business. It is essential that the port can perform the charging/discharging operation quickly and efficiently.

Recently this operator is choosing Aveiro, with strong limitations on the draft, up to 7 or 8 meters in high tide, limiting the size of the vessels up to 30 or 35.000 MT of grains, being short for some trade leads of today.

> "Aveiro Port, although is for small capacities and low efficiency in operations, as a great advantage of not having constrains. Usually the vessels arrive and discharge fast. This is not possible in Leixoes, where waiting times are very costly. Availability and fluidity of the operations are very important for the trading operations. Also in Aveiro, you have expanding capacity opportunities if you need. It is a port in growing track, but its draft is a big limitation unfortunately"_t_14:48

The same beliefs we can have for the ARA region, in a parallel similitude but in larger scale. As well, there in ARA, it is a maritime congestion zone. Also waiting times are long. We could expect that easily, an alternative port for large reception of grains could face competitively a substitute destination to ARA grain terminals.

Port services and availability of space are strong advantages, seen by this interviewee for his operations in Aveiro. For a second time, the trader is expecting the opportunity to extend its operation in a near future. Aveiro Port gives such advantage of permitting expansion of activities in extra available space. The ports should have this “space stock” to

allow operations to extend as business progresses. Usually old and city-surrounded ports cannot offer these opportunities. In the north of Portugal, we may expand only in Aveiro. In the South of Portugal, the interviewee clearly identifies the Port of Sines as the big opportunity to expand services and receive deep draft vessels.

> "Aveiro port as the big advantage of having free space available, the operators may expand easily their capacities if necessary. There is free space in stock. You may request extra space to operate; you are not as limited as in other ports. This allowed this port to grow in the recent years. Its biggest constrain is the draft, very short"_t_14:47

The discussion went on with the evaluation of the opportunity focused in the example of bringing big cargos from the South America in large, like 150.000 MT size. A vessel full of corn, eventually having a terminal for the reception of this cargo in Sines, and from there, later making the transshipment of a partial cargo of 30.000 MT into smaller ports. These smaller ports would then make the local supply of the food and feed industry, ports like Leixoes or Aveiro.

> "(…) the key question is always the economy of the operation; this is ruling the choices of the trader and logistics operator. Eventually if industry customers and trade operators fit to a new logistics layout less expensive, this will work. The economy of the overall operation is the simple trigger to change the center of the operation, I am fully positive about that. It doesn´t matter where to change the cargo, anywhere is ok if operations are efficient and less expensive"_t_29:15

Not introducing longer delays, if cost is more effective, the interviewee is absolute positive about the viability of the transshipment operation. Initially, the cargo would be taken by an intercontinental transport, in large Panamax or Post-Panamax vessel, at a low cost per ton, followed by a transshipment operation in a South European port, and yes eventually Sines would be a good location, having a deep draft for that. Finally, followed by a secondary short-sea coast transportation in a small Handy size vessel of 20 or 30.000 MT cargo. The calculation and comparison of the overall costs are the decision line for the trader to take the option.

"(..) It is the arithmetic working. We just add all costs, and easily the choice is made. This might take some time, but the arithmetic is working and ruling in this kind of choices. Absolut no doubt about."_t_47:10

For a grain trader the market environment is always an important context to deal with secure options and alternatives. Being in Portugal, our interviewee knows by experience that ARA is an important and liquid market. There are plenty of alternatives to dispatch a cargo, the trader has many options to deal the commodities if something goes unexpected way, the trader finds alternatives shortly. In Portugal, small market, limited storage capacity, trade leads are in majority made back-to-back, this means the trader buys whenever is having a purchaser behind for the same cargo. Rarely is buying uncovered. Nevertheless, unexpected situations happen, this is when the trader has to look alternative destinations for a cargo, or partially dismember the cargo into alternative clients. This will be more easily done if you are in a liquidity zone with several alternative to sell or stock your commodity and find the solution on the right time. In ARA there are already the transformation industries, the immense silos for stocking cereals in large quantities, the intermodal infrastructure to discharge and swap to railways for easy destination to other clients. In addition, river barges are distributing cargos along the river ways in central Europe. There are plenty of alternatives.

"The big advantage of ARA is that their operations feed the transshipment but also supported by the inland operations of a very well established network of trade routes by train, road and barges that make the market much more competitive, and above all, you have liquidity in the market. This infra-structure may be the weighing factor that determines the choice and make this region very interesting for traders to operate (...) depending of the carry cost a long time, the trade operator may be able to choose to make transshipment, to store or to give away the cargo to the market. When you have different liquidity options, you make your market more efficient and competitive. Being closer to consumption is an advantage. Nevertheless, having the lower cost of overall logistics operation is clearly an advantage"_t_47:58

Looking the potential operation of grains transshipment in Sines region, the trader questions if the international market would need this hub. Definitely if the cost compensates.

A port grains operation makes sense if it would also develop in the hinterland industrial transformation of grains and seeds. For the food and feed industries, it would then make all the sense to make installations in the zone, benefiting from the port terminal

proximity. Naturally, by the economies of the operations, this should occur through means of the industry initiative, whether or not stimulated by authorities.

> "(…) any strategy for grains transshipment must be aligned with the hinterland consumption. This is important for the grains trading operations, it gives liquidity to the operations and this is very important for traders. Grains are perishable raw materials, as we know it costs a lot to store and losses increase along time. (..) Considering all grains by maritime traffic, Portuguese market values today around 4.5 million MT, from which 3.5 million MT are coarse grains and 1 million MT is Soya. Today we do not have a grains transshipment strategy in Portugal, our traders are importing for industry and international traders are not focused in our small country has consumer. Looking for the transshipment is not a question today; there are no facilities to do it. However, if it will be launched, they will come…"_t_33:18_40:32

From Source M, we can resume the subsequent table of variables and identify significant structural places and ideas as follows:

Variable	Level 1	Level 2	Level 3	M	SP
1.0.0	***Grain facts***	***Grain facts***			
1.1.0		Grains moving south		3	X
1.2.0		Corn & Soya complex change		3	
1.3.0		Protein consumption raise		4	X
1.4.0		Soya protein source		1	
1.5.0		Seaborne trade evolution		4	X
1.6.0		Port Systems evolution		1	X
2.0.0	***EU Infrastructure***	***EU Infrastructure***			
2.1.0		ARA traditional ports		5	X
2.2.0		New EU south hub		4	
3.0.0	***Efficiency Drivers***	***Efficiency Drivers***			
3.1.0		Logistics Cost		6	X
3.2.0		Time to market		2	X
3.3.0		Environment		0	
4.0.0	***Constrains***	***Constrains***			
64.1.0		Geopositioning			
4.1.1			Atlantic coast	1	
4.1.2			Mediterranean	1	
4.1.3			MENA	0	
4.1.4			Panama channel	0	
4.2.0		Port system			
4.2.1			Deep water	3	X
4.2.2			Port efficiency	2	X
4.2.3			Services	1	X
4.2.4			Intermodality	3	X
4.2.5			Inland capacities	5	X
5.0.0	***Value Model***	***Value Model***			
5.1.0		Infrastructures			
5.1.1			Deep water port	3	X
5.1.2			Grains transshipment	2	X
5.1.3			Grains services	3	
5.1.4			Port Efficiency	3	
5.1.5			Train, Roads, others	4	X
5.1.6			Crushing Hub	0	
5.2.0		Strategy			
5.2.1			Eur South Atlantic Port	1	
5.2.2			Portugal HUB	2	X
5.2.3			Transshipment	1	
5.2.4			Geocentrality	0	
5.2.5			Med and MENA	1	
5.2.6			Hinterland Grains Industry	3	X

5.2.7		Commodities Port Systems routes	0	
5.2.8		Concession Hypothetical scenario	1	X

Table 47 - Variables count Content Analysis for source M

6.6.12 Case 12 - Source N – Brazil international senior commodities trader

Case 12, or Source N, is a fine professional trader in Brazil, for long time experienced and knowing very well the Sao Paulo financial business environment. In Brazil, agribusiness financial operations have strong significance, beign very important for the country's incomes. The share of the Brazil economy sectors, taken by agribusiness, is very important. The interviewee is an international commodities experienced trader and risk exposure manager in the grains, oils, metals, real estate, and combustibles domains, having experienced in international markets in several continents.

Contacts and phone conversations were initiated along the first weeks April 2020, preparing the interview, that took place in 27th April 2020. The preparation of the interview gave the information about objectives, the scope of the study, and the clear information of use and consent of the interview content gathered during the informal conversation, that also would be recorded for later processing in the study.

The table below resumes the information CV, the regional range of experience considered, and classification of the source N from the panel of interviews:

			Professional EXPERIENCES along it's carrier Classified - 1 to 10				
Interv	**Position / Organization / CV**	**Location**	Regional experience	Logistic	Port	Trade	Agro
N	Senior Commodities Trader in B3, leading Brazil brokerage house, responsible team leader for international commodities trade	São Paulo Brazil	Brazil, USA, Europe	6	6	10	10

Table 48 - Description, region and experiences considered for source N

The conversation interview with the source N was taken in an after-hours, welcoming, quiet moment and environment allowed discussions and exchanging ideas about the main topics. The source is by professional formation very engaged with research subjects and markets knowledge and intelligence. The theme proposed in discussion motivated a more

profound reading of the interview, even after the interview concluded, in the following days, the exchange of information and phone discussions showed the deep interest that the conversation opened to this source, being a professional in commodities market with long years of analysis and experience of trade knowledge. Several times the interviewee came in contact for later information's and follow-ups.

The interviewee started with a long conversation and discussion on the topics of the Brazil agribusiness short-term trade, opening and development agriculture areas, trends and technology advances. The interviewee had a large critical vision on the tendencies and developments of the major agriculture houses and agribusiness investor groups, he beign daily dealing with, having an insight knowledge of the Brazilian agribusiness market in the last years as a broker and trader professional in some of the top brokerage houses of Sao Paulo, the Faria de Lima avenue, kind of wall street in Brazil, where the agribusiness major business headquarters are around.

The Brazil agriculture Boom, triggered by the soybean demand in all world, compelled by the entrance of American farming big companies, looking for cheap and large extensions of soils. It took some years to adapt and develop endogenous technology. Still the logistics infrastructures are improving, but in a few decades, Brazil became a very developed agriculture country, where professional companies, international groups and also Brazilian ventures are leading a top world-class industry.

> "The agriculture production here in Brazil or in general in south America made a big growth in the last decades, the introduction of technology and agriculture knowledge were the drivers. Brazil introduced technology to prepare the land, correct soils structure, also adapter the seeds for water, climate and soil. In the last decades the production raised enormously and arable land business, become a very disputed asset in the agriculture business, by big world players, as they could find easily in Brazil large plane parcels of land to cultivate, with adequate clime and soil. Especially for the soybeans, that rapidly made Brazil to become the main source of protein in the world imports. This agribusiness miracle in the last 20 years was just not only in Brazil, Argentina and recently Paraguay faced the same phenomena. Moreover, here in Brazil we still have opportunity to grow areas in the years to come. At the same time, we already observe the move of Brazilian farmers and North American farmers, big agriculture companies, moving to Africa, especially the west coast"_t_10:35

The agriculture in Brazil knew a fast development, international cooperation with the big American and European agribusiness firms, brought technology and administrations best practices for the industry. In a few decades, research agencies, at federal, states and local levels quickly disseminated the best technologies for improving practices in crops management. Harvest figures, the productivity yields are improving along time considerable. Universities and technical schools rapidly created a stock of well trained, including lots of onsite practice training in cooperation with the big farming houses. A solid work force was created and developed itself by the experience and rapidly grow of the professional opportunities for the qualified technicians in all levels, good Agriculture engineers became high salaries specialists, classmates to the international experts of the international farming houses, attracting many new youngsters in the professional choice of agriculture technology and engineering.

All subsidiary industry for the sector also moved in the territories to sustain the agribusiness development, like the major players in fertilizers, seeds brewing, phytosanitary products for specific local plagues and diseases, agriculture machinery for seeding and harvesting in large scale, agribusiness software and IT in the most advance utilizations of GPS intelligent controlled agribusiness processes.

Brazil in a few decades became a top world payer in Agriculture, its players are now looking to expand in new territories to also develop fresh new areas, expend their activities in opportunity land, searching more markets, more resources, more arable surface at the lowest cost. It is the circle of life, the circle of economic development going-on. Africa is the new move of the Brazilian farming houses, developing new ventures to enter in some west coast areas. Angola and Mozambique are Portuguese-speaking countries very attractive for these farming companies willing to expand. Some initial moves are already made, some facing the initial problems of a new territory adaptation, others progressing in a sustainable development long lasting journey. Brazilian farmers are not the only looking for grabbing farmland in Africa, many others world companies are doing the same transfer.

> "(…) today the necessary “technology pack” to develop grains production in Africa continent has not surprises for our agribusiness investors. Brazilian farmers became specialists in the agribusiness domain, our Agro engineers have

> a very good education standard and experiences in the finest production sites of the world. They are able today to start getting initial good production in these new African areas. Far better than Europeans. There are regions very alike the Brazilian biomes and weather conditions. We are in the same geographic latitudes. The problem in Africa is political, the governance, the institutions are not yet opened and friendly to foreign companies. Investors need favorable and steady political environment to spend in new ventures. We observe many Brazilian groups making also initial moves in Africa, by now experiments and prospecting opportunities. Africa will be the next big player, a new agriculture zone in the future, and promising very competitive, close to south Europe and also close to China"_t_14:25

The source did not enter in world-talks ethical discussions topics, about being correct or not, which measures for diminishing impacts and recompensing actions to implement. The industrialization of the farming activities in the rural undeveloped world bring jobs and economic development, it is what facts are pointing, succeeding, the agriculture development of Africa being a promising growing origin of grains, reinforcing the south hemisphere origins role in agriculture, for the next decades.

In the interviewee opinion, south hemisphere geographies are definitively growing their roles in the agriculture production. This is a worldwide tendency.

> "The big growth of agriculture in South America is ongoing; I believe the next world geography is Africa continent. In addition, in the south, Australia and Southeast Asian regions also have raised its productions, but their markets are around in Asia"_t_11:50

The intense world meat consumption keeps growing demand, with population figures and economic development generally raising all countries along time. Soybeans are today the most efficient way to feed meat production, poultry, pork, beef, ovine and caprine, fish farming industry. The vision of our interviewee is that soya has no competition or alternative for meat production in the nest years to come. Eventually the direct human soya based food, that is a slow progressing trend, might overcome the animal meat intermediate step to feed protein into human kind traditional meals. The trend is moving slowly but increasing along time. It will be soybeans, farming soybeans, business as usual.

"(...) soya is today the main source of protein for meat production; I do not see an alternative in near future. You can produce more kilos of beef meat per hectare of land using soya, and the cows don't care what they are eating, so why to produce other commodity for meat? t_21:34

The conversation jumped to the logistics aspects of the south-north trade of soybeans, which the interview knows very well. Being active in the trade market, the need to solve logistics solutions the most efficient way is a daily challenge. Large trade leads are trendy, international buyers look to assure and close quantitates as soon as reasonable, today usually before the crop, more than half of the production "is already closed" with buyers. This is because the farming house is looking to finance the harvest, but also the buyer purchase power meant for closing and securing the commodity aimed at its future markets deliveries. Prediction and estimations about crop sizes in function of the planted areas and following the weather evolutions along the crop. Some world known agencies are empowered to change the market. The day USDA delivers its usual quarterly forecast for world agriculture, the stock exchanges quotations trembles and moves fast. The international trades frenetically make and close their leads. The agriculture agencies today can easily estimate in advance the expected crops sizes, establishing earlier prices and allowing speculative markets on commodities futures, to move dynamically the quotations and the financial agribusiness ecosphere.

The internal moves of the Brazil grains cargos, as deeply described in the interview with the Secretary of State of Agriculture of Maranhao, can introduce disequilibrium on the value of the commodity to the farmer, making the region lower or higher value in land, labor and agriculture development. The price is established in the ports, the internal logistics is discounted to the agriculture production place, if the logistics is not efficient, and the farmer is paying the price on this discount value.

"The impact cost on the transport is very important. In Brazil some areas are less or more valuable due to the logistics costs of their logistics channels"_t_35:12

The international agriculture commodities trading business is supported by seaborne transportation, as we saw in previous chapters. The interviewee reinforced the propensity for larger volumes in trade leads, increasing the demand in logistics for bigger vessels and deep-

water ports. The limitations in the trade business have strong time constrains, buy booking the vessels time-slice to move the cargo in the exact period, many times made with months in advance confronting the freight reservation scarcity in crop periods, and causing operational problems. The crops operations every now and then differ from weather natural reasons, like rain. In addition, the operation is limited to the destination ports that can operate large vessels, beholding to limitation of drafts for large bulk carriers docking anchorage.

> "(...) the draft is main problem of the port expansion in the majority of the ports administrations around the world, all the rest you can solve more or less easily. Keeping a low draft by mechanical artificial technology is very expensive, so a strong constrain"_t_22:45

When confronted with the opportunity to make the international cargos from Brazil and Argentina to Europe into two-steps operation looking for economy of the cargo transfer, the interviewee had a clear and affirmative opinion. A primary phase with a large vessel carrying the long distance intercontinental transportation of the commodity, and after a secondary transportation made by small handy vessels, the distribution in short-sea operations along the south Atlantic coast and Mediterranean waters, including Black Sea and MENA destination. This intermediated by a transshipment operation in a southern port in Europe, alternative to the North Sea port of Hamburg traditional attracting the protein cargos to Europe. The interviewee was sincere and pragmatic in this analysis. Once again, the economic efficiency comes to the botte mine of the decision of the trader choice for the operation.

> "(…) makes all the sense to have a transshipment operations port in the south of Europe for grains. Financial costs, risk, depreciation of the grains. In addition, the ports in the north are very crowded. Shorting the time-frame of the vessel trip is very important, you can use these very valuable assets with more rotations, it becomes very productive economically. An evaluation must be carefully made, but in a first sight it would reduce the overall costs, because the transport impacts are very high and the transshipment operation is less relevant in costs proportionally. Seams very important"_t_24:10

Reducing time to market is very important in agriculture products. New perspectives on others products could be added for a food terminal in south Europe, looking for other

specific agriculture perishable products. The interviewee indicates to fruits and vegetable export market of Brazil, that he also knows in deep experience.

> "I understand your focus is grains, but if you take other crops from Brazil like fruits, vegetables, or even meat, the same type of logistics could apply. Moreover, in these cases, the shorter time to market is even more relevant. For products so delicate like fruits, 5 or 6 days in the vessel have a great difference in conservation of the cargo. I am sure reducing drastically losses. As you know to overcome this long journeys by sea, “we are flying” to Europe many products; this could also be an opportunity for this fresh agriculture products, especially fruits. I know I have some friends in some investment funds that would be very wisely looking for it"_t_38:45

In interviewee experience with the north ports or Europe, other problems might be overcome if a new alternative is built efficiently in the south entrance of Europe. Maritime traffic is conditioned by bad weather conditions, many times the ports entrances are closed due to winter storms that do not allow vessels traffic for the security of the circulation in the entrance and inside shallow waters channels. Therefore, availability to access the terminals reduces and is suspended some days. As a generality, as northern is the port, more days per year you might find of deferment because of storm conditions. Likewise, some collateral costs are connected with these risk assumptions of the weather problems of maritime transportations.

> "(…) the bad weather in the north ports is also a very important question to make us look for a southern port alternative. Days waiting and losses caused by the bad weather have strong significate in the operations. This will affect also other collateral costs, like insurances for example. The risk coverage of a cargo traveling to south Europe should cover less risk that the same cargo traveling from Brazil to North Sea"_t_29:48

The vision of the interviewee about the efficacy of the logistics is of the direct impact in the Brazilian quotations prices. So looking to efficiency gains in logistics, this will be transferred immediately to the value of the commodity in the origination market, making the Brazilian agriculture more valuable. We all look for this.

> "Today the grains strategies are focused not only in the production, but the farmershouses understood that the logistics issues to access the markets in the best conditions can make to win or lose a lot of value in the operation. Makes

> no sense to produce with very competitive levels and high technology in production, to lose value on the logistics to market. Logistics is always discounted from production because the price is established by the market place; the producer must warrant his merchandize in the best conditions to reach the market incorporating the logistics. Making a new entrance and diverting the cargos, in smaller transshipment operations in the south of Europe makes all the sense. I fully agree with the confirmation of your primary question."_t_37:45

Finalizing, the interviewee disclosed the opinion of total agreement with the perspective to evaluate the logistics alternative of a southern transshipment port in south Europe, as an opportunity for the protein cargos of South America. Other varieties and cargos like corn and fruits, could also be in line with this logistics relevant economies. The effort must be done to find out its likelihood investment opportunity. Launching a concession scenario will be a demonstration test to the trading and logistics international market.

> "(...) the thesis is very well grounded in reality, you know very well Brazil agriculture and Europe's commodities trading structure. Your perception is 100% in line with my view of reality."

From Source N, we can resume the subsequent table of variables and identify significant structural places and ideas as follows:

Variable	Level 1	Level 2	Level 3	N	SP
1.0.0	***Grain facts***	***Grain facts***			
1.1.0		Grains moving south		2	X
1.2.0		Corn & Soya complex change		2	
1.3.0		Protein consumption raise		1	
1.4.0		Soya protein source		2	X
1.5.0		Seaborne trade evolution		2	X
1.6.0		Port Systems evolution		1	
2.0.0	***EU Infrastructure***	***EU Infrastructure***			
2.1.0		ARA traditional ports		1	X
2.2.0		New EU south hub		1	
3.0.0	***Efficiency Drivers***	***Efficiency Drivers***			
3.1.0		Logistics Cost		1	X
3.2.0		Time to market		1	X
3.3.0		Environment		0	
4.0.0	***Constrains***	***Constrains***			
64.1.0		Geopositioning			
4.1.1			Atlantic coast	0	
4.1.2			Mediterranean	0	

4.1.3			MENA	0	
4.1.4			Panama channel	0	
4.2.0		Port system			
4.2.1			Deep water	1	X
4.2.2			Port efficiency	1	
4.2.3			Services	0	
4.2.4			Intermodality	0	
4.2.5			Inland capacities	1	
5.0.0	***Value Model***	***Value Model***			
5.1.0		Infrastructures			
5.1.1			Deep water port	1	X
5.1.2			Grains transshipment	2	X
5.1.3			Grains services	1	
5.1.4			Port Efficiency	2	
5.1.5			Train, Roads, others	1	X
5.1.6			Crushing Hub	2	
5.2.0		Strategy			
5.2.1			Eur South Atlantic Port	2	X
5.2.2			Portugal HUB	2	X
5.2.3			Transshipment	3	X
5.2.4			Geocentrality	1	
5.2.5			Med and MENA	1	X
5.2.6			Hinterland Grains Industry	2	
5.2.7			Commodities Port Systems routes	1	
5.2.8			Concession Hypothetical scenario	1	X

Table 49 - Variables count Content Analysis for source N

6.6.13 Case 13 - Source Q – Grains terminals and storage development expert

The case 13, or Source Q, is a senior international business executive and construction manager engineer in grains terminals around the world. Today working in Singapore, Asian markets, this Spanish executive embraced a career in the grains world, in silo systems fabrication and construction, grains terminals and port silo systems development and construction in several site in world. His experiences, covering Europe and particularly Spain where he started in the business with a grain storage facilities leader, encompassed experiences in construction projects in North Africa, South America, Mediterranean Proxy Middle East countries. More recently in the South Asian region, including the coverage of Malaysian and Australian markets, where he is the country manager working with a German

company, Buhler AG. Group of companies spread in 140 countries worldwide, a global leader in port facilities and technology for grains transfers, storage and processing.

The interviewee Q knows very well the south and north Atlantic ports logistics for grains from his experience in the systems for storage silos, grains transfers and treatment in the ports. Engineering base formation, multinational experiences, he is a leading project engineer and business developer for the commodities port logistics business. This professional knows and visits many ports installations around the world, in the scope of his professional functions, duty calls and displacements. He has a strong experience in bulk logistics of food grains, upcoming from his extensive professional career with the major ports and trading houses operators of the world.

Preparatory contacts and phone conversations took place along the first weeks of February 2021 for of the preparing the interview. This contact was much later than all the previous interviewed invitees were. As explained in the introduction of this chapter, this inventee was picked and interviewed in the end of the research work, due to the lack of opportunity to finalize with three of the interviewees that accepted the challenged to participate in the research at starting phase. One of them had a solid port infrastructures experience in grains terminal, and port silos, working at Dubai Ports world. This one had a unique profile, so interviewee Q was invited to replace the missing classified interviewee "O" looking for the same or similar professional profile and experience in port construction infrastructures for grains.

The interview took place in 18th February 2021. The preparation of the interview gave the information about objectives, the scope of the study, and the clear information of use and consent of the interview content gathered during the informal conversation, that also would be recorded for later processing in the study.

The table below resumes the information CV, the regional range of experience considered, and classification of the source Q from the panel of interviews:

			Professional EXPERIENCES along it's carrier Classified - 1 to 10				
Interv	**Position / Organization / CV**	**Location**	Regional experience	Logistic	Port	Trade	Agro
Q	Grains technology Storage Expert Sea & Oceania, Head of Business Unit at Buhler Asia Pte.Ldt in	Singapore	Europe, Med, Asia,	10	10	6	4

	Singapore, responsible for implementing large grain storage silos and facilities in port terminals around the globe. Buhler is a world leader in grains transfers and storage technology	Asia	Atlantic, MENA				

Table 50 - Description, region and experiences considered for source Q

The discussion with the source Q took place by Zoom conference, being interviewed in the main company in Singapore, in a quiet moment and environment, which properly allowed discussions and exchanging ideas about the main topics and entering in details with some of the closer subjects to him. As expected, deeper insights were naturally exploited in subjects matching the professional profile of the source.

The interviewee started with a general introduction and discussion about the latest projects being held by the company on the South Asian region, the majority of them related to Port infrastructures for grains, and as expected, some of them of huge dimensions when compared to European infrastructures. Many of the South Asian region countries are being helped by international world organizations, to establish grains facilities in ports and other infrastructures, especial the countries that are food import dependent. For these territories, where food security is a state problem to solve, the governments have given high priority and importance for the safety of their populations.

> "(…) definitely the south hemisphere agriculture is growing much more rapidly than in the north territories. They came later to industrialize the Agriculture and there is still a lot of work to be done. Fortunately, the world still has this opportunity, so otherwise we could not have food for all the people. Today we can have food for all, if some countries are facing hunger, it is by causes of political problems and economic issues, not agriculture subjects."_t_11:15

Countries with food security lack are not worried with supply. Origination of grains is not a problem in the international market today. Big tenders launched by the state department services to purchase grains and seeds for their food security stocks, are being disputed by major's players in the trade commodities industry. The big ones in the world of food commodities, the major trading houses are planning and supplying the needs based on their predictions and vigilance in the food world. A major traderhouse knows by its own predicting calculations and planning of activities when Egypt is launching the next tender for Wheat, and can even predict its estimated size, that should be around 200 thousand MT. So

the problem then is the logistics to ensure the proper delivery and storage of the commodities, food security stocks are critical for countries depending of imports to feed their populations. The reception logistic, storage and distribution is a national problem that the governments have to manage. These logistics problems are nowadays the main challenges of the developing world countries to resolve.

> "(..) Food security is strongly linked with the assurance of food logistics, which projects became of primary importance for the governments. I am currently involved in project like in Bangladesh, Peru, Equator, India, Indonesia, Singapore and others, where the main concern is food security. This is essential to protect the stability of the country. Many geographies in the world depend on trading, imports to survive, so food security are among the most essential, and priority issues for the countries, food is basic. Food is as much important as peace and strongly related, without food, you have wars, because without food you get instability and maybe civil war to dispute power. So the governments classify these infrastructures food projects has priority projects, and the development banks from ONU, EU, China and others, are easily financing the infrastructures. One of the big grains port silo that I'm now involved in construction in Bangladesh is classified priority and is financed by World Bank to the local government, and amount like 110 M usd"_t_33:52

The port logistics to operate grains, with specific technology for loading, unloading, drying, cleaning and storage the grains, is very well known by the interviewee. The evolution observed along is career is immense. The specialization of the grains terminals installing modern equipment to fast load or unload a vessel, with minimum losses, replaced the traditional cranes with transferring grips and paws, operation slow and with high losses. The grains bulk vessels in the world got bigger consequently needed fast loading and unloading equipment to reduce waiting time in the quays left to operations, to sail sooner. Old systems with grips and paws could take like 40 to 50 Mtons of grains per/hour. Today we discuss the installation of technology that easily achieves standards like 1,5 Thousand MT per/hour unloading, using screws or buckets elevators, also like 3 thousand MT per hour loading using pneumatic delivery suckers.

> "Seaborne trade evolution is immense, because transferring grains between countries must be efficient, in very large bulk quantities, the vessels keep growing and terminals and silos systems also growing. Technology to improve grains operations are every year more efficient, bigger, quicker with more speed,

> drying and cleaning capacity, to operate efficiently. This is why the grains terminals are popping up all around. The seaborne grains traffic zones need dedicated terminals for grains, technologically modernized and well equipped. In addition, not only in the oceans and in seas, also up the rivers to reach more industry and population with large bulk quantities efficiently flowing on river barges, we are today working in several projects at the same time"_t_37:10

The interview focus then his discussion on the European opportunity to develop a south terminal to discharge the grains. The interviewee recognized especially the opportunity for the oil seeds, like the soybeans. The importance of reducing time to market in the oil seeds, from hi experience, is immense. The protein seed reduces quality fast and measurements of the characteristics correct the economic value of the commodities, as seen in chapter “2.3 - Soybeans became the source of protein for meat production “. Therefore, when the grains are coming from south origins like Brazil or Argentina to Europe, having the opportunity to make transshipment sooner and save sailing days from the trips, to and from, the north European terminals might have great importance for the agriculture trading business value chain.

> "the soya, all grains in general, but being a high oil content seed is even more relevant in Soybeans, these products are alive, so as longer the time to transit and process, more depreciation in characteristics, and consequently in value it gets. The living seed need to consume its own protein and sugar to keep surveying along time, this can be measured in laboratories, at reception, when discharged and discounted in the trading price, as we all know. Therefore, time to market is essential for different reasons, all related with costs, carry financial costs, environmental costs, hedging exposure costs, but also to preserve the quality standards of the seeds and not discount quality on the price. As short, it is the logistics and processing, higher is the value of the all operation. Very important it is"_t_35:37

Moreover, it is important to reduce maritime impacts and unnecessary traveling. Any project augmenting efficiency of the commodities transports and reducing impacts in environment is very welcomed. The interviewee Q has strong knowledge about the regulations and the evolution agenda of compromises, of both parts, the countries and ship owners associations, established to protect environment.

> "(…) all projects that go towards the objectives of 2030, reducing emissions, sea protection contaminations, and environment protection in general, have strong

> public and institutional support today. For the operators is not less valuable when you can join the economy of the operational costs, this is very important for all. If you reduce costs, time to market, at the same time reduce environment impacts, so this becomes a priority project."_t_324:55

In interviewee Q opinion, it matters to evaluate the gains of a project like a terminal of grains in the south Europe. For him, the trigger cause to develop such a project is the international concern with logistics efficiency. The relevance of the seaborne logistics in climate impact is enormous, like we saw before, seaborne trade could represent around 2,5 % of the global GHG emission in the world. The environment efficiency might be the pushing reason for such a project to be implemented, in his opinion. Governments in the developed world are looking to do so, no matter the cots. In a long-term perspective, politicians and public opinion base their spendings for saving the planet.

> "(…) all the efficiency project for food are relevant. According to previsions, in 2050 we will be like 10 or 11 billion people in the world. ONG's are claiming that with the same consumer trends and lack of efficiency we will need the resources of 1,7 earth planets, and we do not have it, we have just one planet. All aspects regarding sustainability, efficiency and environment, are being handled each day more seriously. Governmental institutions and agencies, the public itself, give primary importance to sustainability. So we need to become more efficient in the operations, this means we should make the more operations with less resources, to save the planet. Logistics world has a lot to improve; especially the big logistics has a great impact in environment, the oceans and seas. International institutions, governments will care a lot about this projects that might bring efficiency for international logistics."_t_32:25

The interviewee Q, being a specialized port engineer in construction of grains infrastructures, moreover, with a Spanish origin and knowing very well the Iberian ports, predicts the importance of such an infrastructure in the south of Europe. In his opinion a terminal today must be equipped with modern high-speed capacity to load or unload grains, interconnected to a silo, large capacity, with intermodal capacities to connect railways and road trucks.

> "I believe a terminal dedicated to the transshipment in the south of Europe, would be very important for the reasons explained. Moreover, today I do not know any terminal specialized in this kind of operations. I presume it is a good opportunity to develop. It would need to be a modern terminal with equipment

> for large operations, high transfer speeds for loading and unloading operations, which is today very easy to install in port terminals. "_t_37:57

In a preliminary vision about size and investment costs of what could be a grains terminal in a south port of Europe, he offered an experienced professional opinion, of great importance, for the evaluation of such an infrastructure in the south of Europe.

> “For the costs I can give you figures of some typical projects. A ratio of 10 K MT capacity at 1 M euros is a correct ratio for the equipment, in a typical project you double with the same value for the infrastructures in civil construction works of the silo, the terminal costs around 2 M euros per 10 K MT capacity. Today in Europe would make sense to have like 400 to 500 KMT installation in a transshipment port instalation"_t_42:38

Several construction development models were known and experienced by this professional in the projects developed in different parts of the world. Private initiative asks for the space conception, leading to the opportunity study of the authorities to launch it. Also the governments and/or the port authorities are foreseeing these installations, building and operating them; or launching in concession, with or without the installations already built.

> "(…) today we observe both models of developing the projects. Who is moving first, and what type of country politics you have is the key shifting between the two models. Sometimes the private operators take the lead and ask for the concessions. Equally, the government through the port authorities are building the infrastructures and providing services to the economical agents, traders, or directly the industry. In addition, we find models where the port authorities contract by long term concessions to the constructions and operations; or just the operations, for this grains terminals and storage silos in the ports. Both models are happening in the projects I know around the world"_t_43:33

The past involvement of the interviewee with the major world traders ABCD was strong. He knows that the opportunity would be easily taken by any of the world big traders, even disputed, if it proves to be efficient. These big trading houses, with thousands of millions of turnover, can easily built a terminal installation of around a hundred millions euros today. It is “pinouts” for them, they would conquer a strategic position and a valuable efficiency infrastructure. The calculations are easy to be made; they have the models already studied.

The interviewee knows from experience several initiatives from the private players in industry that took the lead.

> "(…) in some cases, the big company trading houses, like Bunge, ADM, Cargill, Dreyfus or COFCO are contacting the governments to star discussing projects like this, if the project takes opportunity and the government allows, they just ask the concession for long period to build the terminals and infrastructure and operate during that long term, pure private. Sometimes it's a mixed project where the local governments usually through the port authority is taking a position in the project."_t_44:08

Discussing the opportunity for the ports in the south, the source Q, knowing very well the ports capabilities and the geography of Spain, could rapidly make a general picture of the main reasons to sustain or decline the opportunity for each port he knows very well. This concluding that, if the opportunity exists, it will be the fast movers achieving the project to take the lead, whether in South Portugal, Spain or North Africa.

> "(…) other port in the south Europe, Huelva, is chemical oriented and has not big draft for large vessels. Sevilha is a river port, makes no sense would cost a lot to bring the draft in the port. Barcelona is a very occupied and has strong congestion, is a port working with its strong inland industrial activities, focused on energy and containers, there are strong constrains to grow. Malaga could have opportunity for grains, but myself I contacted the port authorities and they are not focused on grains. Valencia would be probable an alternative, but it is not equipped to do that by the moment."_t_50:32

Concluding, the interviewee made some reflections about the trigger for the decision of such a project. In his opinion, showing the efficiency of the logistics, the political will shall move the project forward by investing on it, or launching it in concession, bringing the operators to build and explore it. Being efficient, it will be done, he says.

> "Food security is a trend for all countries, not only a political speech trend, but a real problem needing to be carefully undertaken by international institutions. When you do not have food, you face instability and even war. People fight for food, is human behavior at it is lower basic survival instinct. So any project bringing food chain value efficiency is very important for international food security institutions like EU, or ONU health, and Food departments, and independent organizations. So a project like this, proving that it brings better efficiency would rapidly collect this international institutional back support to be sustained and developed"_t_32:10

From Source Q, we can resume the subsequent table of variables and identify significant structural places and ideas as follows:

Variable	Level 1	Level 2	Level 3	Q	SP
1.0.0	***Grain facts***	***Grain facts***			
1.1.0		Grains moving south		5	X
1.2.0		Corn & Soya complex change		1	
1.3.0		Protein consumption raise		5	X
1.4.0		Soya protein source		4	
1.5.0		Seaborne trade evolution		2	X
1.6.0		Port Systems evolution		1	
2.0.0	***EU Infrastructure***	***EU Infrastructure***			
2.1.0		ARA traditional ports		1	
2.2.0		New EU south hub		2	
3.0.0	***Efficiency Drivers***	***Efficiency Drivers***			
3.1.0		Logistics Cost		2	
3.2.0		Time to market		3	X
3.3.0		Environment		4	
4.0.0	***Constrains***	***Constrains***			
64.1.0		Geopositioning			
4.1.1			Atlantic coast	0	
4.1.2			Mediterranean	0	
4.1.3			MENA	0	
4.1.4			Panama channel	0	
4.2.0		Port system			
4.2.1			Deep water	1	X
4.2.2			Port efficiency	1	X
4.2.3			Services	1	X
4.2.4			Intermodality	1	X
4.2.5			Inland capacities	0	
5.0.0	***Value Model***	***Value Model***			
5.1.0		Infrastructures			
5.1.1			Deep water port	1	X
5.1.2			Grains transshipment	4	X
5.1.3			Grains services	1	X
5.1.4			Port Efficiency	4	
5.1.5			Train, Roads, others	2	X
5.1.6			Crushing Hub	3	
5.2.0		Strategy			
5.2.1			Eur South Atlantic Port	1	X
5.2.2			Portugal HUB	4	
5.2.3			Transshipment	1	X
5.2.4			Geocentrality	1	
5.2.5			Med and MENA	0	

5.2.6		Hinterland Grains Industry	3	
5.2.7		Commodities Port Systems routes	0	
5.2.8		Concession Hypothetical scenario	1	X

Table 51 - Variables count Content Analysis for source Q

6.7 Resume and Analysis of the sources interviews

Discussing the results, the research considers the variables of the second empirical model analysis. The interviews beign made, were considered to cover the complete range of expertizes as pre-established for the research work. The exceptional sources that were missing, due to practical or professional reasons, were considered unnecessary to be replaced except for one case, as previously justified.

Forward work is focused on the empirical results discussion. The qualitative analysis, in a constructivist paradigm, makes its mental construction on experienced base reality, the individual cultures and life experiences are pasted on the result findings, we cannot extract lifespan involvement (Guba Yvonn As, 1994). The research work is a proceeding from the interaction of the researcher with the interviewees, interpreting ideas, varying subject constructions on the dialogue interview, making the variables identification and the structure places of the dialog hermeneutical and dialectic, along the discussions between investigators and respondents. The job reflects the “view perspective” of the source, but also the interpretation of the researcher. Epistemologically the investigator and the interviewee are not independent entities on the study work, rather the opposite, together are bringing the findings along their discussion, in a transactional and subjectivist experience (Monforte & Smith, 2020).

6.7.1 Answering the Research questions

Once the sources of information materials dissected and treated the discussion and analysis of the results, the researcher focused on formulating the answers to the investigation

questions previously formulated for the study interviews. Discussing the results and findings, the research looks to understand if:

1. Is food production Latitude coming down?
2. Should Europe look for alternative ports in the southern continental countries?
3. Is Portugal potential geographically competitive to become an alternative food port to Europe?
4. Possible impacts of a food terminal to the regional hinterland of the port?

From the materials collected in the conversation interviews, using qualitative analysis methodologies, the researcher made the transcription of relevant materials, dismembered the information about the ideas content of the interview, using the frequency count of keywords and identification of structural places in the discourses of the interviewees, being able now to systematize and discuss.

6.7.2 The empirical results discussion

Resuming the empirical findings from the in-depth interviews made, the research method follows the identification of the empirical model variables, based on the hermeneutical of the dialogue speech had with each study participant. The quantitative analyses of the interviews based on “keyword” count presented some limitation and difficulties. In fact, transcription to English resulted from several languages used upon the diverse nationalities of the participants in the interviews: Portuguese, English, French, Spanish, and Romanian. Furthermore, we could also consider that the Brazilian participants used different terms to express the same objects and realities, differently from the Portuguese participants. Therefore, the analysis of the interviews, that was guided using open-ended questions and free discussion conversation as previously explained, under the qualitative analysis (Saldaña, 2009), states that all codifications presuppose a researcher vision, an individual perception. In his theory, the author also presents useful tools for electronic coding using software for analysis, like Invivo, Atlas and Maxqda. Keyword analysis is an example of a “pre-code”, defined as a way to circle, highlight or underline passages of

text coding with short words or phrases. The application of the keyword system consisted of reading on the interviews the main keywords that were listed in order of frequency, excluding those defined only by an interviewee.

In a parallel counting, identifying the content interviews materials, the same questions, answers and discussions used for the keyword classification were again analyzed by another method – resorting to structural places. The author Maxwell, (Joseph A Maxwell, 2002), states in Huberman and Miles 2002, 37 that “validation has been a key issue in debates on the legitimacy of qualitative research (…)”, and that was the reason that led to the compare the two methodologies. The analysis using structural places was inserted in the theme of treatment of bulky materials referring to isotopy and descriptive condensation. "A bulky material cannot be analyzed line by line and the information can be dispersed throughout the text”. Information relating to the same unit of meaning is the structural places. The isotopes correspond to the same level as the structural places, with the same number of incidences, and the descriptive condensation to "synonyms of multiple language versions”. Structural places found in all definitions were listed for each interview, in the case of repetitions, this data was checked once.

Variable	Leve	Leve	Level 3	A	ST A	B	ST B	C	ST C	D	ST D	F	ST F	H	ST H	I	ST I	J	ST J	K	ST K	L	ST L	M	ST M	N	ST N	Q	ST Q
1.0.0	***Grain facts***																												
1.1.0		Grains moving south	3	X	3	X	5	X	1	X	2	X	3	X	3	X	4	X	3	X	3	X	3	X	2	X	5	X
1.2.0		Corn & Soya complex change	1	X	0		3		1	X	1	X	2		4		3	X	2		1	X	3		2		1	
1.3.0		Protein consumption raise	2		2		1		0		2		3		3		0		1	X	3		4	X	1		5	X
1.4.0		Soya protein source	2		2	X	1	X	0		2	X	2	X	5		6	X	1	X	1		1		2	X	4	
1.5.0		Seaborne trade evolution	2		3	X	3		0		0		1		3	X	3	X	2	X	2	X	4	X	2		2	X
1.6.0		Port Systems evolution	2		2		0		0		0		1	X	2		2		4		1		1	X	1		1	
2.0.0	***EU Infrastructure***																												
2.1.0		ARA traditional ports	1		1		1		0		1	X	2	X	5		6	X	1	X	2		5	X	1		1	
2.2.0		New EU south hub	3		2		3		1	X	1		1		3		3		1		1	X	4		1		2	
3.0.0	***Efficiency Drivers***																												
3.1.0		Logistics Cost	4		3		4		1	X	2	X	0		4		4		1	X	1	X	6	X	1	X	2	
3.2.0		Time to market	2		2		1		1		1	X	1	X	6		6	X	1	X	1	X	2	X	1	X	3	X
3.3.0		Environment	1		1		4		0		0		3		5		1		2		1	X	0		0		4	
4.0.0	***Constrains***																												
4.1.0		Geopositioning																											
4.1.1			Atlantic coast	1		1		5		1	X	1	X	1		2		2	X	1		1		1		0		0	
4.1.2			Mediterranean	3		1		2		1	X	1		2		3		3		2		1		1		0		0	
4.1.3			MENA	2		0		0		0		0		1		1		1		0		1		0		0		0	
4.1.4			Panama channel	5	X	0		0		0		0		1		0		3		0		0		0		0		0	
4.2.0		Port system																											
4.2.1			Deep water	4	X	1	X	5	X	1	X	1	X	1	X	4		4	X	2	X	1	X	3	X	1	X	1	X
4.2.2			Port efficiency	5	X	1	X	1		1		2		1		6		1	X	1		1		2	X	1		1	X
4.2.3			Services	5	X	1		1		1	X	3	X	0		4		1		2		1		1	X	0		1	X
4.2.4			Intermodality	6	X	1		0		1		1		1	X	0		2		2	X	2	X	3	X	0		1	X
4.2.5			Inland capacities	7		0		0		1		2		1		3	X	5	X	2		1		5	X	1		0	
5.0.0	***Value Model***																												
5.1.0		Infrastructures																											
5.1.1			Deep water port	5		1	X	5	X	1	X	2		1	X	0		2	X	2	X	1	X	3	X	1	X	1	X
5.1.2			Grains transshipment	5	X	2	X	3		1	X	1	X	1		4	X	5	X	1	X	1	X	2	X	2	X	4	X
5.1.3			Grains services	3		1		1		1	X	2		1		2		5		2		1		3		1		1	X
5.1.4			Port Eficiency	4		1	X	1		1		2		2		4		3		2		2		3		2		4	
5.1.5			Train, Roads, others	5		0		0		0		1		0		0		4		2	X	1	X	4	X	1	X	2	X
5.1.6			Crushing Hub	0		0		0		2	X	1		1		2	X	5	X	1	X	0		0		2		3	
5.2.0		Strategy																											
5.2.1			Eur South Atlantic Port	3	X	2		5	X	2	X	1	X	1	X	2	X	5		1		1	X	1		2	X	1	X
5.2.2			Portugal HUB	4	X	2		5		1		2		2		3	X	4		2	X	1	X	2	X	2	X	4	
5.2.3			Transshipment	4	X	3	X	4		1	X	3		1	X	2		3	X	1	X	1	X	1		3	X	1	X
5.2.4			Geocentrality	3		1		1		0		1		1		1		1	X	0		0		0		1		1	
5.2.5			Med and MENA	1		0		1		0		2		0		1		1		0		0		1		1	X	0	
5.2.6			Hinterland Grains Industry	2		2		0		0		2		1		3	X	6	X	1	X	0		3	X	2		3	
5.2.7			Commodities Port Systems routes	1	X	1		0		1		3	X	1	X	1		1		0		1		0		1		0	
5.2.8			Concession Hypotetical scenario	4		0	X	0		2	X	1	X	1	X	1	X	0		2		1	X	1	X	1	X	1	X

Table 52 - Variables and structure places of the interviews analysis

Supporting the discussion, to help interpreting the interviews content for each chapter of the empirical model used in the interviews, a condensed frequency count of both analysis criteria was obtained in the form of a table, as follows:

Variable	Level 1	Level 2	Level 3	Frequency	ST P
1.0.0	***Grain facts***				
1.1.0		Grains moving south		40	13
1.2.0		Corn & Soya complex change		24	5
1.3.0		Protein consumption raise		27	3
1.4.0		Soya protein source		29	7
1.5.0		Seaborne trade evolution		27	7
1.6.0		Port Systems evolution		17	2
2.0.0	***EU Infrastructure***				
2.1.0		ARA traditional ports		27	5
2.2.0		New EU south hub		26	2
3.0.0	***Efficiency Drivers***				
3.1.0		Logistics Cost		33	6
3.2.0		Time to market		28	8
3.3.0		Environment		22	1
4.0.0	***Constrains***				
4.1.0		Geopositioning			
4.1.1			Atlantic coast	17	3
4.1.2			Mediterranean	20	1
4.1.3			MENA	6	0
4.1.4			Panama channel	9	1
4.2.0		Port system			
4.2.1			Deep water	29	12
4.2.2			Port efficiency	24	5
4.2.3			Services	21	5
4.2.4			Intermodality	20	6
4.2.5			Inland capacities	28	3
5.0.0	***Value Model***				
5.1.0		Infrastructures			
5.1.1			Deep water port	25	10
5.1.2			Grains transshipment	32	11
5.1.3			Grains services	24	2
5.1.4			Port Eficiency	31	1
5.1.5			Train, Roads, others	20	5
5.1.6			Crushing Hub	17	4
5.2.0		Strategy			
5.2.1			Eur South Atlantic Port	27	9
5.2.2			Portugal HUB	34	6
5.2.3			Transshipment	28	9
5.2.4			Geocentrality	11	1
5.2.5			Med and MENA	8	1
5.2.6			Hinterland Grains Industry	25	4
5.2.7			Commodities Port Systems routes	11	3
5.2.8			Concession Hypotetical scenario	15	9

Table 53 - Variables frequency and Structural places

A bar graphic presentation of the Key-words accounted for each variable and respectable the ideas discussed, as considered structural places of the in-depth interview information.

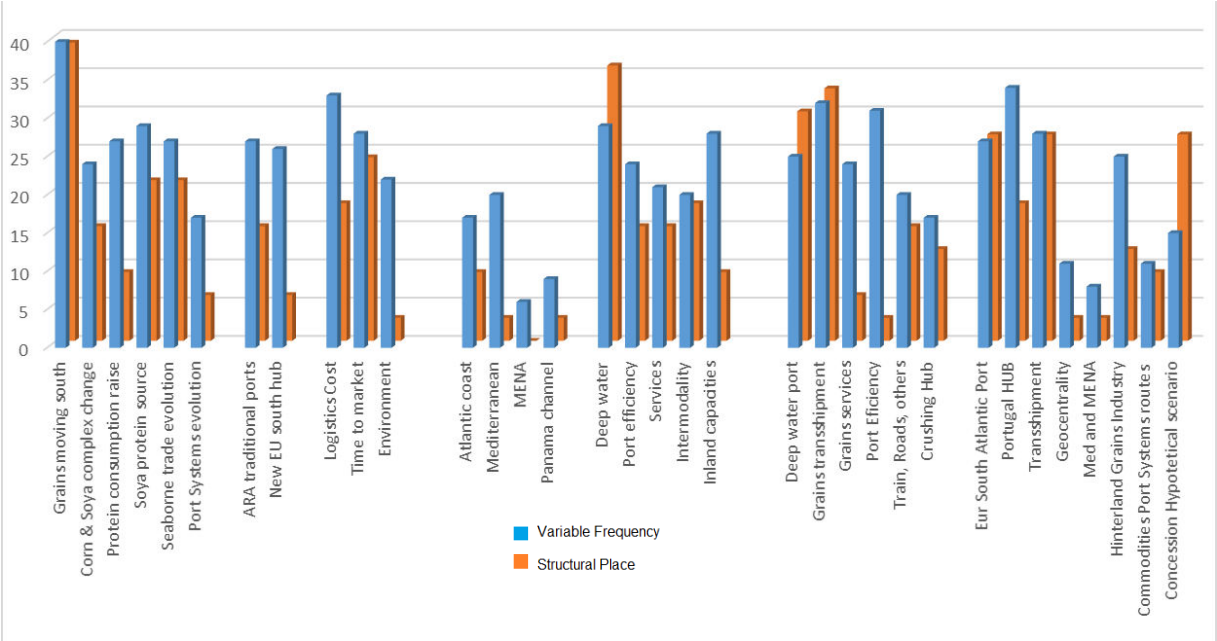


Figure 115 - Variables frequency count and Structural places

Therefore, we structured the analysis in five main sections according the group of variables of the empirical model. Primary, the grains facts. The findings of chapter "5 - Southern evolution of world agriculture production latitude" that were already responded by the quantitative research analysis, were in any case triangulated by retrieving in the qualitative phase of the research, the interviews, the same topics gathering the opinions of the multiple experts interviewed along the research.

After the characterization and discussion of the EU Ports infrastructures, especially those oriented to grains and seeds operations along the north Atlantic coast, has been brought to attention the actual structural role of the ARA ports in the intercontinental logistics of grains and seeds.

The respondents focused on the fact that food commodities global trade is progressively more competitive, obliging operators for looking to lower cost operations. "Efficiency drivers" identified and discussed by interviewee's fence the choice of operations and infrastructures to use.

The main constrains of the grains and seeds trade and logistics international operations are well known by the professional players in the global market. Several major elements due and must facilitate, an operation, increasing gains and confidence of the international trade of food commodities, otherwise disrupt and create mistrust on the trade market.

Subsequently, in the end, a Value Model free discussion was left as outcome corollary of all the interview conversation, relieving the main strategic factors to be apprehended by the port authorities and operators in favor of a new value added logistics model in Europe North Atlantic and Mediterranean coast.

We know deeply discuss and analyze each of the Level 1 groups of variables, from the respondent sources of information, making the résumé and respective corollary of Propositions for each main group of variables of the empirical model.

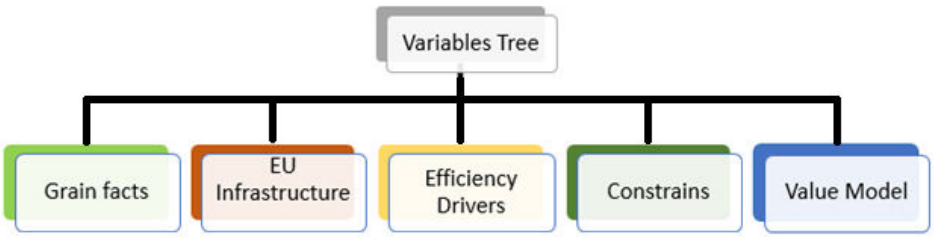


Figure 116 - Group of Variables Level 1

6.7.2.1 Confirming the world Grains facts on production latitude evolution

The 13 participant interviewees, all confirmed by their experience and historical knowledge of the industry, that the southern countries agriculture production took a large evolution on the last decades, not meaning that the north countries also increased their production, but the significate higher growth rate of the agriculture grains harvested volumes in southern hemisphere countries are well known. The recent years, world food organizations, like FAO or EU, and its statistical surveillance services, Faostat or Eurostat, clearly evidence the progressively displacement of the origin of the food commodities in the world from north to south countries.

Variable	Level 1	Level 2	Level 3	A	STA	B	STB	C	STC	D	STD	F	STF	H	STH	I	STI	J	STJ	K	STK	L	STL	M	STM	N	STN	Q	STQ	Frequency	STP
1.0.0	*Grain facts*																														
1.1.0		Grains moving south		3	X	3	X	5	X	1	X	2	X	3	X	3	X	4	X	3	X	3	X	3	X	2	X	5	X	40	13
1.2.0		Corn & Soya complex change		1	X	0		3		1	X	1	X	2		4		3	X	2		1	X	3		2		1		24	5
1.3.0		Protein consumption raise		2		2		1		0		2		3		3		0		1	X	3		4	X	1		5	X	27	3
1.4.0		Soya protein source		2		2	X	1	X	0		2	X	2	X	5		6	X	1	X	1		1		2	X	4		29	7
1.5.0		Seaborne trade evolution		2		3	X	3		0		0		1		3	X	3	X	2	X	2	X	4	X	2		2	X	27	7
1.6.0		Port Systems evolution		2		2		0		0		0		1	X	2		2		4		1		1	X	1		1		17	2

Table 54 - Grains facts variables frequencies

On a visual bar diagram representation of the same variables regarding the Grains facts discussed with the interviewees, the match correlation between the variables count and structural places ideas discussed, is observed, as per graphic figure bellow. The analysis that follows, retakes some of the most expressive experts citations to illustrate and base the conclusions, although, we could easily find transcriptions and repeat the citations of many others.

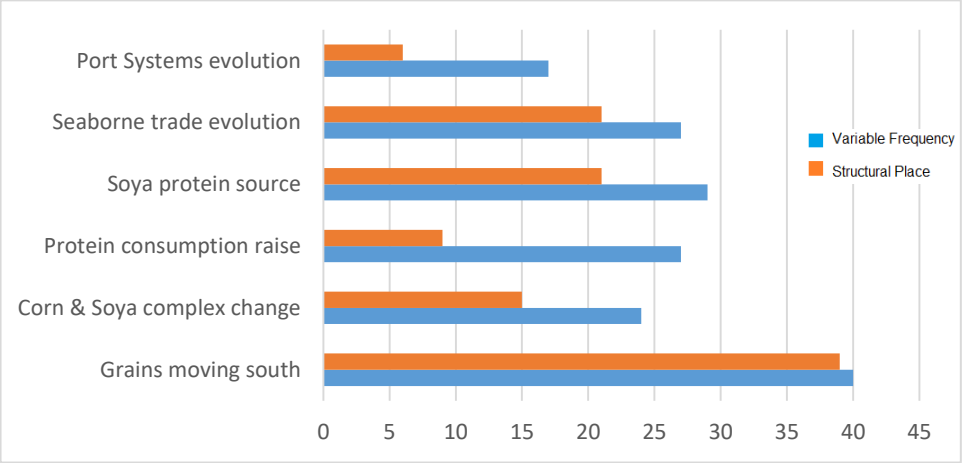


Figure 117 - Histogram of Grains facts variables frequencies

Grains agriculture production are moving south. The figures of agriculture development and especially of the imports from southern countries, exhibited large growth in the past decades compared with the northern countries, as per experiences of the interviewers. Always Brazil is appointed as the new super-power agriculture producer by the information sources; also in a second level Argentina and come time South Africa. Some respondents highlighted the expectation of the advance of Africa agriculture high potential,

even though, the endemic political instability appointed as the delaying cause of this development process.

The southern growth of agriculture in the world fact bared as an obvious evidence for all the respondent sources of information. With a record unanimous response on the variables frequency and on the identification of structural places discourse, this was an obvious no discussion result variable. As for every commentaries like "It is common sense, the agriculture new areas developed special in south America developed the agriculture commodities trade from this origins in the last decades. This I experienced …" (source B) referred in general, as a common sense "veritas" in the industry. All other interviewees were in line with these thoughts. "(…) we are assisting the increase of agriculture production in south America. Unfortunately, Africa is decreasing due to its context of instability, wars and political conflicts. Europe is losing the Agriculture production for other countries, and south countries are growing. Europe is losing capacity. Meat, protein, Europe is not sufficient, must import. Today is very easy to move grins if logistics is efficient (…)" (source L). Agriculture engineering education and professional training, together with technological development, were appointed as the main causes of their development in the southern countries. "Since I'm on the trading business, for more than 12 years, I can observe the significate growth and importance of the south America origins in the commodities business. And keeps growing (…)" (Source J). Technology essentially based in modern machinery to mass process land and inputs, new industrial fertilizers for the correction of soils and adequate seeding development, phytosanitary treatments to sustain and preserve production against plagues and diseases, and seeds genetics to improve resistance and productivity growth. "Brazil and other south hemisphere countries developed its agriculture in the last 40 years. The introduction of technology was determinant (…)" (source E). The interviewees observe the development speed of the agriculture growth in the south countries general, "(…) definitely the south hemisphere agriculture is growing much more rapidly than in the north territories. They came later to industrialize the Agriculture and there is still a lot of work to be done (…)".

Corn and Soya Complex change production geographical center, more than other food commodities. The transgenic seeds used in American continents, not allowed in European agriculture policies, made a different map of the geographical origins of this two leader

commodities. "(…) soya is today the main source of protein for meat production. I do not see an alternative in near future. You can produce more kilos of beef meat per hectare using soya, and the pigs and cows don't care what they are eating, so why to produce other commodity?" (source N). Soya become "a king" of protein source in the last generation, pushed by the technology for seeds resistance and high conversion ratio of the vegetable protein that allowed tremendous effect on the production growth of animal meat everywhere in the world. "(…)"one generation before the animal feed was conventional cereals, today soya is ruling the feed for meat (…)" (Source J). Some of the expert interviewees from Brazil can live this experience, "This year (2020) Brazil once again, is beating its record production in soybeans and Corn. Brazil will keep growing its areas in agriculture, some states are matured but others still have potential growing areas. Brazil raised this year 8,5% its soya production (…)" (Source K). "(…) South America is the important new source of protein for us, we at our company xxx we are buying Brazil, Paraguay, Argentina, only a part form New Orleans, EUA. This tendency is increasing as these countries are becoming more productive and trading is getting more competitive (…)" (source J).

Thus, the consequences of the growth of the agriculture areas in distant continents, demanding transportation in long distance intercontinental destinations, brought the need of the efficiency for the logistics. Intercontinental logistics of grains and seeds is today based in Seaborne trade infrastructures and capabilities. "(…) today the traffic of bulk grains is made in large scale, by bulk vessels, otherwise the grains become outside and not compatible with price targets of the market (...)" (source M). "(…) seaborne is the most efficient, less expensive and more environmental friendly way of transportation for goods (…)" (source L) . Likewise, vessels are growing in size. "(…) as bigger the size, less cost per ton of commodity trade cost. Size matters of course"(Source H).

Moreover, large vessels for cereals bulk cargos, oblige ports specialized to grains, deep-water births, also heaving loading/unloading high rate transfer equipment and silos facilities. "(…) vessel sizes are very important to make the shipment costs low. Trading with small vessels make no sense today. So deep water ports are essential (…)" (Source C). Deep water ports are the ones that can receive large vessels and obtain the advantage of the big trade leads logistics. "(…) the draft is main problem of the port expansion in the majority of

the ports administrations around the world, all the rest you can solve more or less easily. Keeping a deep draft by mechanical artificial technology is very expensive, so a strong constrain (…)" (source M). Engineering works might today solve the deepness of the bed (water bottom) of the ports, but at high costs, with environmental complex impacts, also with intensive maintenance as the sea keeps moving sands, mud or weeds, requiring periodically and expensive dredge works.

In resume, from the analysis of the empirical model variables for section One "Grains Facts" we resume the following four propositions:

Proposition 1	World food commodities agriculture production weighted geographic center, displaced to south significantly in the past 40 years. Big south hemisphere countries entered and developed industrial agriculture.
Proposition 2	Soya became the main protein source in the past 40 years. Soya production is mainly growing in America and Asia continents. Africa has strong potential;
Proposition 3	Commodities seaborne grains logistics increased vessel sizes for improvement of logistics efficiency, has grains consumption and trade volumes raised along the past 40 years;
Proposition 4	Commodities big volumes seaborne trade, requires specialized terminals, deep-water births for big vessels;

6.7.2.2 Recognizing the EU grains logistics morphology

Europe continent, and focusing in the north Atlantic coast, has a long historical trade tradition with the world. Along the centuries, the origins regions moved has the trading routes and maritime world capabilities changed and expanded.

In the last century, the European continent knew a strong social and economic evolution, leading the transition of the predominant sectors from primary activities, to industrialization and services, being agriculture progressively loosing quota in the population

allocation, this at the same time mitigated by the introduction of technology industrializing agriculture production. Cities got bigger, population increased in prosperity along the 20th century. The central Europe market, observing a growing deficit in food resources production, become importer, to feed internal consumption. Traditional receiving from northern hemisphere countries, like ex-URSSR, Canada and United States, organize its grains logistics capabilities in the northern traditional trading ports, for feeding central Europe market needs.

ARA, Amsterdam, Rotterdam and Antwerp ports, together with Hamburg a little further in the north, are the main destinations of the import trade of food commodities in Europe. Transshipping then to other destinations along the coast by smaller vessels, or throughout the European inland, using Railways, River barges and Road transportations.

Variable	Level 1	Level 2	Level 3	Frequency	ST P
2.0.0	***EU Infrastructure***				
2.1.0			ARA traditional ports	27	5
2.2.0			New EU south hub	26	2

Table 55 - EU Infrastructures variables frequencies

On a visual bar diagram representation of the same variables regarding the EU ports infrastructures for Grains and Seeds, as discussed with the interviewees, the match correlation between the variables count and structural places ideas discussed, is observed, as per graphic figure bellow. The discussion and analysis that follows, retakes some of the most expressive experts citations to illustrate and base the conclusions.

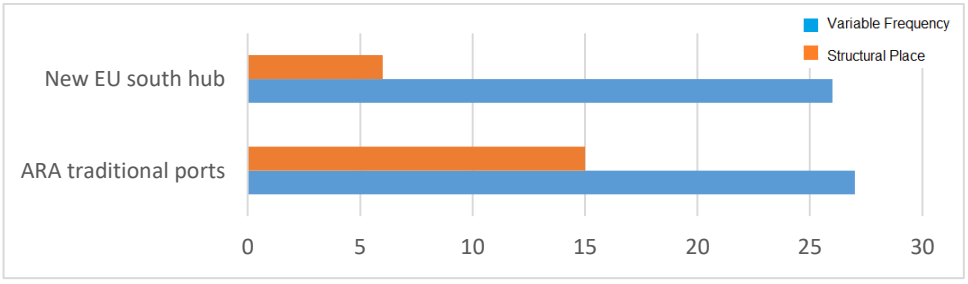


Figure 118 - Histogram EU Infrastructures frequencies

ARA and Hamburg are the main centers of grains and seeds trade operations. From there central Europe markets are supplied and transshipment operations for other destinies

are diverted. In a country like Holland, not having big agriculture surface, a tiny little country in the European context, Holland is the biggest grains and seeds exporter in EU, as we saw in chapter “2.4 - Intercontinental food Logistics, trade and vessels”, the trade and transshipment operations from grains and seeds received, make its exports value large volumes. Being located in the extreme north Atlantic coast, Hamburg already in North Sea region, this makes the traditional European Atlantic hub of grains and seed, eccentric, in the extreme north of the Atlantic coast. Historical tradition market strength, infrastructures existence, lack of alternatives trade ports with infrastructures.

Ara and Hamburg are hubs where operations of large size in the domain of grains and seeds can occur, are secure ports for big trade of food commodities cargos. "*The business is still based in this region by tradition links. Dutch traders had a strong presence in the world, this made ARA ports very strong destinations and trading origins of merchandizes, very appropriate to establish the business home (…)*" (Source H). This same idea was verified has common sense, among the participants in the interviews. Today, a trader in food commodities is not considering alternative ports for large cargo of grains and seeds, where else we can make large discharges and transshipment for grains and seeds? For large vessels the trading need capacities to load/unload bulk vessels at high-speed rates so the time cost for a docking operation is charge per day. To operate grains, traders also need specific operations in the port. To store, clean and dry are basic operations. Labs and certification surveyors must be ready 24H. Conditioning capacities for grains are very important to preserve and sustains along time the good quality of the cargo, otherwise the value will be discount or even lost.

As per the logic of the data presented, soya, also corn, are important grains cargos today in the global food commodities business. Origination of these cargos is tending to southern origins in the globe, Brazil and Argentina well recognized here with the panel of interviewees. Several of the participants, recognized that at least for part of the cargos, makes sense to look alternative logistics solutions in the south Europe coast, for diverting cargos for southern destinations and especially the Mediterranean area, this including North Africa, Middle East and Black Sea regions. The eventual opportunity to have this alternative hub in the south Atlantic European coast has in general, a very good perspective on the trader’s

views and opinions. Serious economic and feasibility studies should and have to be made. But the primary idea for a new hub in the south makes sense, especially for diverting the growing cargos originated in the south hemisphere.

Today, in a few decades, especially important due to the growth of the protein business, based in the soybeans imports from Brazil and Argentina, even when considering USA, the major cargo beans are descending along the Mississippi, to Baton Rouge/ New Orleans in Golf of Mexico. Thus, the origins are south hemisphere. The geostrategic position of Portugal, in the perspective of the interviewees is a great opportunity to evaluate a new grains hub to serve partially the European food commodities trade business. Portugal and Brazil are linked historically in their cultures, and this was originated by the maritime proximity of the territories. The maritime route from Portugal to Brazil that allowed the first discovery contacts between Europe and South America in the XV century, today is looked otherwise as a route for the trading of agriculture business. "*(…) Portugal is the nearest point between Brazil and Europe. Makes all the sense to study a hub in this corner, from Itaqui we are just 3.500 milles away, compared with Ara/Hamburg we are around 5.000 miles away(…)*" (source K),

Proposition 5	The maritime routes for the increasing commodities cargos from South America to Europe, will benefit of efficiency if a southern port with a specialized grains terminal
Proposition 6	Freight impacts of the seaborne transportation and distribution of grains, would be reduced, if Portugal (as well as others European Southern Atlantic or West Mediterranean countries like Spain, Algeria, Maroco) would have an alternative port to ARA, for reception and transshipment of food commodities.

6.7.2.3 Efficiency drivers of the grains and seeds logistics

What are the main drivers that may cause the change or replication of such an important infrastructure like a specialized big grain terminal in a Port, for the south Europe? The question is not easily to solve. Apart from the efficiency measured, other influencing factors might be determinant for the success of a port terminal.

Measuring better efficiency of a logistics operation in terms of fuel consumption, time to market, of even emissions, are mathematical calculations based in current acceptable rates and parameters of evaluation in the industry context. The interviewees, did consistently recognize the fact that a terminal in south of Portugal, receiving from South America and transshipping partially the cargo for a Mediterranean destination country, would represent a considerable economy on the overall shipping costs and impacts.

Other strategic ideas are clearly targeted. The south hemisphere potentially will keep growing their capacities for harvesting areas. The actual big agriculture commodities producers ones like Brazil and Argentina, are being fast tracked buy new entries in industrial farming like Mexico, Chile, Equator, Peru, more recently and tackling Paraguay and Venezuela. South America is a powerful grains and seeds garden to feed the world. "*South America will lead the protein production in the next comings years. Maybe in another 10 or 20 years' time, some Africa countries might also become important agriculture producers, but it depends of economic development this means also political stability which is difficult to observe or predict*." (Source C) . Looking in a global perspective, the future potential development of agriculture areas, following publication of the sector, is seen by the interviewees, as having an opportunity-developing phase in African continent countries, opening new areas and introducing technology "*(…) The big growth of agriculture in South America is ongoing, I believe the next world geography is Africa continent(…)*" (Source N) . Big farming houses are making initial attempting moves, testing the geographies, looking for goof soils and clime, but essential for political stability and territorial trust, generally the main lacks in African opportunities. "(…) *Today the necessary technology pack to develop grains production in Africa continent have no surprises. Brazilian farmers are able today to start getting initial good production in these new areas. There are regions very alike the Brazilian biome and clime conditions. We are in the same geographic latitudes. The problem in Africa is political, the*

governance, the institutions are not yet opened to foreign investors. Investors need favorable and steady political environment to invest. We observe many Brazilian groups making also initial moves in Africa, by now experiments and prospecting opportunities. Africa will be a big player in the future and very competitive, close to south Europe (…)" (Source N)

The Portuguese case, is an example presented by the professional food commodities trader houses in Porto and Lisbon, from where 3 interview sources are executive trading leaders. Portugal traders are importing more than 5M MT per year, of grains and seeds with food and feed destinations, being 3M MT for feed mixtures for meat, eggs and dairy industry.

The global southern trend origins also influenced Portugal sources, as stated by interviewees. Today, the majority of the food commodities have southern origins, weather from the south hemisphere countries like soya meal or soybeans from South America And Mediterrean countries. Even part of the USA origin is from southern ports of Golf of Mexico . Observing the information in "Table 56 - Portuguese food and feed commodities origins (INE / IACA) " resumes INE, the Portuguese Institute of Statistics, in a study recently elaborated by IACA, the feed industry Association . We can clearly see that southern origins dominate the map, countries like Spain, Ukraine, Romania, Brazil, Argentina, Egypt, USA. The actual trend only the case of France, predominantly the port of Rouen in the Atlantic coast, is a wheat leading supplier (IACA, 2019).

Importação de Matérias-Primas

Produtos	2011	2012	2013	2014	2015	2016	2017	Principal Origem (% de Valor)	
Mandioca	1 613	994	1 361	926	645	858	4 237	Croácia	90,7
Trigo Forrageiro	1 256 236	1 399 773	1 075 542	1 243 089	1 275 576	1 433 822	1 546 477	França	50,0
Cevada Forrageira	334 268	220 832	240 115	276 761	297 586	364 465	342 611	Espanha	39,0
Aveia Forrageira	15 562	10 306	12 826	10 883	11 658	9 113	7 099	Espanha	100,0
Milho Forrageiro	1 588 221	1 668 875	1 633 843	1 769 178	1 801 096	1 880 649	2 107 238	Ucrânia	34,5
Sorgo Forrageiro	23 407	4 044	4 539	5 250	4 623	5 127	6 527	Espanha	73,5
Soja (Grão)	642 235	610 364	798 447	734 822	787 131	759 328	796 075	Brasil	40,2
Colza (Grão)	252 120	187 931	134 695	311 434	337 344	281 584	282 519	Ucrânia	28,6
Girassol (Grão)	243 587	286 439	307 084	245 133	235 112	155 623	243 195	Roménia	65,5
Farinha de Luzerna	25 080	36 902	35 215	25 243	37 211	35 940	22 942	Espanha	97,8
Gorduras Animais	900	1 053	8 727	3 675	14 573	9 985	5 010	Espanha	98,6
Melaço	61 247	60 773	68 827	64 690	48 204	56 255	57 261	Egipto	60,6
Glúten Feed de milho	63 598	24 136	49 959	61 698	36 768	76 887	71 398	EUA	96,0
Farinha de Carne	817	605	1 365	1 137	896	1 651	2 793	Espanha	98,1
Farinha de Peixe	5 211	5 582	5 054	4 045	2 507	3 617	2 852	Espanha	91,9
Bagaço de Soja	253 055	217 300	100 194	145 287	103 089	178 687	146 325	Argentina	86,7
Outros Bagaços	279 088	234 277	210 722	301 696	182 602	184 102	161 025	França	26,9
Polpa de Beterraba	6 247	20 914	8 146	5 640	10 174	12 017	14 794	Espanha	69,4
Bagaço de Frutas	30 735	30 681	16 946	13 731	14 912	19 792	13 438	Espanha	96,1
Sub-Prod. Cerveja	41 168	5 149	6 937	12 527	3 664	19 515	6 236	EUA	100,0

Fonte: INE/IACA

Table 56 - Portuguese food and feed commodities origins (INE / IACA)

The interview sources recognized that Portugal destination is struggling between buying from transshipped big cargos from north ARA, or smaller cargos directly from south hemisphere origins.

The transshipment total operation, when being a combination of a long distance origin cargo, followed by a short-sea shipping distribution operation, makes the long distance operation phase benefit the economies of scale, bringing down prices and environment impacts per MT transported. This economy has to cover the transshipment operation, considering the overall transport cost per ton, financial cost of the global operation, time to market costs, environmental impact, which is in most cases easy to demonstrate, has we discussed previously in chapters 2.6 and 2.7 of this thesis. The interviewees, as exposed in the previous chapter, consistently further underlined the major arguments for these hipotesys new geographic map of distribution creating a new south Hub in Europe for the south hinterland and south transshipment of grains cargos.

In the existing traditional trading lines the food commodities cargos are crossing up the Atlantic Ocean to the North Sea destinations essentially of ARA and Hamburg ports. Big vessels, over 100 K MT, low cost and impacts per Ton. From there the hinterland is served by

road, rail or barges, also transshipments in smaller vessels are serving the Atlantic European West coast, the Mediterranean Sea destinations, North Africa, Middle East and Black Sea.

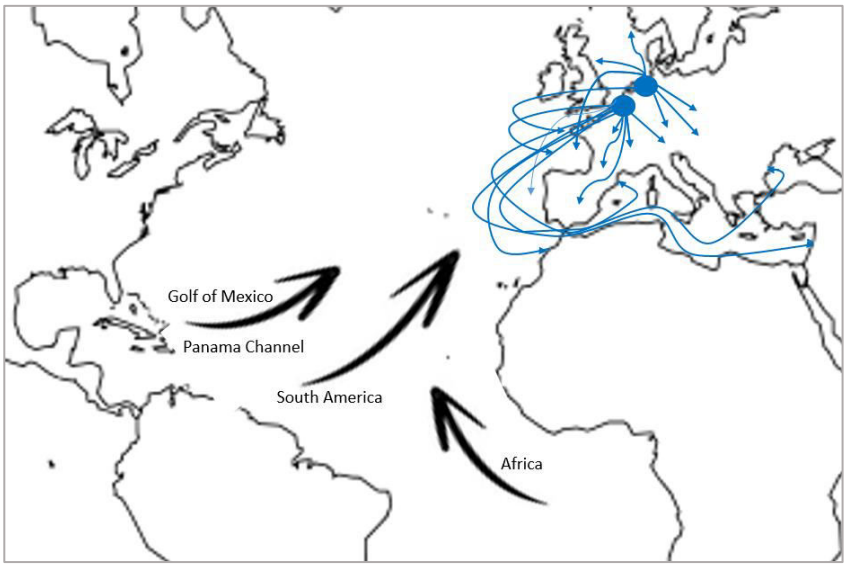


Figure 119 – Actual main grains logistics for Atlantic southern origins

The economies of a south-Europe transshipment operation would bring a new geographic picture for the logistics map, closing the shorter the distance between the south destinations of South West Europe, the hinterland and costal destinations, as well as the Mediterranean Sea destinations, North Africa, Middle East and Black Sea. As an exercise example, the gap maritime distance between Sines and Hamburg is approximately

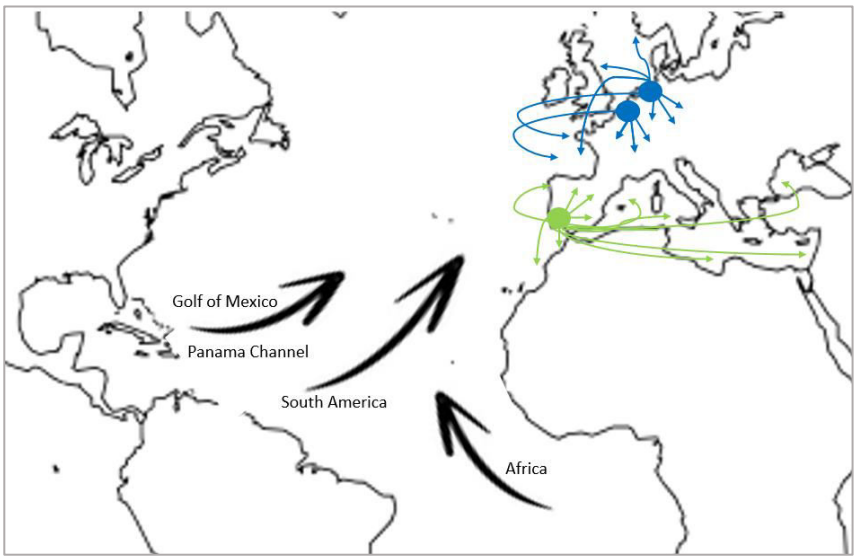


Figure 120 - Hypothetical New logistics map for south origins

The interviewees sustain the hypothetical new logistics map, serving the criteria for big cargo splits earlier for shouter destinations "*(…) it makes all the sense for the south countries in Europe, Mediterranean markets and north Africa, to receive grains from southern origins, like Soybeans form brazil, through a cargo split in a port in the south Europe. It has to be a deep-water port to allow big vessels, if not the advantage is lost with small vessels. Exporting Beans form Brazil, it makes all the sense to split the cargos sooner before ARA to send a partial of tons in Mediterranean markets for instance (…)*" (Source C)

The efficiency drivers are the main key, to trigger the stakeholder's interest on the subject in discussion. Possible further evaluation and hypothetical implementation are clearly pushed by these economies of efficiency. Experience international logistics professional are unanimously stating "(…) *The business is still based in this region by tradition links. Dutch traders had a strong presence in the world, this made ARA ports very strong destinations and trading origins of merchandizes, very appropriate to establish the business home. Today this origin has a global links in port systems due to trade tradition. Efficiency is the driver to change the tradition* (…)" (Source H).

Consensually, we identify in revised "Empirical Model" three main criteria, with measurable parameters being cost, time and environmental impacts. The decision drivers for a hypothetical decision would have fundaments by means of measuring the three drivers:

- The total sail time of the cargo, between origin port and the destinations ports;
- The economic costs considering the overall charges of transportations the cargo, transshipment operations, financial carry costs along time, as well also risk exposure coverture costs;
- Certainly, not the less relevant, the environmental impact, being negative is always seen as a cost to minimize.

From our source interviews we can extract the following frequency count, expressing the consensus of the around the factors, as per table Table 57 - Efficiency Drives variables frequencies bellow.

3.0.0	*Efficiency Drivers*		Frequency	ST P
3.1.0		Logistics Cost	33	6
3.2.0		Time to market	28	8
3.3.0		Environment	22	1

Table 57 - Efficiency Drives variables frequencies

On a visual bar diagram representation of the same variables regarding the Efficiency Drivers, as discussed with the interviewees, the match correlation between the variables count and structural places ideas discussed, is observed, as per graphic figure bellow. The discussion and analysis that follows, retakes some of the most expressive experts citations to illustrate and base the conclusions.

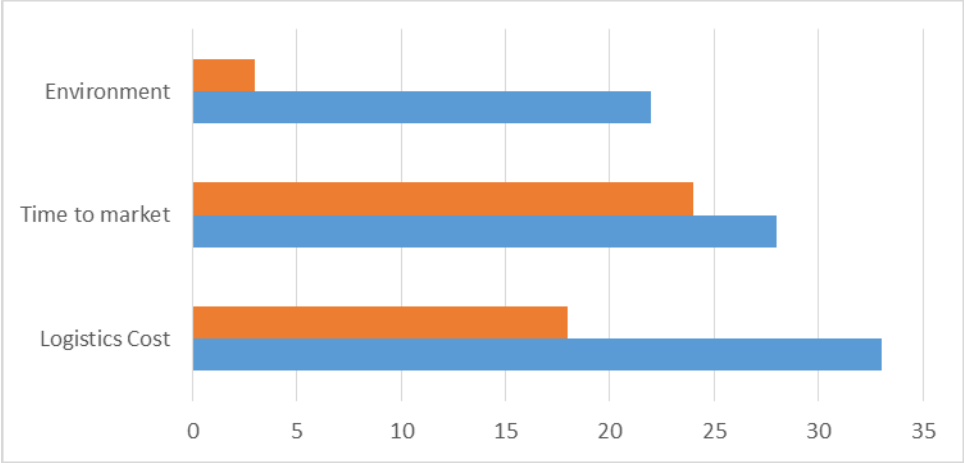


Figure 121 - Histogram Efficiency Drivers frequencies

To conclude the discussion of this variables level 1, we might say the following statement, sustained by the previous discussion and citations.

Proposition 7	A new Southern European grains HUB, is easy to understand and explain, especially oriented for southern origin food commodities big cargos to be distributed Southern Europe hinterland and transshipped to other destinations in Mediterranean, North Africa, Middle East and Black Sea zones. This, driving down the overall costs, time to market and environment impacts.

6.7.2.4 Constrains and opportunities for a South EU HUB bulk grains logistics

The installation a new port terminal, visioning a modern HUB in the South Europe zone, in present times, is a complex project, so as we saw in the previous chapter “2.5 - Port Competitiveness in the world” the ports complexes and its authorities, in the last century developed the specialized terminals for each cargo types as volumes growth. Due to this increasing volumes evolution, the need to speed operations of loading and unloading with specialized handling equipment, required specialized equipment and materials for the port tasks and maneuvers. Before, any quay was a general cargo quay, loading or unloading any type of merchandize. We were talking of small size vessels, with cargo capacities like 5 or 10 K tons. Today we can multiply these cargos sizes x10, x20 or even x40, so it was necessary to develop installations to make efficient volume operations. And port administrations made the necessary investments or concessions for this new specialized terminals. This allows the port operations to be quicker, more efficient, and viable in the limit consideration.

Many examples might be found in Ports worldwide. There are specialized terminals equipped with facilities, equipment, cranes for loading and unloading a myriad of different types of cargo. We have today specialized big carriers above 100 KT for many cargos, so matching terminals are equipped in the main ports of operating this big carriers. Like standard 20 or 40 feet Containers, enclosing all types of consumers and industrial goods and materials. Ro-Ro terminals for cars and other vehicles, having special platforms to connect with the vessel decks for loading and unloading vehicles by driver. Terminals for specific solid bulk cargo, like grains, minerals, pellets, coal among others, usually these solid bulk materials terminals interconnect the kay equipment with inland warehouses or Silos, using appropriate conveyors systems, crane bucket lifters or suction drag nozzles. Liquid bulks terminals, for products like crude, oils, edible oils, liquid chemicals and combustibles, have also mechanical arms to interconnect the pipelines with the vessel and the inland tank farms for storage. Liquid gas, the LNG/LPG terminals, pipelined with inland pressure tanks and with the eventual downstream distribution main gas network. Brake bulk cargo, like large pieces of machinery, big boxes not standardized, wind towers and its giant blades, among other specific cargos, usually operating with large general-purpose moving cranes.

A new HUB for grains in the south Europe, has to be a specialized terminal. Should be able to receive large vessels for solid bulk cargos, having the necessary equipment for fast loading/unloading operations, interconnecting the quay with storage facilities, these with intermodal connection with road trucks and rail-cars. “(…)"*Seaborne trade evolution is immense, because transferring grains between countries, must be efficient, in very large bulk quantities, the vessels keep growing and terminals and silos systems also growing. Technology to improve grains operations are every year more efficiently, bigger, quicker, with more speed on operations, also including drying and cleaning capacity, to operate efficient. This is why the grains terminals are popping up all around the seaborne traffic zones with dedicated terminals for grains* (…)” (Source P).

The geo-position opportunity for a new grains HUB in the South Europe to interconnect the southern grains origins with the south West Atlantic cost, Mediterranean, North Africa, Middle East and Black Sea ports, was extensively discussed with the interviewees. Several sources are matching with this Souce C citation *"(…) an Atlantic port in Portugal, would be ideal not only for the south America beans, also the corn, which are today probably the main leading commodities entering Europe from the south Atlantic gate. But in the years to come, the Atlantic coast of Africa will become also exporting grains. Those countries have similar natural condition like Brazil to produce grains; agriculture is developing rapidly, not as fast as it could due the political instability and security lack. But in time, Africa will develop its Agriculture and will be also supplying the world. Once again is a south origin towards Europe. Angola, Namibia, Uganda, Nigeria, many countries are being targeted by the farming industry (…)”* (source C).

The scenario of having an alternative large capacity grains HUB for cereals and seeds, is seen as a opportunity for the general interviewees respondents, like without any doubt about it “(…) I fully agree that Europe should have a south hub to minimize costs and make more efficient its grains logistics (…)" (Source L). The European industrial evolution showed how the central Europe progressively left its power to distribute the units all around the countries. The transformation units for grains and seed are in the first line the milling factories producing flours, feeding the sectors of bakery, pasta, cookies, pizza, etc. ; the crushing factories, producing vegetable oils and meals, oils for cooking, mayonnaises,

margarines, sources, etc.; meals for feeding the animal compound aliments industry for producing meat. Population and welfare living, meaning market, is in the end locating the industry "*(…) I understand why the ports of ARA are close to the central Europe, big cities, dense populations and existing historical industry. The big ports developed were there are big consumption centers. So central Europe is obvious a big traditional consumption center. But life changes, and logistics looks for efficiency and many other big cities and industrial centers developed around the Mediterranean, North Africa, East Europe, MENA, everywhere there are now industry and production clamming commodities at good prices (..)*" (Source N)

From our source interviews we can extract the following frequency count, expressing the consensus of the around the factors, as per table Table 57 - Efficiency Drives variables frequencies bellow.

4.0.0	*Constrains*			Frequency	ST P
4.1.0		Geopositioning			
4.1.1			Atlantic coast	17	3
4.1.2			Mediterranean	20	1
4.1.3			MENA	6	0
4.1.4			Panama channel	9	1
4.2.0		Port system			
4.2.1			Deep water	29	12
4.2.2			Port efficiency	24	5
4.2.3			Services	21	5
4.2.4			Intermodality	20	6
4.2.5			Inland capacities	28	3

Table 58 – Frequency count Main constrains and Opportunities for a new South HUB

On a visual bar diagram representation of the same variables regarding the Constrains and Opportunities of a South Europe Grains HUB terminal, as discussed with the interviewees, the match correlation between the variables count and structural places ideas discussed, is observed, as per graphic figure bellow. The discussion and analysis that follows, retakes some of the most expressive experts citations to illustrate and base the conclusions.

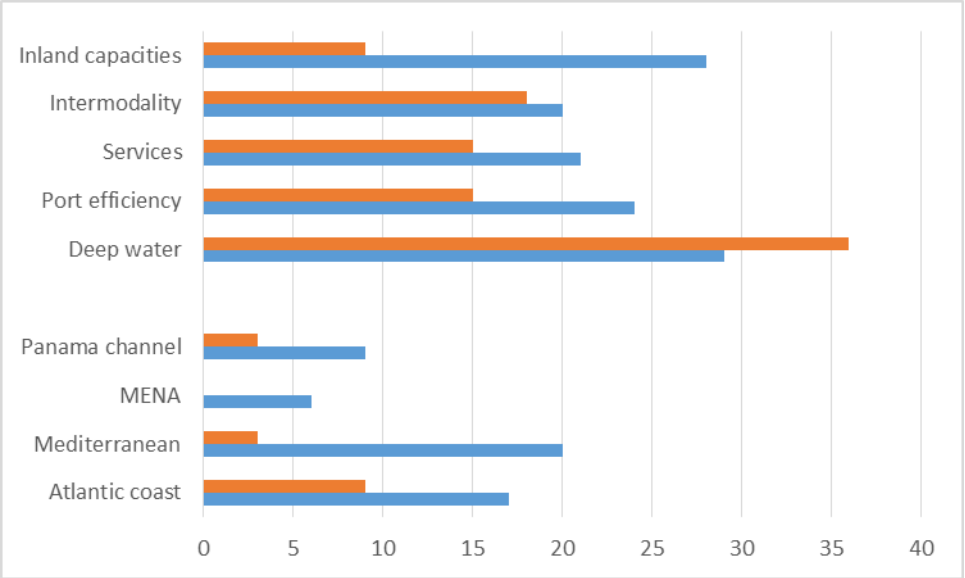


Figure 122 - Histogram Constrains and Opportunities od a Grains HUB in South Europe

Regarding for a new grains HUB in the south Europe, in theory, it would be always possible to load/unload grains in any port, using a general cargo quay, with mobile cranes and trucks, we can always unload a bulk carrier. The problem is the speed. Example, we might unload a bulk carrier with a mobile small crane and a convoy of trucks at a good speed of 50 MTs per hour, even considering 3 cranes during 24 hours and along 7 days, this would take 1 month to unload a 150.000 MT Post-Panamax vessel, which is inviable. This is why for large carriers specialized and equipped terminals are required. With a specialized terminal for grains, equipped with fast loading/unloaders, that today can reach 1.500 MT/Hour, the same unloading operation could take maximum 4 to 5 days. Imagine the docking of the vessel could cost like 10.000 eurs per/day + vessel daily rate 25.000 eurs/day, the time cost difference can easily reach 1 M eurs.

This specialized terminals made the port-systems networks organizations, as we saw in previous chapters “2.4 - Intercontinental food Logistics, trade and vessels” and ”2.5 - Port Competitiveness in the world”, so the ports facilities, the ship-owners and ship-agents, could organize specific lines, sea routes, between this specific terminals searching compatibility to treat efficiently the cargos.

For Inland cargo destinations, the intermodal capabilities are essential issues in the port infrastructure equipment. Modern facilities have to operate at large transfer rates the cargos between vessel, silos/warehouses and the transport facilities taking the cargo to the

processing destination industry, whether road transportation by trucks or preferable grain rail-cars. "(…) *the question will become, not just what port to use, or where to bring in commodities, but where will those commodities get processed. The idea is shrink the gap between commodity discharge, and commodity processing. Creating port handling and commodity processing eco-system is a potential development path* (…)" (Source I)

One other main question in this opportunities and constrains discussion, is the draft of the quays. This is not preferable or desirable; it is "a must" for the terminal characteristics, as we saw previously in chapter "2.4 - Intercontinental food Logistics, trade and vessels". If the terminal does not allow vessels with deep drafts, a quay with water level profounder below 15 meters from surface, there will be limitations as blocking the access of the trending bigger vessels. The draft of the generality of the Ports is the question mark limiting the size of the vessels docking in the Port terminals. "*(…) for grains trading, big volumes of seeds require big vessels, and these vessels requires a deeper draft. This is a main constrain in some Portuguese ports in the north like Aveiro. Although is very good in terminal availability, draft is a big limitation. In Leixoes, we may bring slightly bigger vessels, up to 50.000 MTs we made, but this Port is in its operational limits, we lose too much time there. For a Panamax we have to use Lisbon, Trafaria terminal, we make up to 60 max 70.000 MT. Post Panamax, in Sines, but there are no grain facilities, so not in Portugal by now (…)*" (Source M).

Proposition 8	A new Southern European grains HUB, requires a specialized grains terminal with high transfers rate for large cargo vessels operations
Proposition 9	Deep water quays are essential for large carriers above Panamax size
Proposition 10	Intermodality for grains cargo is essential to efficiently operate grains transfers between the vessel and trucks or rail cars.
Proposition 11	A hypothetical South Europe grains terminal would introduce efficiency splitting the distribution of agriculture commodities from south origins, to European South destinations, Mediterranean Sea, North Africa, Middle East, Black Sea destination ports. An economical and market assessment must sustain this opportunity.

6.7.2.5 Value Model factors for bulk grains logistics

During the interviews with the invited sources, in a prospective discussion analysis, several themes were raised exploring each one experience and expertise in the specific domain of the discussion. What is the value model strategy to exploit this eventual opportunity of a new HUB for grains in the South West Europe ? the question subdivided several other questions identified in the "empirical Model" as per "6.4 - The new Empirical Model constructed during interviews" that guided the interviews job phase. Several direct questions and answers on a prospective discussion context, following the expertise and experience of each source participant. Questions like "Do you consider this "South west Europe grains HUB" an opportunity? more dedicated for inland or transshipment operations? opportunity for Portugal or you see other better location ? in a public or concession development model ? among others.

To be able to respond towards the opportunity of building a new grains HUB in the South west Europe, the candidate Port shall have to fulfil certain requirements, being some of them what we could classified structural endogens opportunities, this means they are "natural environment" of the existing location, or it would be very difficult to recreate. Example, the geo location in the south Europe zone, the deep-water bottom for receiving large vessels, the existing road and rail interconnections to the Port. These three factors, we may consider "endogenous" meaning whether the Port infrastructure already has them, whether it would be very expensive to build these same opportunities.

From our source interviews we can extract the following frequency count, expressing the consensus of the around the factors, as per Table 57 - Efficiency Drives variables frequencies bellow.

5.0.0	*Value Model*			Frequency	ST P
5.1.0		Infrastructures			
5.1.1			Deep water port	25	10
5.1.2			Grains transshipment	32	11
5.1.3			Grains services	24	2
5.1.4			Port Eficiency	31	1
5.1.5			Train, Roads, others	20	5
5.1.6			Crushing Hub	17	4
5.2.0		Strategy			
5.2.1			Eur South Atlantic Port	27	9
5.2.2			Portugal HUB	34	6
5.2.3			Transshipment	28	9
5.2.4			Geocentrality	11	1
5.2.5			Med and MENA	8	1
5.2.6			Hinterland Grains Industry	25	4
5.2.7			Commodities Port Systems routes	11	3
5.2.8			Concession Hypotetical scenario	15	9

Table 59 - Frequency count Value model variables

Also using a visual bar diagram representation of the same variables regarding the Value Model variables, grouping the Infrastructural items and the Strategic options, of a South Europe Grains HUB terminal, as discussed with the interviewees, the match correlation between the variables count and structural places ideas discussed, is observed, as per graphic figure bellow. The discussion and analysis that follows, retakes some of the most expressive experts citations to illustrate and base the conclusions.

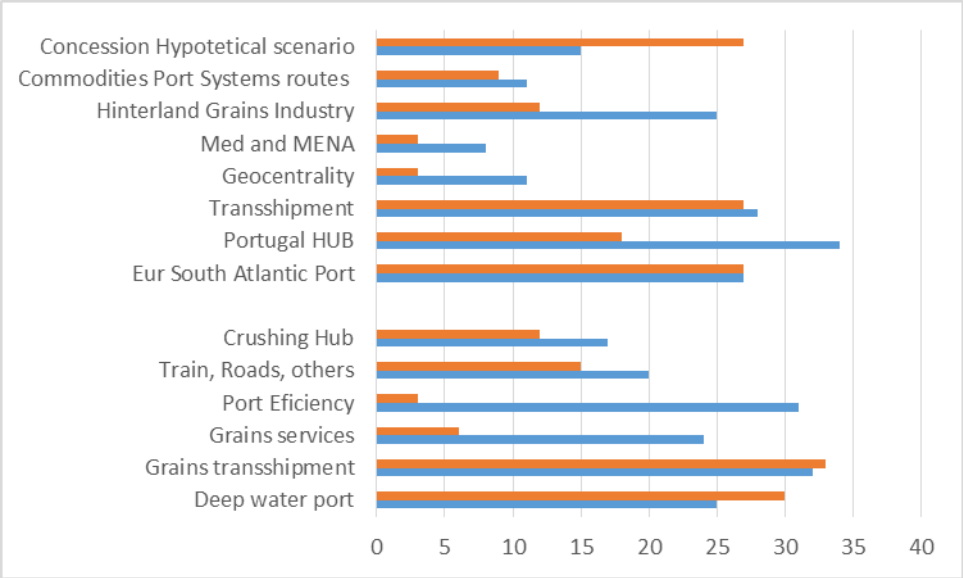


Figure 123 - Histogram Value model for a Grains HUB in South Europe

The Port geo location is very important for the trading business. Shortening maritime routes may has a positive and definitive impact in the trading of the operations. *"(…)on the physics trade, the importance of the connections is key factor of the port, after commodities are traded. The liquidity of the transaction operation, especially in spot markets are depending of the quick dispatch of the merchandize*" (source R). Contributing to the ability to make shorter times is the geolocation, the efficiency of the services and the intermodal capabilities of the Port. Above all, the opportunity for a new south UHB in south is consistently in the interviewees mind, looking for the benefit of the geolocation of the new terminal in south Europe to receive the merchandize from South hemisphere and dispatch closer and sooner. This shorter distance would represent several advantages for trading improvement opportunities. Meaning with less transportation costs, less time to market, anticipated payments, so more liquidity and better quality delivered. The transshipment opportunity, making long distance in large vessels and transshipping for regional distribution in short-sea services with smaller vessels is probably the most commonly foreseen operation creating volume in a short time of operation this new hypothetical Hub. *"(…)"Today the grains strategies are focused not only in the production, but the farmers houses understood that the logistics issues to access the markets in the best conditions can make to win or lose a lot of value in the operation. Makes no sense to produce with very competitive levels and high technology in production to drop value on the logistics to market. Logistics is always*

discounted from production because the price is established by the market; the producer must warrant its merchandize in the best conditions to reach the market incorporating the logistics. Making a new entrance and diverting the cargos, in smaller transshipment operations in the south of Europe makes all the sense. I fully agree with the confirmation of your primary question (…)" (Source N). The opportunity exists "*(…) the European infrastructure is modern, you can make good operations in transshipment, and interconnect with the smaller ports (…)*" (Source K).

Follows other important factors identified to "bring to life" a grains terminal. The services, Silos/Warehouses, loading/unloading systems and interconnection conveyors, intermodal interconnections for grains. *"(…) the transshipment operations, like Sines is very well positioned to do, as well as being a south Atlantic deep water port, can be done anywhere, as it does not depend of inland facilities, just port operations. So being competitive and efficient is the most import for the logistics operators and ship owners" (Source A).* Efficient services to operate a terminal, meaning unloading, storing and dispatching are the main operations. However, we might look also for other specialized operations important to receive grains and seeds, like cleaning using screening facilities removing foreign matters mixed in the grains from agriculture origin or transportation. In addition, very important is the possibility of drying the grains and seed, considering that if humidity is above certain limits this might cause the fermentation or putrefaction of the grains. In the first case, the fermentation may cause severe damages in the installations, being able to cause fire. Inspections, Fumigations, other specialized services when storing and handling grains are necessary. *"The key question is always the economy of the operation; this is ruling the choices of the operator. Eventually if industry customers and trade operators fit to a new logistics lay-out less expensive, this will work(…)"(Source M).*

The development model of such a terminal was a discussion that had no controversy, instead, very common aligned opinions. The Port should care to design the strategy of the use of the terminal, on single or multiple players, its interconnections, size, technology, type of operation, services provided, tariffs regulations, among others. Launch the tender for the concession, selecting the best proposal and offer. But the immediate following question is if there are submissions to such a tender. Our interviewees have expressed their indication

about the opportunity *"(…) the key question is always the economy of the operation, this is ruling the choices of the operator. Eventually if industry customers and trade operators fit to a new logistics layout less expensive, this will work. The economy of the overall operation is the simple trigger to change the center of the operation, I'm positive about that. It doesn´t matter where to change the cargo, anywhere is ok if operations are efficient and less expensive (…) is the arithmetic's working, we add costs, and choice is made. This might take some time, but the arithmetic's is working and ruling."(Source M).* An experienced logistics manager, working with some of the big commodities trading houses of the world, could express is confidence in a tender process result, prosing himself to bid at the possible tender. *"(…) it is necessary to study deeper (…) but foreseeing that with a more efficient logistics system I would better positioned for the success of the trade operations, Yes, I would candidate to the concession of a new terminal in the South of Europe (…)"(Source H).*

In the opinion of another experienced maritime logistics expert the question to raise is why it was not made before, reminding himself about the south countries tradition *"I wonder why this did not occur yet? Makes all the sense. Probably because that the countries that could be potentially more positioned geographically to make this transshipment of grains in the south of the continent, are Portugal or Spain, and their strategies are not focused in food commodities as the norther ports are from long time, with strong tradition (…)" (Source D)*.

The existence of a Crushing Unit in the Port industrial zone was considered strategic from the trading point of view, so the protein complex is often traded and operated in complementary/sequent operations. For some interviewees, experienced with trading and industrial seeds crushing, the question has a simples answer *"(…) an oil and meal extractor factory is obviously there in the future. The trade operations will have more options if there is soya meal in the complex. Where there is a Soybean port, you can find closer an extraction operation, to convert meal for the local feeding industry but also to re-export on the port, we know many examples where this is as such." (Source N)*. Other experienced international traders working protein underline the same perspective *"(…) the transshipment of the protein is not only the soybeans, big part of it is the crushed beans, especially the meal for the feeding industry, the oils goes for food and biodiesel, but we always need the meal part from the beans. So, in my opinion, if a terminal for shifting soybeans would make sense in Sines,*

immediately a crushing unit would be demanded by the feed industry (…)" (Source J). The discussion also progressed around the initiative of such a crushing unit. Who's the right profile partner to make the investment in such a unit. The general opinion is that the Port should not even care about, only to preview the space for the installation. As possible closer to interconnect with the silo, perhaps allowing a conveyor chain to transport the grains, and this silo on its turn, interconnect with the unloading terminal in the quay. The installation of an industrial oil seeds crushing unit, would than come from the economical opportunity to develop the oils extractions business in the location.

To conclude the discussion of this variables level 5, we might say the following statements, resumed in 4 propositions as follows, sustained by the previous discussion and citations.

Proposition 12	A new HUB for grains in South west Europe, should attend large volumes, (idea size, estimated min 200 scalable to 500 K Tons) , equipped for fast loading/unloading grains, with storage facilities, intermodal. An economical and market assessment must sustain this opportunity.
Proposition 13	A Port-zone Seeds Crushing industrial facility, would integrate/complement the protein complex trading. An economical and market assessment must sustain this opportunity.
Proposition 14	The interconnection with other Grains port systems and trading systems would result in efficient operations. Info systems, real time trading data for Grains specialized info systems.
Proposition 15	The opportunity for an international open tender for a "Concession of a grains terminal" would be a model to follow, as per international experiences. An economical and market assessment must sustain this opportunity; produce a teaser for attracting preliminary "letters of intent".

6.7.3 The research interviews corollaries summary

Matching with the calculations made for the evolution along 40 decades, considering the average production Latitude of all countries agriculture crops, of the seven quoted and biggest traded food commodities in the world (grains and seeds), the grains facts are unanimously confirmed in the interviewees experienced knowledge. The global production of grains and seeds is increasing in the south hemisphere more than in the north part. The average latitude is tending to south. This confirmation, works has a double check and confirmation of the calculations of the research findings in chapter "5 - Southern evolution of world agriculture production latitude" showing the evolution along last 4 decades where a value of 6,2 grades south was calculated in the displacement of the average latitude of global grains production. This representing around 700 km N-S increasing in the medium of all food commodities maritime traffic for grains and seeds, representing like 1,6 days of medium sail time.

Europe grains and seed trading centers keep the same from more than one century, regardless of the geographical change in Latitude of the agriculture production global center. Trading tradition markets and luck of alternative infrastructures are the possible only cause to divert cargos in southern regions of Europe.

Looking to change for an alternative location, shortening cruise time, transshipping in the south region of Europe and North Africa, especially the cargos from the South America zone of origin, the protein; the unanimous opinion focus on the efficiency trigger. *"Quicker, cheaper, safer… go for it."(Source D)*

What we look for? a southern new entrance Port in Europe for grains and seeds; Deep water port; with a Specialized quay; having storage silos; grains services; oil seeds crushing capacity; intermodality with road and rail.

The development model, being the port able to establish the strategy for the terminal, the development and project finance might be is appointed for a tender to concession to build and operate, recognizing that there are several international players able to be attacked to the operations opportunity. The same for the oil seeds crushing unit.

As a corollary the observation of an interview source with world experience in the construction of port infrastructures for grains and seed, shows the importance of making the

necessary infrastructures to allow the logistics operators to be more efficient, drive value high and reduce impacts. *"(…) Logistics world has a lot to improve; especially the big logistics has a great impact in environment, the oceans and seas. International institutions, governments will care a lot about this projects that might bring efficiency for international logistics (…)" (Source Q).*

6.8 Port Competitiveness requirements inquiries

Ports are crucial strategic elements in international economic development so they operate as trade facilitators in the global economic, being consequently developing regional economy interfacing between nations its physical trade movements of merchandizes. Port competitiveness is than an important subject, considered by international institutions focused in economic development, also many scholars, producing relevant number of articles and literature. The port competitiveness studies build some constructs that have been exploited and progressively adapted. We can resume, from all of them, that the evaluation focus essential three main aspects : The Services of the Port, what is the offer of specialized services to vessels in traffic, the costs, availability and promptness ; The hinterland, intermodal connections, industry attraction, regional collaboration, skills and external services; The Convenience, water depth, info systems, labor stability (strikes).

The port competitiveness measurement helps administrations to understand from its users the needs to improve facilities, operations and services offered, to better configure the offer towards ship-owners, ship handlers, line operators, exporters and other clients of the port in general. Strategic investments, looking always to improve the offer, should consider the improvement opportunities appointed by the port customers. Improving the services, making the necessary and more efficient, is a necessary the continuous improvement process of any management organization. The Ports, gathering and managing a vast number of activities, have many different fields and details for improvement. An example expressed y one of the interviewees in previous chapters, was very well demonstrative "to discharge the cargo, the client and insurances requires an accredited "surveyor report". The accredited surveyors companies must be installed in the Ports services zones. The vessel should not wait 1 day more to start discharging because the surveyor is coming from Lisbon, with excuses

“now is late and too much traffic, he will come tomorrow”. This is not acceptable. The waiting time cost of the vessel is twenty times more expensive than the inspection cost. So the service exists, but is not efficient, next time we choose another port” (Source L)

From the crowd of institutions and scholars that have addressed the study and analysis of the port competitiveness in the past, the classifications criteria and selection of the parameters to analyse, are the basic difference between the evaluation models.

Early, United Nations in its annual conference for Trade and development, in Genev 1976, published what become a base guide for appraisal the ports services internationally (UNCTAD, 1976), this was a request of the committee of shipping, pressured by ship-owners to establish standards of services, that are also linked with the cost/price evaluation between ports. This guide, became a “Bible” for the Port Administrations, it went upgrading and followed in the coming years with improvements and amendments including indicative performance indicators and score cards examples to follow (UNCTAD, 2016). Later and meanwhile, the World Bank edited also a revision of the port services evaluation factors (Worldbank, 1993). This performance features, where grouping different criteria and parameters that ranged from services quality assessment evaluation, to value for money comparators, returns on investment and efficiency measurements.

Scholars were also assessing port services evaluation methodologies, creating constructs of analysis and scientifically framing their findings. The initial research literature, very focused in port productive concepts, goes back in the 80´s. Roy Pearson in the University of Liverpool, was pioneer developing assessment methods for Port services competitiveness (Pearson, 1980).

Understanding and making systematic analysis of the port sector was an effort made by different academics, measuring economic performance and operational productivity of the sector. Bringing the research for improvement of the assessment methodology, looking for what is relevant in Port Services in the user viewpoint, also the relevance and acceptability of the valuation constructs by the port clients, are often assessed in this research jobs (Pallis, T., & Vangelas & Beneficiary, 2014), orienting the construct for measuring the performance in the users perspective (Vaggelas, 2019). Measuring efficiency factors and port performance parameters are orienting some research on past and current performance efficiency indexes,

what Wag called a hybrid data envelopment analysis (Wang et al., 2021) . Evaluating services between in an international level, comparing operational parameters, has to consider cultural behaviours and traditions in the assessment methodology (Feng, Mangan, & Lalwani, 2012). In an industry where cost of the assets is high, capital investment return is a main question, this research showed that speed of delivery is many times more important that the charges values, this should impact the performance assessment of the Port (Steven & Corsi, 2012).

Initially the studies for evaluation Port efficiency were focused in productivity factors in several activities of the port operations. Later other studies were focusing in the engineering capabilities and simulation scenarios. Today a more holistic approach brings together services and capabilities in global operations performance indicators, including environmental impacts, social welfare and safety. No matter what is the approach, the basic need to make the assessment and appraisal of the Port performance, therefore sustain the politics, economical and operations decisions of Port Administrations and their stakeholders community, "Ports need to have a method of identifying and prioritizing port investments to take advantage of the opportunities for future growth" (González & Trujillo, 2009).

For our research job, we consider a model and further upgrade some specific parameters on the construct to cover specific Grains and Seeds port operations, eventually necessary as well as the location factor in the south Europe. The same conceptual model and construct for the research will base the theory of Gi-Tae Yeo (G.-T. Yeo, Roe, & Dinwoodie, 2008) where the construct for "Port Competitivenes" is based in 7 factors and 38 components is used to test and compare the port factors of competition, based in a scenario where the Port of Sines might be considered a food commodity port infrastructure accordingly.

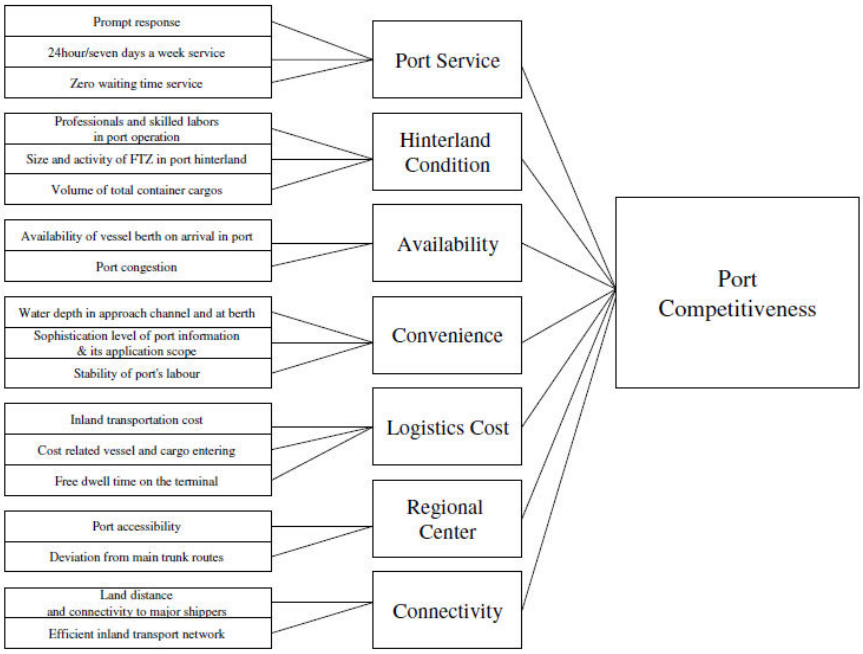


Figure 124 - The construct of Yeo, Roe & Dinwoodie

But fot his research we should introduce a new factor of comparation with another 6 components, as described bellow :

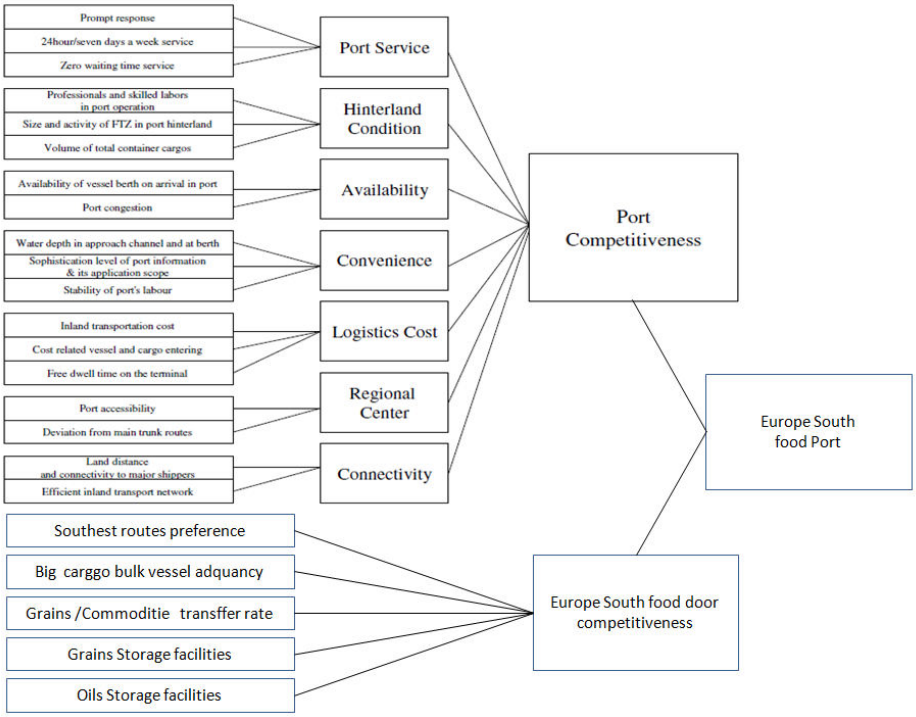


Figure 125 - Constructed revised and upended for the present research job

6.8.1 The inquiring objectives, and new variables

Having the opportunity to meet the interviewees of the panel for the in-depth interview moments proposed for this research, 13 international persons. The opportunity was also used for an exercise of assessing their opinions about Port competitiveness in the view of a Grains and Seeds trader or logistics operator perspective. Meeting high-level international professionals in the trading and logistics of the industry was a unique opportunity.

The construct used, was built from literature review consensus as explained in the previous sub-chapter, after, upended with 5 new variables in third level, focused in the specify of the research job on-going, the new south west European door for grains and seeds, building one higher second level variable. This would combining with the model of Yeo, Roe & Dinwoodie that brings the port competiveness parameters.

After the discussion on the grains moving west Europe, to direct destinations and from transshipment movements, the acceptance of a southern route for Grains and Seeds was a obvious opportunity to evaluate “southern rotes preference”. Being the grains and seeds traded in large bulk volumes, the efficient way to treat international transportation f this cargo type was substantially growing in size along the pasted decades, as we saw in chapter “2.4 - Intercontinental food Logistics, trade and vessels”. Though, the consequent question was about the ability of the port to receive big size vessels, usually limited by its draft, inquiring the opportunity to dock “big cargo bulk vessels adequacy”. Having large volumes of bulk cargo in the ship holds, a quick and efficient unloading and loading systems for grains is necessary, the adequacy questions “the importance of the grains transfer rate”. The storage facilities, silos and or warehouses, for temporary hold of the merchandize in the Port, allow to buffer the cargo between the quay operations and the interconnexions inland rail or road, allowing different transfer rates, without losing efficiency in the quicker side. This might be between sea to road, sea to rail-car (train), or sea to sea. Therefore, evaluating the importance of “grains storage facilities” was included. On the international trading of grains and oil-seeds, vegetable oils are many times together, as we discuss before and was stressed by some of the interviewees. Early, during the empirical work, the same questions was gathered for “Storage of Vegetable Oils”.

The five parameters of evaluation described, constituted the strength of the variable level 2 on the new construct, for “European south commodities door competitiveness”. This level two was then closing the model for evaluating the importance of the parameters for each competitiveness factor of the hypothetical “Europe South Food Port”, joining Yeo construct with the general services value assessment, as we saw before. What services and facilities are relevant for the logistics trade of Grains and oil-seeds, in the view of the interviewees participated in the research job, was the final finding objective.

6.8.2 The results

The table below resumes the importance given by the interviews for each variable of the evaluation construct model.

Factor of competitiveness	Inclusions, description, meanings	A	B	C	D	F	H	I	J	K	L	M	N	Q	avg
Considering the of Yeo, Roe & Dinwoodie construct															
Port Services	Prompt response	4	3	3	2	3	3	5	4	3	2	4	4	5	3.5
	Availability 24Hours /7 days	4	3	3	1	4	2	4	1	3	2	1	1	3	2.5
	Zero waiting time service	3	3	3	1	4	2	1	1	3	2	1	1	3	2.2
Hinterland Condition	Professionals and skilled labors in port operation	5	5	4	2	3	2	5	5	5	4	5	3	5	4.1
	Size and activity of FTZ in port hinterland	4	1	3	1	1	1	1	2	1	1	1	4	3	1.8
	Volume of total cargos	4	1	2	1	1	1	1	2	1	1	1	1	3	1.5
Availability	Availability of the vessel berth on arrival in port	3	2	2	1	4	2	4	4	1	3	3	1	2	2.5
	Port congestion	2	2	2	2	4	2	4	3	1	2	3	2	2	2.4
Convenience	Water depth in approach channel and at berth	5	3	5	5	5	5	4	5	5	4	5	5	4	4.6
	Sophisticated level of port information and applications	4	3	1	1	1	1	1	1	1	1	1	3	3	1.7
	Stability of port’s labor	2	3	3	1	2	1	3	4	5	3	3	3	3	2.8
Logistics Cost	Inland transportation cost	2	5	4	1	1	1	2	4	4	4	4	2	1	2.7
	Cost related vessel and cargo entering	3	4	1	1	1	1	3	1	1	4	2	1	1	1.8
	Free dwell time on the terminal	1	4	1	1	1	1	3	1	1	1	1	1	1	1.4
Regional Center	Port accessibility, regional connections and services	4	1	2	1	1	1	1	3	1	5	4	1	3	2.2
	Deviation from main trunk routes	1	1	1	1	1	1	1	1	1	1	2	1	1	1.1
Connectivity	Land distance and connectivity to major shippers	2	1	3	1	1	1	1	1	1	3	3	3	4	1.9
	Efficient inland network	3	4	2	3	1	1	4	1	1	3	2	3	2	2.3
	Rail interconnection	5	4	4	5	1	5	4	5	5	5	4	5	5	4.4
Considering food commodities in particular															
South preference	Southwest location in a European supply logistics context;	4	3	5	5	4	5	4	5	5	5	4	5	5	4.5
	alternative for carriers with south hemisphere origin;	5	3	5	3	5	4	3	3	5	5	4	5	4	4.2
Bulk cargo	Facilities For loading/Unloading, storage of grains and veg oils	3	3	4	5	4	4	4	5	4	3	3	3	5	3.8
Transfer rate	Importance of the speed of loading/unloading operations	2	1	4	5	5	3	4	3	2	3	3	3	5	3.3
Grains storage	Storage silos, for grains and meals;	2	4	4	5	5	3	4	3	4	3	2	3	4	3.5
	Loading and unloading equipment’s, conveyors;	2	3	4	5	4	3	3	3	2	3	2	3	5	3.2
	Grains conditioning, cleaning, drying equipment’s	2	1	2	4	4	3	3	3	2	3	2	3	4	2.8
Veg Oils storage	Multiple Tankage for veg oils;	2	3	4	5	4	3	4	1	2	3	2	3	5	3.2
	Loading/unloading pumping and pipelines for veg oils terminal+B11	2	3	4	4	4	3	3	1	2	3	1	3	4	2.8

Table 60 - Results survey about important factors of Port competitivness

Traders and logistic professionals leading with grains and seeds intercontinental markets, in Portugal or internationally, are somehow consistent on their views of the main relevant factors of competitively in the ports services and facilities offered to the ship-owners and ship-agents, to their clients operations in trading grains. A visual bar diagram illustrates

the mains factors to comment bellow.

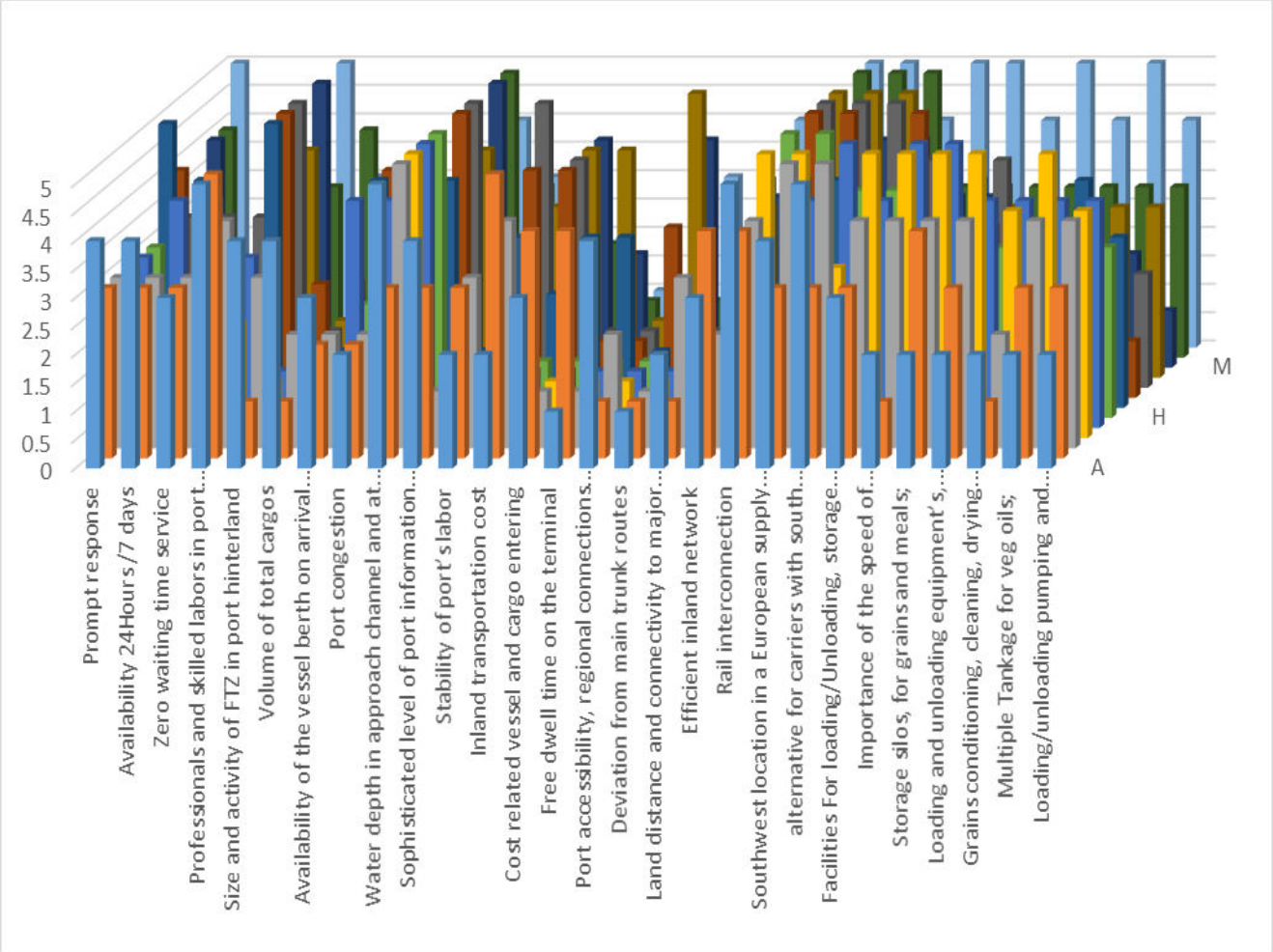


Figure 126 - Survey with interviewees - Port factors of competitiveness

Due to the consistency, we may illustrate a simple bar graph using the calculated average response per item, as follows.

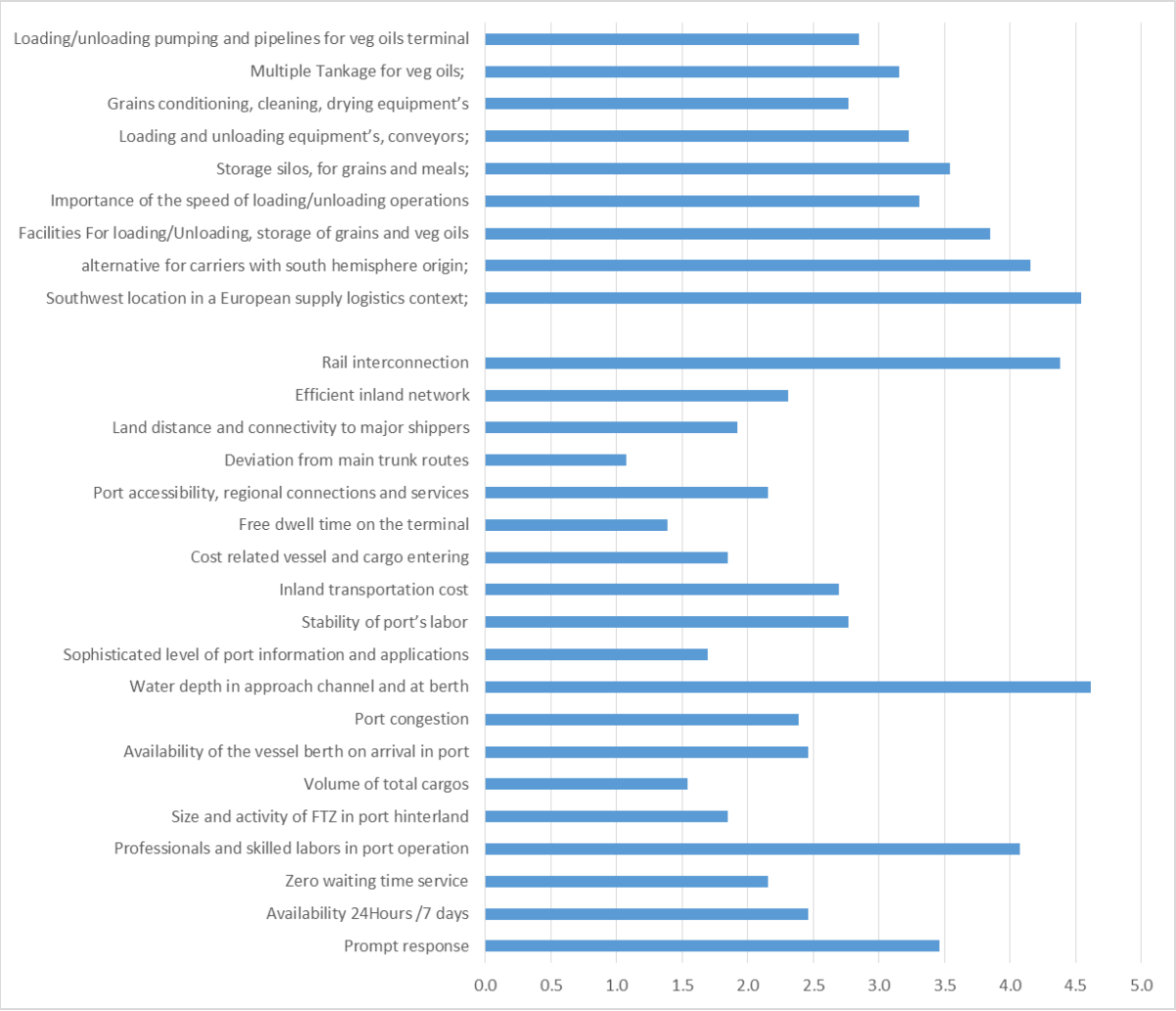


Figure 127 - Bar graph for the mid-average of the responses to the survey

6.8.3 Discussion of the results of the enquiry

The inquiry was performed and confined within the participant's interviewees, the sources of information for the in-depth interviews made in the research process of this thesis. We can make considerations about the validation of this sample, on size and diversity, once we were talking to grains specialists as clients of the ports services. This profile characteristic of the respondents is evidence in the high quotes given to the grains services of the port. However, the proposed evaluation had exactly the purpose of guiding the discussion about the main factors of competitiveness to choose a port, using the Yeo construct. In addition, in

case we are operating gains and seeds, which are the main services and capacities highlighted.

The nine variables upended in the original Yeo construct and oriented to evaluate the competitiveness importance of certain services and capabilities, of a hypothetical South west Port in Europe, was no surprise, considerer high value by the generality of the respondents. We would not expect other way, having a new terminal for grains, therefore the high tech services and equipment are required for efficient serve large volumes of bulk grains operations.

Having an alternate European Southwest Port location in the continent to supply gains and seeds in a Port with a logistics context for handling large volumes, big vessels is clearly identified by the respondents. In a 0 to 5 scale, the block of two variables regarding the geo location of a new grains port in the south west Europe, exhibits a medium punctuation of 4,3 revealing the emphatically agreeance of the respondents with the capabilities expressed. The all block of answers regarding the 9 variables intrinsically related with grains and seeds is punctuating 3.5 expressing a positive thinking about the competitive scenario in the opportunity of a south grains terminal in Europe.

All the other variables from the Yeo construct are evaluated and the responded results are more or less consistently. It is true, all services and capabilities are welcome and considered needed. Ranking them was the challenge. One respondent even clarified is position as “all of the services and capabilities mentioned are important and must available” establishing a ranking of priorities was the challenge during the discussion. On these other 19 variables of the Yeo construct, the respondants clearly underlined with high scoring 4 of them.

Rail interconnection, the capability to interconnect the port cargos in an intermodal infrastructure. The cargo might reach or dispatch the Port by Sea, using the maritime transportation with cargo vessels, buy road interconnecting the main highways of Europe, and buy train, using rail-cars for the specific cargo or rail platforms move the merchandize. The distances, the urgency and the infrastructures at the land dispatcher are the main parameters to choose between the interconnection transport options.

The water depth in the entrance channel and in the berth is crucial for the large sized vessels. The tendency for large cargo is a consequence of the economic growth on the demand side, but also the way to make more efficient per unit/ton the overall costs of the transportation, once divided per unit. Big vessels require deep water on the entrance of the port and on the berth to dock the vessel. This parameter is often the limitation gate for many large vessels to access medium ports. In a scenario of intercontinental trading of bulk grains and seeds logistics, the size of the efficient vessel is today above Post-Panamax, smaller vessels reduce efficient of the intercontinental long distance transportation.

The respondents also consistently valued high two other variable, together they highlight the requirements of excellence in the port services. In a Port, the vessels are transiting to unload and load operations. Performed by people and machines the ship-owners want the vessel to be immobilized as short as possible to fulfill the operations in the minimum time required. “Time is money” when the assets and the crew team are immobilized in the Port not moving instead of moving cargos. The skills of the port professionals and the prompt response of the services, of course, both prominently rated from all respondents point of view. In a certain way these variables are interconnect, nevertheless the answers reflect the importance given to high end services from the port amenities to dispatch quickly and efficiently the vessels in transit.

From this sub-chapter we may produce the following propositions, contributing to the conclusions of the research work,

Proposition 16	The three main factors of attraction to a new Grains terminal would be focused in the capacity to receive big size vessels (the water depth), intermodal capabilities, and the excellence of the services (promptness and skills)

6.9 The comparative case Terminal XXI in Port of Sines

Terminal XXI is an operational terminal dedicated to container cargo, the single one for cargo container ships in Port of Sines. This terminal was created by the decision of the state and the Port Administration, as developing concession in BOT model, Built-Operate-Transfer (construct and exploit) initially for a period of 30 years. The project was conceived in 1997, the concession launched in 1999, after building the first phase of Terminal XXI, it started operations in 2004. PSA Sines, a SPV company of PSA Europe, a subsidiary of Port of Singapore, took the concession. A budget of 330 M eurs was established (Benefit 4 transport, 2015).

Sines port, in terms of geostrategic factors, is recognized as a unique opportunity to develop new activities, so the Atlantic location offers natural deep depth and costal protection, together with a unique expansion opportunity for port related activities in the ZAL/ZIL on the inland side as probably no other port in Iberia or Europe. This is a port able to receive large vessels, like a Post-Panamax vessels size, a distinctive feature of a few ports due to the deep water required on the entrance and berths for mooring big vessels. In the evaluation made on its Development Strategic Plan (Porto de Sines, 2003) recently initiated revision with strategy contributions studies in 2020 (Nascimento, 2020) and in line with the government options for the ports development (Secretaria de Estado dos Transportes, 2006), the expansion of the infrastructures capacities for attracting international cargos.

Terminal XXI, is a good example for what might be the development of a new European South West Grains HUB, the reason some exploratory discussion analysis in a parallel viewpoint, comparative, both of the business model and also the cargo operational phenomena, in a wide-reaching logistics context that occurred with this terminal in the past years. In this sub-chapter the research does not want to enter in a deep and detailed study, but only to highlight the factors and the relevant implementation results of both scenarios. The results of a serious deep comparative research, using Terminal XXI case, with similar or in some cases the same variables and factors, allowing to make a comparative analysis of the potential opportunities for a Grain terminal in the same port. Some exploratory considerations are the in this chapter objectives. Other fundaments and further research are necessary to validate the analysis made in this preliminary discussion. Some secondary

research based in literature review and other scholar's previous jobs, was considered to feed the qualitative research discussions during some of the in-depth interviews with specific actors, people by some means related to Port of Sines, or its large port community of users.

6.9.1 Object for an exploratory comparative analysis

The comparative analysis methodology, allows the research work to infer tentative conclusions by factors with relevant success implementation of similar parallel cases. We will try to make a short comparative analysis between the existing Terminal XXI in Port of Sines, and a hypothetical European South West Grains terminal in Sines, focusing in their factors of sustaining its early implementation and success. The analysis starts to outline a theoretical framework for the variables and factors of the competiveness that assured the container terminal of Sines strong attractiveness and several phases of growth, investment and business development.

Sines was created in the 70's, looking to build a deep-water port for energy purposes, serving a new oil state refinery. It was built in the 80's, in the 90's started operations with coal for the electric power plant, and oil reception for the new largest refinery installed in Portugal, and sooner began exporting the refined products. In the first two decades, this was the main purpose of the Port. In the entrance in the new century XXI, toking the strong advantage of the geostrategic location in the extreme south of west Europe and its physical characteristics of deep-water port, the strategy pointed other opportunities.

Figure 128 - Port of Sines, source APS

The large cargo operations, looking for big vessel operations, from far distances, serving the transshipment for other regional ports, was seen a business development opportunity and initiated with the launch of the container terminal in a PPP model. Named Terminal XXI, the container operations with big size vessels, started operations in the new century and is following its expansion plan according to programmed phases. In the same period, Sines developed a new GNL terminal, to create a strategical alternative to feed the main national gas pipeline coming from Algeria. Moreover, the GNL tankers can reach big sizes especially when travelling far distances, demanding deep-water ports (APS, 2009), (APS, 2021).

Early the port started calling direct lines from far distance regions to Sines, due to the characteristics of its terminals, as showed in fig. 128 below (APS, 2012).

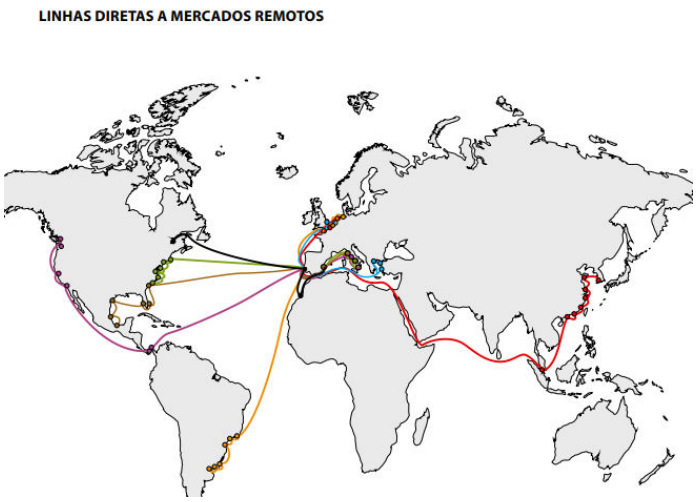


Figure 129 - Far distance direct lines calling Sines 2011, source APS

Sines, faces the regional competition with other ports, from Spain like Algeciras, Valencia, Barcelona and Tanger from Morocco. Still leading some advantages of its geolocation and natural conditions, also having the expansion opportunities of its vast territorial inland space (Porto de Sines, 2003). However, new projects are coming soon, like the port in construction in North Africa, the new Central Port of Algeria, D'El Hamdania, in Cherchell, a concession launched in 2016 with a large Chinese state company (El Watan, 2021). Although Algeria has a state controlled fragile international port management capability, there are news indication and progressing in public, appointing that this port might be operated by the Chinese giant Port of Shanghai administration. This company, world leader, would empower a strong competitive positioning of the new Algiers Port, on the Mediterranean and South European maritime operations, having 20 meters deep water, this port is well located in the north Africa, Mediterranean entrance (Watan, 2021).

The Sines Port Administration aligned and comprehended in the national strategy for energetic transition, is coherently monitoring and searching the opportunities for its activity future shifting, anticipating the impacts of the energetic transition in the coal terminal, already in shutdown phase, and the hydrocarbures, oil and gas activities in general in the future. New research and pioneer projects are developing in Sines, like the Hydrogen strategy national project and others. Sines is involved in the location of the Portuguese National strategy for Hydrogen pilot project, being an active player on the energy transition objectives, through supporting the consortium "H2Sines". It is a port with expansion capacities but also

looking to replace its initial energy vocation based on hydrocarbures and coal until now (Sec Est Energia, 2020).

Portugal and Sines administration are engaged in the European commitment for decarburization from the Paris Agreement in 2015, showed in the target as per fig 129 bellow, as expressed in the PNEC 2030 the Portuguese national strategy for clime and energy (ADEN, 2019).

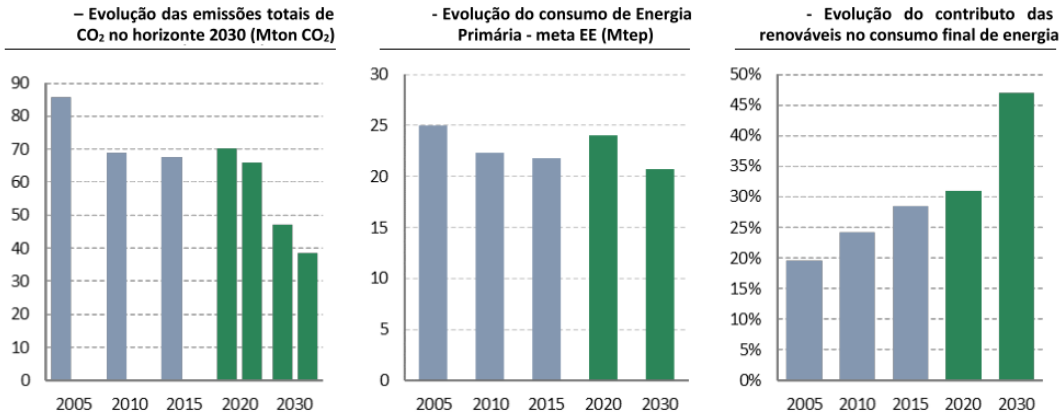


Figure 130 - PNEC targets for CO2 emissions, primary energy, renewables, Source ADEN

Sines is today a world HUB port with global interconnections; the figure 130 bellow shows the interconnection ports with lines calling in Sines.

Figure 131 - Ports interconnected with lines calling Sines in 2018, source APS

Later the comparative analysis infer several tentative conclusions that demand further economic and technical studies, which fundaments are nonexistent in the base of this short exploratory comparative analysis sub-chapter.

The strategy of this terminal, terminal XXI, focused exclusively in the container cargo, unlike any other port in the Portuguese coast, dedicated its line of attack in the logistic operations of container cargo. The terminal strategy focus on the foreland, ocean-ward mirror of the hinterland of the port, much more important that the territorial side for the strategy of the terminal. Regarding the focus in a set of operations based in transshipment and short-see-shipping strategies, this terminal turned Sines port in a global hub of containers circulation, serving international traffic, due to some competitive factors of the Sines port location and exceptional characteristics.

Transshipment operations might be looked in a first glance, as non-strategic for the internal economy of a country, merchandize is just passing by. Multiple research in the recent past, showed the opposite. How important is a transshipment HUB (Kavirathna, Kawasaki, & Hanaoka, 2018), Min Fui et Al. also discuss the strategy to develop a port for transshipment to have a catalyst effect and achieving critical mass for the regional economic growth. The paper goes deep in existing literature and shows the theoretical evidence, the possible factors that profiles strategy to make a transshipment port. This research provides not only theoretical insights, but is also also strategical manual for organizations directors (Min Fui, 2019) . It might develop port services, generating jobs and economic for local operators. It will have a positive effect on the reception prices especial of raw materials, once it is receiving them from the first level of cargo distribution. Following, this prime access to raw materials and components, will be procured by transformation industry to locate and become more competitive also, generating more local economy and jobs.

Seaborne is transporting 90% of the world merchandizes trade, as we saw in the chapter “2.4 - Intercontinental food Logistics, trade and vessels” the cascade effect resulting from increasing vessel sizes, together with infrastructure limitations in regional ports, small qauys and shallow waters limitations, emphasizes the vital role of transshipment operations. A HUB is necessary between the big cargo intercontinental lines, to allow interconnecting with regional short-sea shipping lines serving smaller ports final destinations.

Sines is the port on the extreme western south corner of Europe continent, and its deep see water characteristics make it a valuable resource for the European maritime logistic strategy. Sines is the “South Atlantic European door” as the port authorities numerous times

state in theirs strategic documents, like a brand signature mark of the port. Sines became a priority connection on the TEN-T European network .

Source: TEN-T Executive Agency.

Figure 132 - The priority RTE-T corridor 16 in Iberia and Sines, EU

"Growth needs trade. And trade needs transport. Areas of Europe without good connections are not going to prosper" referred by Siim Kallas, former Vice-President of the European Commission, in a TEN-T conference, and followed "Transport is fundamental to an efficient EU economy, but vital connections are currently missing. Europe's railways have to use 7 different gauge sizes and only 20 of our major airports and 35 of our major ports are directly connected to the rail network. Without good connections Europe will not grow or of prosper." The European project TEN-T network is made comprising two layers: a core network that shall be finalized by 2030 and a comprehensive network system serving hooked on this, and to be finalized in 2050. The comprehensive second phase grid network, is warranting total handling of accessibility of every European regions. TEN-T most relevant lines and nodes are the priority and have to be achieve full functionality up to 2030. The conjunction of the two layers must interconnect and use all the existing transport modes like roads, railways, air traffic lines, continental waterways and maritime transportation. Important intermodal platforms are considered in the TEN-T network for the interconnection and efficiency of the infrastructure services and junctions (EC DG Mobility and Transport, 2011). Sines is included in

the priority projects of the TEN-T logistics corridors. Its potential as a transshipment port, receiving big cargo vessels due to its deep-sea waters rare characteristics, and its south Atlantic geolocation, does not exclude that in time, Sines is progressively contributing for the emergence of a regional economy, as per various scholars already contributed (J. Moreira, 2013).

Recently “the global bridge” was a concept established by the President of the European Commission speech, Mrs. Von der Leyen. On the opening ceremony, the message was foreseeing a strategy to reinforce connections between Europe and South America, to the global world, materializing the case of the new infrastructure, the communications cable “EllaLink” established between Sines and Brazil, a demonstrator of the proximity link between the continents, supporting business and social development (LUSA, 2021).

6.9.2 The comparative strategic factors

Making the exploratory comparative analysis, using the Terminal XXI and the eventual Grains HUB in South Europe in Sines, is based on the coincidence of factors sustaining the business development in both cases, in a preliminary analysis discussion with the interviewees and the . A deep comparative analysis was established in a thesis work, sowing the prevalence factor of Sines in the regional context. Also underlining the opportunity of contributing to the local social economic development, stimulating investment and creating jobs, by persistently capture value added operations to the ZAL and ZILS of the Port in the opportunities to access raw materials and components in the transshipment cargo opportunities (N. Campos, 2016).

We start to look the evolution of cargos in Sines, the global brake of cargos and specifically the long distance containers operations essentially dedicated to transshipment. The cargo type’s evolution in the past 10 years in the Port is shown in “Figure 133 - Port of Sines, split per cargo type, Source:APS”, exhibiting the growth of the container segment. The solid bulks, accounted by the carbon supplying the thermoelectric power plant, are closing. The liquids related with combustibles and petrochemical industry are stable. With a refrain in the last Covid period the container cargo is the one pushing the port cargo volumes growth,

bringing it to the leader position as we may observe in figures bellow 133 and 134 (APS, 2021).

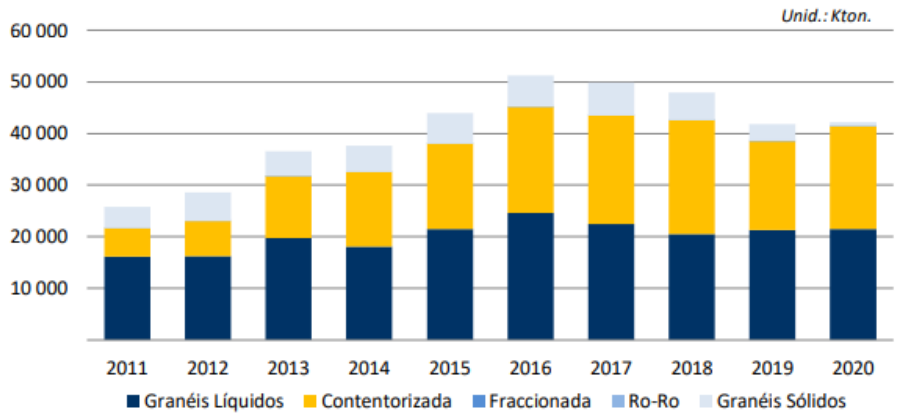


Figure 133 - Port of Sines, split per cargo type, Source:APS

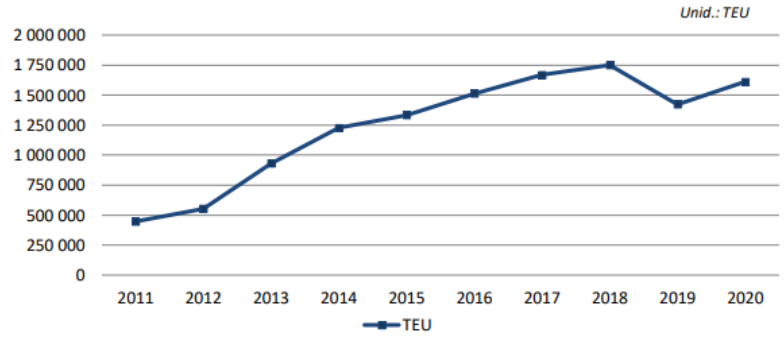


Figure 134 - Terminal XXI, evolution of container cargo, Source:APS

The Table 60 below highlights the identified strategic factors of the Terminal XXI that also serves the strategy for attracting an intercontinental grains terminal for the West South Europe zone as discussed in "6.7.3 - The research interviews corollaries summary". Along the past years, several scholars and sector studies for the ports, made different evaluations of the success factors of Sines Port. Using swot analysis and other analytical methods, here we find common understanding of the main strong factors that sustain the vast projects development in the port (P. Moreira, 2014a), (Casaca, Carvalho, & Oliveira, 2013), (ECORYS, 2006), (P. Moreira, 2014b), (Pereira, 2014), (N. Campos, 2016), (Cacho et al., 2020), (Steven & Corsi, 2012), among others.

In the following résumé, we try to establish the parallel importance of those factors both to the actual activity of the Port, but in a simple comparative discussing the importance of the same factors, for the hypothetical South West Europe Grains terminal. Further research is necessary to consolidate these preliminary ideas discussed. The results are shown below.

Factor	Existing Terminal XXI	Hypothetical Grains South Europe HUB for Grains	Supported by the contributions of the interviewees
Origin region. Main origins of the cargos	ASIA, south sailing lines, or Panama channel lines	South America (Brazil, Argentina, others), south sailing lines	A, B, C, D, F, I, M, N
Cargo Characteristics : big volumes, large vessels	Containers	Big bulk volumes, bulk grains and seeds, cereals cargo vessels	A, B, C, D, F, H, I, J, K, L, M, N, Q
Type of vessel	Container carrier, size Post-Panamax and above	Bulk carrier, size Post-Panamax and above	D, F, I, J, L, M, N, Q
Deep water requirements in port entrance and Berths	15 m +	15 m +	A, D, F, I, J, L, M, N, Q
Dedicated and equipped terminal	Yes, necessary	Yes, necessary	D, H, I, Q
Concession arrangement	PSA Sines	to research, tender to launch	A, B, C, D, H, I, N, Q,
ZAL / ZILs expansion new opportunities	medium important	Very Important. Logistic activities related to simple treating, drying, cleaning, and packing. Or more complex transformation industrial processes may be foreseen in a medium term sequent timeframe. Milling industry, Crushing oil seeds, Feed compounds, Food industry, Bio-combustibles, among others	A, D, F, I, J, N, Q
Attracting FDI	medium important	Very Important, so industrial activities are heavy capital investments	A, D, I, J, N, Q
Geolocation - In a crossing of lines S-N and E-W in the middle Atlantic routes	Capturing routes effect - positive and important	Capturing routes effect - positive and important	B, D, F, I, K
Modern Port, expansion opportunities	Medium importance factor	Strong importance factor	A, C, H, J, N, Q
Competitive services costs	Important factor	Important factor	C, F, J, L, M, Q
Promptness, low waiting times	Important factor	Important factor	B, D, F, H, J, L, M, Q
Time to market response. EU south entrance geolocation	Important factor	Very Important. Food Commodities are depreciable along time, especially in humidity environments like the maritime transportation; Food commodities are quoted, time is a risk factor on the volatility of the quote value;	C, F, H, L, N
Intermodality	Important factor	Important factor	A, B, D, I, Q
One of the European ports that provides better accessibility	Important factor	Important factor	A, B, C, D, F, H, J, L, M, Q

Table 61 - Comparative analysis of factors Term XXI and a hypothetical Grains Terminal

6.9.3 Discussion of the comparative analysis

As previously mentioned, although some delayed milestones in the phases of the implementation of the Terminal XXI concession according the initial contract, also motivated by other factors, its interconnections and the construction of necessary complex port infrastructures, the growing figures of the trading operation in the port, underlines the success of the Terminal XXI operation.

As per previous "Table 61 - Comparative analysis of factors Term XXI and a hypothetical Grains Terminal" the main arguments of geolocation in the middle of the Atlantic routes of the mains maritime cargo lines, furthermore the opportune deep-water port characteristics, are the base to serve large vessels docking in discharging and transshipment operations. Moreover, Sines is the land door of a large region, with strong opportunities and potential for expansion of inland industrial transformation activities. This are the arguments for Terminal XXI, as well could be for the hypothetical South West Europe Grains terminal.

A grains terminal, as expressed by several interviewees in chapter "6 - Industry leader's discussions about logistics efficiency gains, a new South West European Grains transshipment Hub", was further detailed by the interviewees as intensely interesting for the grains and meals protein traffic coming from south hemisphere. The soybeans complex, beans, oil and meals, as we saw previously, are intensively cultivated in the American continent, being South American countries like Brazil and Argentina leading the growth of export worldwide in the past decades. At the same time, the meat animal breeders, everywhere in the world, swapped their feed raw components for soybeans based mixtures, due the efficient conversion ratio of this vegetable protein, consequently efficient meat production, using the soya meals base feed mixtures or compounds. In Europe continent, the low production of non-GMO soya, cannot compete in cropping volumes, so in price, with the GMO variety harvest. Thus, large volumes of soya complex components are been imported in Europe and Mediterranean countries. Being Brazil and Argentina growing fast their cropping areas and production yields, as we saw in previous chapters, the seaborne large trade operations happen in large scale. Using big capacity vessels, as previously explained grains bulk ships are getting bigger and bigger in size to make more efficient the cost per ton transported, also reducing the impacts of food grains logistics worldwide. Later in a second

operation, the soybeans are distributed in short-sea shipping and inland transportations, to the European regions, to supply industry and stocks. Efficiency, splitting part of these cargos in the south part of Europe, can be gained. Like a parallel mirror phenomenon, as it is happening with the containers distribution in Terminal XXI, receiving large vessels from South Asia, distributing in European and Mediterranean port in short sea operations, a smaller part in inland operations.

Deepwater requirements are common for large Post-Panamax vessels, whether it is a Container carrier, or a Solid bulk cargo vessel. A ship class Post-Panamax can have a DWT that reaches 120 thousand Tons, 350 meters long and needs minimum 15 meters deep water in the entrance and berth for docking. For the same class size, both the draft and lengths berth requirements are generally equal, whether the case of a specific containers carrier or a bulk cargo grains vessel. Than specific unloading/loading equipment's are required, as we saw previously for large vessels, sophisticated and high transfer rates equipment are demanded, time is preciouses as the vessel immobilization is costly, operations demand best efficiency and speed. Heavy cranes and handling equipment, computerized, referenced location, interconnected with storage management is the sophisticated scenario for a efficient dispatch of containers in the dock terminal. Boxes "look all the same", today the information systems interconnect with automatic readings/identifications in all handling operations are required to minimize operations times and make stock control, handling sequences and space slots efficiently managed. The same with grains and seeds handling bulk cargos. Today using large hi-seed crane bucket elevators to unload fast the cargo hulls, interconnected with high speed and capacity conveyor systems, and interconnected with systems of silos and warehouses for grains storage.

The main factors of satisfaction and competitiveness towards the ship-owners and ship-agent, their trading clients, choices are common for the Terminal XXI and a hypothetical southwest grains terminal. In both cases, the PPP – BOT concession agreement is encompassing the concessionaire loyal to develop the necessary investments in the terminal and equipment's to operate conveniently and according the industry best standards, not only because it would be a contractual obligation surveyed, more likely because this would be the way to compete and attracted lines and operations in the Port.

ZAL / ZILs expansion opportunities are essential to progressively develop the business opportunities out in the inland side of the port, generation economic growth and employment for the region. This industry also will generate a virtuous cycle of growth for the port, as the internal operation will pump the port operation, requesting more materials but other in/out operations with different kinds of processed products in the inland industrial transformation. The port feeds the ZAL/ZIL and later the ZAL/ZIL feeds the port back. Sines has a vast opportunity to deploy new industry installations, being one of the unique ports in Europe with this availability of expansion space for industrial activities. All the benefits of attracting FDI opportunities, foreign direct investment, have well-known impact generators in the regional and national social-economic development.

The geolocation of Sines is a very important factor for any type of cargo handling. The west coast of Portugal, is in a crossing of lines S-N and E-W in the middle Atlantic routes, Mediterranean Sea, Golf of Mexico that is inclosing the Panama Channel. This is valid both for containers cargo logistics, and for bulk grains traffic.

Moreover, the port of Sines today offers a collection of modern services, like real-time digital information for operations management, specialized services for cargo control, using laboratories and specialized surveyors in place.

Having a high classification by its stakeholders and clients considering competitive services costs, promptness, low waiting times, and Intermodal capabilities. Sines is considered one of the European ports that provides better accessibility. Some benchmarking studies, in the Port views and others in user's perspectives are being deployed by independent organizations, like some recent studies focused (Vaggelas, 2019). The IAPH the International Association of Ports and Harbours, developed and adopted a proposal system, named PORTOPIA (T. Notteboom, 2017).

6.9.4 The Hinterland potential impact of a Grains HUB, similar cases

The terminal XXI, as well as an hypothetical West Shout European Grains Terminal, would not handle the merchandise for the regional destination of Alentejo region, Algarve, in its vast majority neither Lisbon or even Portugal. The grains terminal, in a short future, would

be serving like Terminal XXI, two different operations and destinations: The Iberian and south Europe industry and trade; By short-sea-shipping other regional ports in Mediterranean, Norths Africa, Middle East and Black Sea.

Like many studies mentioned in the previous sub-chapter “6.9.1 - Object for an exploratory comparative analysis”, transshipment operations, in a first phase will developed impacts in the direct port operations and community of services, developing business, operations and creating critical mass size for the port and its stake holders. Moving ahead to a maturity phase, progressively transformation activities will occur in the port ZAL / ZIL, looking for competitiveness of the local offer, also benefiting from the raw materials and components up-stream time and price.

Close to grains terminals, usually interconnected by bulk solid cargo, grains conveyers, and liquid pipe lines for vegetable oils, the first line of grains and seeds transformation appears. The milling industry producing farinas from coarse grains, also the oil-seeds extraction plants, producing oils and meals. In second downstream will come a very diversified collection of food and feed industry transformers. The close access to the source of grains and seeds, is the key competitiveness factor, shortening time and transportation cost, that may bring also to the second level of downstream food commodities industry the competitive advantages of location close to the grains terminal.

All the biggest grains terminals in Europe, established large variety of successive, bounded industries transforming the food commodities in successive different processed products. Some of them are after transformation, again re-exported on the port for new clients and other destinations. It is typically the case of the containers of bagged cereals, containers of bagged flours, meals packed or bulk, vegetable oils refined packed or liquid bulk, all kind of feed and food processed aliments, packed and usually dispatched in containers.

Towards a serious evaluation of the opportunities and factors of competitiveness for the potential cluster of food industry in the Port ZAL and ZILs, further research is necessary. Developing in a successive chain of “close to source” industry, especially in the food sector where the minimizations of time and costs are precious factors of economic competitiveness,

the short and quick access to a hypothetical grains terminal is understandably strategic. Studies must be specific by the sector, by industry, for each different opportunity.

From the discussion of this sub-chapter, we may extract the following proposition,

Proposition 17	Terminal XXI case establishes a replica comparative analysis case, for developing the opportunity to treat the logistics of large volumes of cargo, of long south distance origins, such as the food commodities.
Proposition 18	Portugal is a strong candidate to locate an hypothetical new European South West grains terminal

6.10 Resume of the chapter in-depth interviews, inquiry and case study

This chapter encloses the extensive Qualitative research done along the Thesis research work. It encompasses 3 research tasks, although independent, must be considered complementary as they contributed converging to the same discussion and analysis of results and findings.

The panel of 13 in-depth interviews was performed with leaders in industry, selected and invited according a establish criteria of competences, experiences and geographic logistics knowledge. The interviews were previously prepared, later transcribed, analysed and discussed. From the interviews resulted a groupe of 15 propositions contributing to the conclusions. Resuming, the research allowed to confirm that the world Agriculture in moving to south; The growth of protein soya use worldwide, increased the south origin of grains; Vessels size increased; a new European South West Grains terminal makes sense and should be evaluated; The hinterland of the Port zone should expect a industrial development opportunity in the food and feed sectors.

The assessment inquires about port competitiveness, showing that for this hypotetical new terminal case, three main factors are relevant : a water-depth port; intermodal transfer capacity with the hinterland; the excellence of the services (promptness and skills).

The chapter finalizes with a case study, for comparative analysis discussion, with the terminal XXI project. The factors of competitiveness compiled in this case study, were

considered for a comparative discussion analysis with the hypothetical terminal. Resulted that the relevant factors like geolocation in the south west Atlantic coast, neighboring the main maritime cargo lines of the European Atlantic west coast; together with the physical characteristics of the Port, allowing large cargo vessels; will induct the opportunity for a Hub of transshipment and distribution of Grains and Seeds in the Mediterranean and MENA.

7 Conclusions

7.1 Brief Introduction to conclusions

The theme of this thesis addresses a gap recognizing what might be considered as an inefficient logistic movement of cargos in South West Atlantic Europe, in the seaborne trade of food commodities. The nonexistence of a large south port infrastructure do receive grains and seeds, from there divert to the inland industrial transformation and also make the transshipment of partial smaller cargos, splitting the raw materials received to other destination regional ports, is causing extra sailing time of many cargos, especially those coming from south hemisphere.

In the after wars period the mechanization of agriculture developed large grains and seeds exporters, Europe although producer, was since then as relevant importer and transformer of this raw materials for food and feed. The North America continent (USA and Canada) also Russia, became in the after wars period the strongest exporters of food commodities to west Europe, as we saw in chapter 3. The European logistics for the reception, transformation and commerce of these commodities was then settled by trade tradition and existent port infrastructures in the North Sea coast of Europe, the ARA and Hamburg port zones.

Nevertheless, we demonstrate that in the last 4 decades, the production moved its center to south. It was computed and analyzed a large data job, using FAO agriculture production statistics of all world countries, considering all tradable food commodities, yearly along 4 decades of agriculture production. This data was georeferenced with crossed information of a Latitudes data base, hence we concluded that the average weighted Latitude of agriculture production for this commodities is consistently tending to South. The quantifications were made as an exercise, showing a result of 6,2 grades South. Meaning, the displacement of the global agriculture production center, in this period, for the main commodities, moved close to 700 km to the south in the past 4 decades. This conclusion is very important in qualitative terms to support the reasons to deploy this research and discussion. The numeric figure achieved is not the relevant, although accurate for the

assumptions considered, other commodities not quoted also take part on the global trade of food logistics, being some of them very intensive in the south hemisphere geographies, like the sugar, palm, peas, beans, lupin, teff, lentil, coriander, cotton seeds, sesame, turmeric, among others.

The research was addressed by developing a preliminary mapping of the evolution of global agriculture production of the mains grains and seeds, in the world, in the past four decades and subsequently followed a survey with industry leaders to discuss the opportunity to develop the a new terminal location.

In the thesis, the results of the initial quantitative research phase on chapter 4, the agriculture in the world changed its geography, moving its center to the south, made no surprise with the panel of experts participating in the second phase of the research, the qualitative phase with in-depth interviews of a panel of experts in the industry. It was common acknowledge by this panel, that many of the southern countries hemisphere, acquired techniques and technology, to introduce industrial agriculture production, massively opening new crop areas, at the same time raising the yields. In addition, the same experts expect that agriculture will keep growing on south hemisphere. South America states still have numerous areas opportunities to grow farming land, Africa is the new promising territory for agriculture to discover and develop.

The second job of the thesis showed that the composed panel of experts participating in the research in-depth interviews, as a corollary, considered that a new southwest European port for reception and transshipment of grains, receiving large vessels, would bring more efficiency to the food and feed logistics of grains. This is especially notorious for the gains and meals coming from the south hemisphere, focusing the soya complex products. Destinations interconnecting with of Europe, North Africa and Midle East.

Using the same panel of experts, the research took care of evaluating and discussing other two jobs related to the same opportunity of a new European South West Grains terminal. The main factors of competitiveness of a port, oriented for Grains and Seeds, selecting and adapting a model based in the construct of Yeo. These results showed how important it is the efficient of the terminal for large volume vessels to operate, referring to high-end technology to operate the unloading/loading and storage of grains and seeds. Also

identified the main competitive assets of the port to overcome this market development opportunity, the water depth advantage, the intermodal capacities available and the Excellency of the services, offered by prompt and skilled teams.

The same panel of experts furthermore contributed for the exploratory comparative discussion about the factors of success for Terminal XXI and the mirror of the same factors applied to a new European South West grains terminal. The similarities of the motivation factors applied in the analysis showed strong correlation between Terminal XXI and the hypothetical grains terminal. Treating the distribution of long distance cargos, entering Europe from origins of long distances especially from south hemisphere origins, looking to improve efficiency with big size cargo vessels in the long distance to transship in short-sea operations along Atlantic West Europe, Mediterranean, North Africa, Middle East and Black Sea ports.

The thesis is considered accomplished, in the extent that the initial objectives established and the research questions further proposed, were addressed and responded, as we will resume. The two main objectives proposed are achieved. The three research questions established are responded.

First objective was to determine and calculate whether the agriculture production map was transferring weight to the south hemisphere, especially focusing in the traffic of grains and seeds in the Atlantic zone. The achievement of the first objective, consequently, would propose the second objective as the evaluation of the opportunity for a new entrance door, a new European South west Grains terminal in Portugal.

7.2 Main conclusions and findings

Along the thesis research work, divided in two main blocs, the quantitative research to determine the evolution of the weighted agriculture production average Latitude, and the second block evaluation what implication this fact would introduce in the European Grains logistics, based on a set on in-depth interviews in a Qualitative second phase job.

The compilation of the propositions along the results discussion shows that the research questions launched in the preliminary phase of the research work are affirmative

and validated. The following table resumes the 18 propositions that were built along the discussion of results from both the two blocs of quantitative and qualitative research.

Proposition 1	World food commodities agriculture production weighted geographic center, displaced to south significantly in the past 40 years. Big south hemisphere countries entered and developed industrial agriculture.
Proposition 2	Soya became the protein source. Soya production is mainly growing considerably in south America continent. Africa has potential;
Proposition 3	Commodities seaborne grains logistics, increased vessel sizes for improvement of logistics efficiency;
Proposition 4	Commodities seaborne requires specialized terminals, deep-water births;
Proposition 5	The maritime routes for the increasing commodities cargos from South America to Europe, will benefit of efficiency if a southern port with a specialized grains terminal
Proposition 6	Freight impacts of the seaborne transportation and distribution of grains, would be reduced, if Portugal (as well as others European Southern Atlantic or West Mediterranean countries like Spain, Algeria, Maroco) would have an alternative port to ARA, for reception and transshipment of food commodities.
Proposition 7	A new Southern European grains HUB, is easy to understand and explain, especially oriented for southern origin food commodities big cargos to be distributed Southern Europe hinterland and transshipped to other destinations in Mediterranean, North Africa, Middle East and Black Sea zones. This, driving down the overall costs, time to market and environment impacts.
Proposition 8	A new Southern European grains HUB, requires a specialized grains terminal with high transfers rate for large cargo vessels operations
Proposition 9	Deep water quays are essential for large carriers above Panamax size
Proposition 10	Intermodality for grains cargo is essential to efficiently operate grains transfers between the vessel and trucks or rail cars.
Proposition 11	A hypothetical South Europe grains terminal would introduce efficiency splitting the distribution of agriculture commodities from south origins, to European South destinations, Mediterranean Sea, North Africa, Middle East, Black Sea destination ports. An economical and market assessment must sustain this opportunity.
Proposition 12	A new HUB for grains in South west Europe, should attend large volumes, (idea size, estimated min 200 scalable to 500 K Tons) , equipped for fast loading/unloading grains, with storage facilities, intermodal. An economical and market assessment must sustain this opportunity.
Proposition 13	A Port-zone Seeds Crushing industrial facility, would integrate/complement the protein complex trading. An economical and market assessment must sustain this opportunity.

Proposition 14	The interconnection with other Grains port systems and trading systems would result in efficient operations. Info systems, real time trading data for Grains specialized info systems.
Proposition 15	The opportunity for an international open tender for a “Concession of a grains terminal” would be a model to follow, as per international experiences. An economical and market assessment must sustain this opportunity; produce a teaser for attracting preliminary “letters of intent”.
Proposition 16	The three main factors of attraction to a new Grains terminal would be focused in the capacity to receive big size vessels (the water depth), intermodal capabilities, and the excellence of the services (promptness and skills)
Proposition 17	Terminal XXI case establishes a replica comparative analysis case, for developing the opportunity to treat the logistics of large volumes of cargo, of long south distance origins, such as the food commodities.
Proposition 18	Portugal is a strong candidate to locate an hypothetical new European South West grains terminal

Table 62 - Résumé of the Propositions of the discussions

Revising the research questions, we may now established the relations with the answers conducted by the set of propositions gathered along the research job.

Reminding the Research questions, of chapter “3 - The research questions” , as per bellow,

Research Question 1	Is food production Latitude moving to south ?
Research Question 2	Should Europe look for alternative ports in the southern continental countries?
Research Question 3	Is Portugal, potential geographically convenient and competitive to become an alternative food commodities port to Europe

Still, appointed in the same chapter, but already nominated for further research being out of the scope of this Thesis, a fourth research question mentioned, so it is obviously the next estimation to do

Research Question 4	What are the impacts of a food terminal, to the regional hinterland of the port?

This was the extra understandable question, is “the million dollar question”. We will see, that some of the propositions are already contributing to reply to this questions in its

good sense, meaning that there are strong expectations to follow that the installation of a grains terminal in a Port, will attract and develop further transformation industrial units, as several times referred in the research and especially by the panel of interviewees.

Therefore, following the discussing chapter, the following map relating the Propositions encountered and the initial research questions. We separated the proposition by area theme, dividing them in 5 themes, grouping these findings, to interconnect with the research questions concerned, including the extra fourth questions. The themes retrieved from the variable first level of the construct for the discussion with the interviews, presented in sub-chapter "6.4 - The new Empirical Model constructed during interviews", grouping on the high level variables the mains areas of analysis: the grains facts, the logistics (joining EU infrastructures and constrains), the efficiency, the value model discusses. The propositions are then classified in these areas of discussion analysis and discussion as per figure bellow.

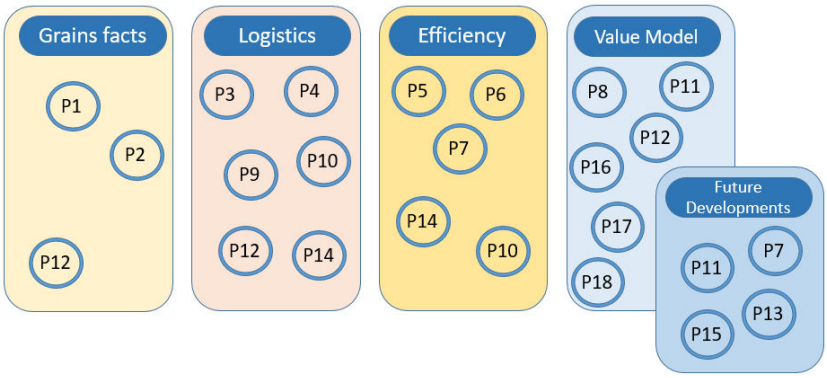


Figure 135 - The propositions grouped per area theme

Some of the proposition are enfolding more than on area of discussions. Others are in a simple area of discussions. Propositions 1 and 2, on the Grains facts; Propositions 3, 4 and 9, the Logistics; Propositions 5 and 6, the Efficiency; Propositions 8, 16, 17, and 18, on the Value Model; Propositions 13 and 15, in the Future Developments; Proposition 7 touches on Efficiency and Futures Developments; Propositions 10 and 14, are in Logistics and Efficiency; Proposition 11 is in Value Model and Future developments; Proposition 12, touches 3 areas, being in Grains facts, Logistics and Value Model.

The propositions board, classified per variable area topic, are focus on the specific reply to each of the three research questions, leaving still the fourth questions for further research with contributions of some of the variables results.

The first research question answer refers to the evidences of the medium average global agriculture production latitude being displacing in direction to south along the past four decades. The propositions 1 and 2 are extracted from the results of the quantitative research achieved in chapter “5 - Southern evolution of world agriculture production latitude”, were was calculated the evolution along 40 years of the medium weighted latitude of global agriculture production, with a moving average illustration along the period, resulting in a displacement south of 6,2 grades.

The second and third research questions are answered from the propositions extracted on the discussion analysis of the in-depth interviews qualitative research done, with 13 international industry leaders of the sector.

The propositions therefore resume the opportunity to develop an alternative Hub for Grains and seeds in the European South West region. The new terminal should encompass a serious of infrastructural characteristics, responding to essential constrains for the opportunity to be developed, as it is resumed in Propositions 3, 4, 9, 10, 12 and 14. The intercontinental trade of food commodities is supported essential by maritime logistics operations, using large cargo bulk vessels. These vessels became larger looking to reduce cost and impacts per Ton of cargo, today typically are class post-Panamax, requiring deep-water entrances and births to dock. Due to the large volumes, typically more than 100 to 150 K MT of cargo, or more, the unloading and loading operation need quick modern high transfer rate equipment, specific for grains and seeds elevation and discharge. In addition, storage at reception is essential for large quantities of cargo being discharged. The grains may follow to main destinations, inland transformation, or short-sea-shipping to other regional ports. The inland transformation industry, forces the port to be able to interconnect efficiently and dispatch the cargo by road trucks and/or rail-cars, being a intermodal accessibility to the grains system of the port essential. In addition, today in modern international trading and shipping, electronic information real time data are essential, obliging the port infrastructure to be able to handle much beyond the cargos. This were the main Logistics factors and

Constrains characteristics of the business, we could deeply discuss with the interviewees panel, absolving theirs experience in the sector.

Still, the collection of proposition, resume the Value Proposal that a southern Port with grains and seeds facilities could bring to the ports market, constituted essentially by ship-owners and agents, contracting the destinations of their lines or time-charter operations.

The Efficiency improvements of the logistics operations are the causes that may trigger the development of new infrastructures, representing large investments, like we are discussing to focus in this research. More than one of the interviewees used the basic verdict "if the calculations are better, it will work". From the interviews discussion, it was possible to conclude a serious of propositions regarding this first level variable. Five Propositions mentioned, the 5, 6, 7, 10 and 14 respond this Efficiency variable. On or after, all the routes serving the cargos of food commodities to Europe, a big part of them, are increasingly coming from south hemisphere origins, especially Brazil and Argentina. But also Golf of Mexico origin, were the Mississippi "grains high-way" ends in New Orleans ports, bringing the big share of USA Soya and corn grains to Europe, as we saw in the subchapter "2.1 - The food production and population evolution along 4 decades", is from south. It is important to understand that part of the cargo imported to Europe, in consumed inside Europe, being distributed by short-sea shipping regional ports, river-barges inside the continent, rail-cars, or road-trucks, to reach the immense industrial food and feed transformations units distributed in the European terroir. Also, part of this cargo imported to Europe, is re-distributing trough-out north-Africa, Middle East and Black Sea external markets. This is the reason why the cargos coming from south origins and splitting to south destinations could more efficiently be transshipped in a hypothetic south grains port of Europe, looking for logistics efficiency and market competitiveness.

Therefore, the research took care to identify what were the components pointed to sustain a Value Model variable to justify the hypothetical project of a new European South West Grains Terminal located in the extreme southwest Europe zone. Were different ports from Europe are potentially competing as we saw in the discussion, even from North Africa can come alternatives from existing and other projects in development. The propositions supporting this variable are the numbers 8, 11, 12, 16, 17 and 18. The new terminal shall have

the capacity to transfer high rates of grains per hour. Today this is crucial, as some interviewees, international specialists in the subject, expressed it. For example, there are modern crane bucket elevators interconnected with conveyor systems to silos, able to unload bulk cereals vessel, at transfer rates up to 1.500 MT per hour. This cannot compare with transfer rates of 40 or 50 MT per hour, made with mobile cranes and trucks, when big vessels need to satay minimum periods in the docks. These huge vessels require also not only the availability of deep-water berths, but also compatible services and requirements to their size. Example the specific pilotage requires skilled harbor pilots for huge vessels, tugboats for large vessels are over powered and dimensioned, interconnection of electrical-power, freshwater and disposals, security response means, ship-chandler appropriate facilities, among many other requirements. The personnel skills of the port teams and its community, to be able serve these big vessels and the support services, are a challenge to be surpassed on this strategy.

The particular issue of Portugal being the response to this eventual challenge, is part of the political strategy of Port Administration and the Government of Portugal to attract new business opportunities, eventually to encourage the industrial development in a crucial food and feed sectors. As an interviewee was imagining an integrated development scenario expressing the idea of the complete downstream chain - The food commodities terminal in Sines, would allow the access to local feed industry to produce compound at competitive prices. They do not have it now, far from ports, allowing the meat production of chicken and pork in the Alentejo space, fish farming along the south coast with better conversion ratios. Fixing then, the meat slaughtering and transformation industry, creating jobs all the chain.

Therefore, the resume of the position interconnection with the answer of the research questions is be drawn in the schematics diagram bellow.

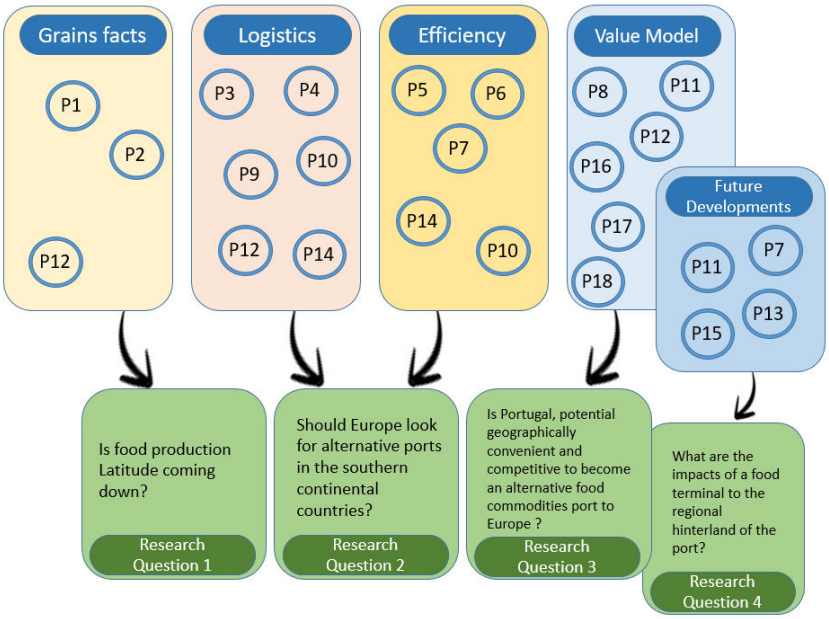


Figure 136 - Schematics interconnections Propositions answering the Research Questions

The résumé of eighteen propositions, sustaining divided the four variables first level, responds with multiple proposition to the three research questions posed. A triangulation effect is then observed, having multiple validations, confirming the answer of the research question. As an example, the response to the "agriculture production Latitude tending to south", question on the first research question, confirmed by several propositions of the research coming from the Quantitative statistical data job, but also from the discussion of the in-depth interviews extracts and conclusions. The triangulation, with multiple validation of the findings, is desired in the research methodology.

7.3 Contributions

From Farm to the plate, food commodities are part of a long supply chain being today on of the primary clusters of activates in terms of employment and economical relevance in the world.

With this research work the author expects to have contributed to the formulation of future discussions conducting the redesign of the logistics infrastructures in Europe and in

particular in Portugal. The impacts of an inefficient logistics are severe, in terms of direct economic costs, when the transport distance, consumptions, time spent and environmental impacts are not minimized in the operations.

If the creation of an alternative European South west grains terminal could be considered in the development strategy of Portugal, and also Europe politic options, the benefits for the region expected would be positive. Indirect social domains would benefit, like jobs, urbanism, consequently the social economic development, local economy, tax contributions, among other benefits.

Also, at global level, relevant issues are directly connected and impacted, in the contribution of this research work results. Environmental actual themes like gas emissions and global warming, sea security, Sulphur emissions, among many others.

The aim to develop the international component of port authority strategy, by discussing and analysing with the Port authorities the case of a specific Grains Terminal, for food commodities, in the Port of Sines. In its future developments, in terms of establishing a developing strategy for the region and its internationalization. The opportunity to discuss the possibility of the operating modes that might exist for port authorities in an international business like the Grains terminal, the investment and organizational structure and management processes thereof, and a discussion on the motives. This research project wants to be involved in the area of “Boosting investment and promoting national competition”.

The present research job of this Thesis was oriented to the business opportunity observed in the experienced of several professionals of the sector, as we saw in the interviews made. No literature or specific studies in the agriculture and logistics could focus this subject. In the end, being obvious to many of the participants in the study, also demonstrated the facts encompassing the conclusions, the subject needs further research and economical studies to sustain the commercial viability of such a new terminal of grains and seeds.

Although we might state now in the conclusions, the fact of the agriculture centre of the latitude of grains production is moving to south, the issue remained apparently not studied as an academic matter or scientific research from former scholars or specialists in the sector. Considering the impacts of these findings, it is quite expectable that other scholars

might find other impactions of this phenomenon to be studied. The importance of the world trade logistics of grains is enormous, and the economic, social, market, environment impacts are very significant. If this Thesis might raise the question of the efficiency of the logistics of grains and seeds, stimulating the opportunity to bring new routes and logistics arrangements to distribute the south origin grains and seeds to Europe, especially the raising protein complex coming from southern geographies, than the economic and environmental impacts are huge. The contribution of the Thesis would be immense.

During the process of the interviews, in particular with the Port administrators, the opportunity to discuss with large audiences, also promote conference discussions with the Port community in Sines, opened a broad discussion on the subject that might have further developments in the near future. The Port of Sines has made interesting moves to further research the opportunity raised in this preliminary academic research job. At the same recently discussed the opportunity with other South America port administrations and operators, the opportunity to cooperate in the domain of the Agro-Business as the Brazilians name it.

7.4 Limitations

During the phases of preparation of the works of these research tasks and the thesis construction, several limitations identified and noted as perimeters that out-bound the scope of this research work, for the moment.

The research thesis project, proposes to consider dedicated focus on the main food commodities and production countries of the total word food commodities. Certainly, it is important to acknowledge the potential limitations of the dissertation in the regional focus and the amount of commodities analysed. Today also, other sub product and transformed product of the food commodities use the grains terminals for its operations, a good example of that are the meals and feedstuff compounds. So, we can suggest how future research could overcome such limitations. However, the focus of the research was to show the opportunity, which does not need all the possible uses of the food terminal to justify its need. The quantification was to validate not necessary to quantify. What was quantified is exact, using

the 7 traded world food commodities, as a criteria. Other commodities could have entered to this quantification panel. There is a special notice to a commodity that is expressively in volumes, and which production was heavily developed in South America, so transferred buyers to be originating from South hemisphere in the last decades. The Soymeal, the sub product of the soybean crushing and oil extraction, very rich in protein, used for animal feed, meat production. This meal origin to Europe market is predominantly from Argentina. Not considering it on the panel of commodities chosen, reduces the impact of the south change of the Latitude, it would be more expressive the southern change including it.

Limitations should also be on the methodology for explaining the nature of services of a grain terminal and its competitiveness in regional terms. Not having a traditional activity in Portugal, interviewees might show inexperience and out of context to comment on the items under evaluation of the questions to test the construct about the Portugal specific analysis questions.

A deeper analysis of the regional hinterland connections was not foreseen in this study. Today, profound research might be conducted for the assessment of the regional intermodal and interconnections of complex logistics infrastructures, but this was not the aim of the scope for the study. Further work might be deployed to overcome this insufficiency in future research projects.

Having critically perspective about the research problem, the student understood the need to search for relevant literature published from other scholars about it, and if correctly assessing the methods for studying the problem, the choice of methodologies might not be the best for the expectation on results. A key objective of the research process is not only discovering new knowledge but to also confront assumptions and explore what we don't know. Although there are many empirical studies focusing on the subject of port performance and efficiency, there is scant literature that has attempted to make quantitative exam of the effect of ports terminals structure and location, on the overall seaborne logistics efficiency of an operations.

7.5 Future research indications

Various open doors remain to further research work from a serious of complementary matters of this thesis. Main subjects are suggested bellow, some of them were even considered to be included, others were satisfying the curiosity and lateral readings of the student in many different other collateral subjects. All of them would enrich and change this thesis in a chain with new complementary subjects, but tending to an endless job.

There are two main fields of future research opened now. The Academic research were still many questions can be raised and further investigated. In addition, a Port Administration decision-making process, if considering the opportunity to develop a grains terminal, needs to sustain strategic future decisions in economic and technical feasibility studies. Both objectives might be crossing the same issues and problem solving. The aims are standing apart in the sense of objectivity to decision making.

The Thesis resume showing the opportunity for a new food commodities terminal, showing its potential efficiency improvement in the European food commodities seaborne logistics. If the opportunity is proved to be there, the economical operators as well as the Port Authorities and government, are keen to know technical an economical evaluation scenarios of the hypothetical construction project and operation.

To sustain a Port Administration the lack of assessment for the quantification of the commercial opportunity in market conditions. A strategic diagnose analysis is necessary to sustain a business model. Then a serious of material scenarios must be drawn and quantified for evaluation of future results. What is the size of the potential market for these operations, how many tons, what kind of vessels, which volumes per commodities, what services needed. The technical proposals should develop a scenario to respond to the market opportunity, developed in phases, contracting construction and equipment as per the development of the project. What terminal, which services and capacities to accomplish, what technological options and possible suppliers, timeframes for the construction development to star operations. The economic feasibility evaluation calculating the provisional Balance-sheets and P&L maps accounts result from the combination of investment, expected operations and the development model, PPP, BOT or others. Doing an exercise of further research for sustainin

Port administrations decision, based on market information. Main phases can be proposed, first to evaluate the market. How many tons of food commodities are traveling in front of the south West European coats? How many of these tons are being transshipped and transferred to other regions, that an alternative southern operation would bring efficiency. What is the market size of the potential capture of tons to be discharged and transshipped in a South Europe grains terminal? Moreover, not least important is the evaluation for the reginal development point-of-view, is to estimate the impacts in the transformation industry of the zone, promoting new investment and jobs creation.

7.6 Conclusions synthesis, final note

The research work reach the expected results on the scope of the Thesis as proposed initially, planned and well defined for this academic job. The achievement of the data analysis, to our knowledge, never made object of studied before, neither the discussion of a Grains terminal to overcome the inefficiencies of the grains logistics cargo movements from the south hemisphere, also in the South West Europe zone, and Mediterranean Sea, in the field of large grains trading operations.

Europe is traditionally importing food trough ARA region reception. Agriculture food commodities main producer countries 3 or 4 decades ago were also northern countries like USA, Canada, URSSR. Today a southern appropriation of agriculture grow, shown on this simple observation, even requiring deeper research and analysis, it shows that the scenario is changing. Countries like Argentina, Brazil, Australia, South Africa, strongly increase their food production and brought to south the geography of the food commodities flows. The research quantitative job demonstrated the clear displacement of the letitude to South of the medium weighted center of agriculture production.

When the crops change place, the European logistics should look for the new map and find the best efficient logistics. Authorities and operators soon will evaluate and political decide where to develop its more efficient port systems for global food trading in the European region. We checked a new terminal in the European South West region makes sense, it has to be technical, economical further evaluated for political decisions.

Portugal, the Port of Sines or other Ports, have to play a strategic role in this discussion, not many Atlantic, south, deep-sea waters ports are available. In addition, here is where we may also proudly exhibit our maritime tradition.

The Port of Sines is today a public Port Administration, its strategic document made in 2003 for a vision of 15 years, or the revision made in 2017 for the next decade, does not include a food terminal in its plan, as a concrete infrastructure to implement, also does not exclude that possibility. In fact the strategic plan of Port de Sines (Porto de Sines, 2003) and especially its recent update, states that to implement the new port activity regimes, determines that it should be done under a concession. This is in line with its recent case of

“terminal 21” a container concession for the Port of Singapore, proven to be a success as lessons learned, exhibiting a consistently growing traffic activity. Being object of an expansion plan of the pier and operations platform.

We can résumé these conclusions in a graphic presentation, showing the implications of the findings of this thesis, in the following three geographic images. The European grains origins after the wars period, based mostly on the farming capacities of USA, Canada, URSSR and Poland, predominantly the origins were in the northern Atlantic region and North sea, the south hemisphere was not a big producer and neither exporter to Europe.

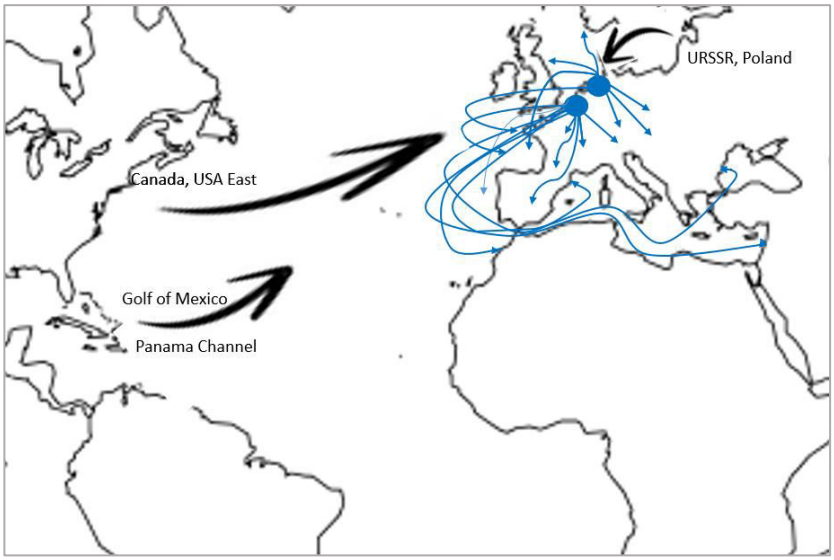


Figure 137 - After wars geography of the main grains movements

The second diagram represents the actual main streams of transit of grains and seeds being received in the European north ports, than transformed in the ARA / Hamburg region also transhipped to the southern regions. We can perceive the inefficiency of the movements, south-north-south, of the grains coming from south hemisphere to redistribute in the European south coast, Mediterranean sea, Northe Africa and Black Sea destinations. The soybeans, soya Meal, and more recently also the South American origin Corn have significativlw develop its exports to Europe along the past decades.

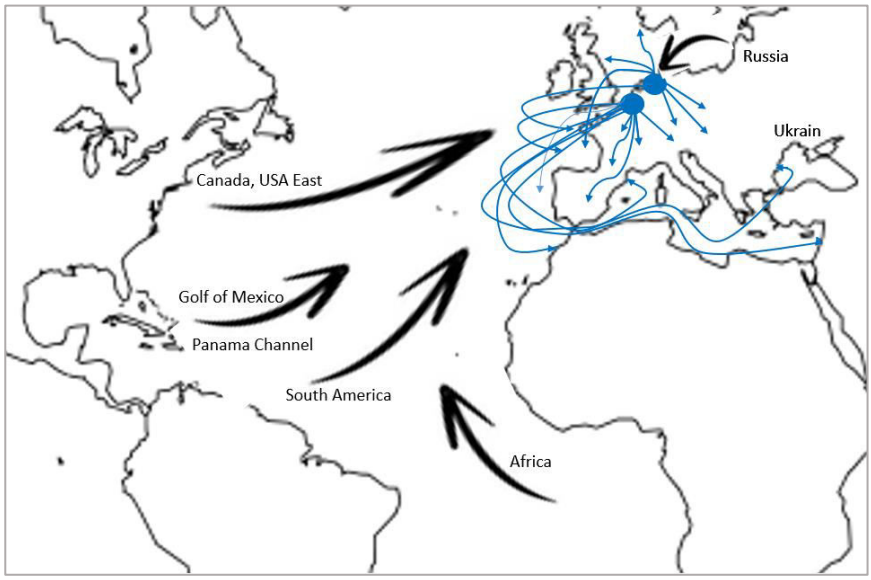


Figure 138 - The actual fluxes of Grains and seeds feeding Europe

What we call “logistics inefficient gap”, due the geographical change to south of the food commodities production centre, would sustain a south west Atlantic port to leader a new hypothetical geographical map for the distribution of grains and seeds in the European region, as per next figure.

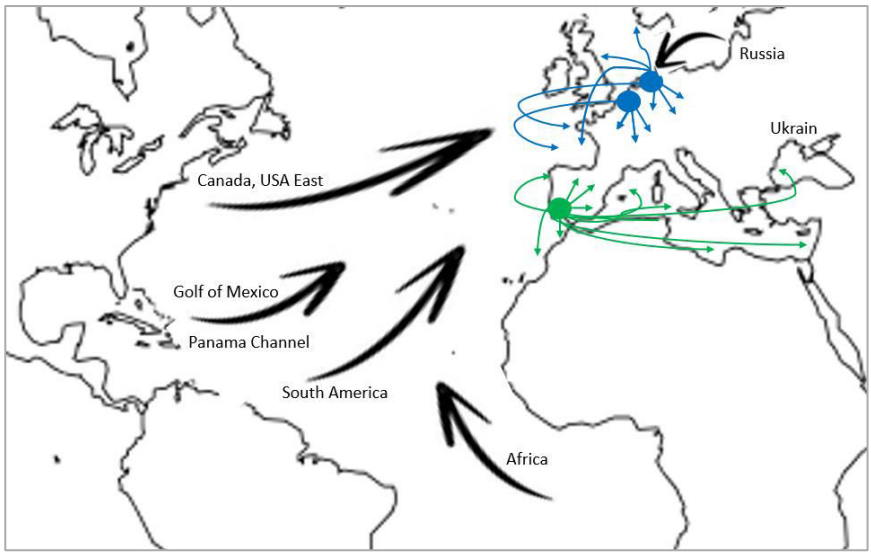


Figure 139 - The hypothetical new grains seaborne logistics geography in Europe

This hypothetical scenario of a new terminal, able to handle fast the unloading and loading of large vessel of grains and seeds, is showing south Portugal zone as the HUB location, but we should not forget, that it competes with other ports in the south European

region, like the existing Mediterranean Ports of Algeciras, Valencia, Barcelona or Tanger in Moroco. Furthermore, other new ports are able to capture this traffic in the near future, as the case of the new Chinese concession in Cherchel – Algeria, the new port D'El Hamdania, as we saw in the previous chapter 6.

Resuming in visual "idea map", simplistic representing the thinking process of this Thesis, the structure diagram resumes the different information, concepts and conclusions of the research done.

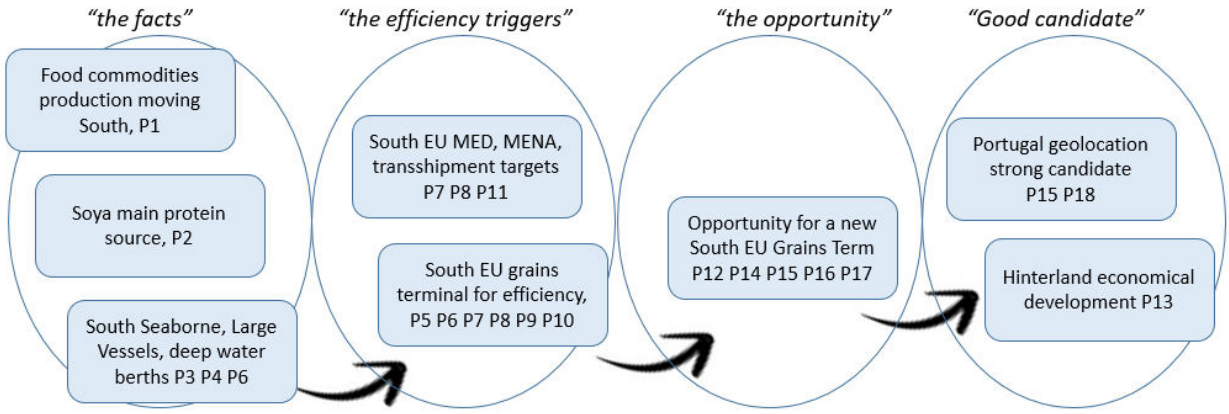


Figure 140 - Synthesis *"Idea Map"* of the thesis

The facts collected, encourage the discussion and sustain the opportunity challenge. The motivations for further technical and economical assessment of the opportunity anchor on the favourable positions of several industry experts. Is now up to the Governments and Port Administrations to proceed and track further the subject, eventually validating a strategy for this opportunity.

8 Annexes:

Several annexes information follows, considered complementary to sustain and fundament the information presented in the main text, but not essential to be introduced integrally in the essential chapters, but complementary referred as per references in the main text:

8.1 The industry leaders participants in the in-depth interviews

The in-depth interviews with industry leaders used in the research job, are a collection of people distributed by different countries,

Source	**"Name"**	**Position / Organisation / CV**	**Location**
S01	A	Actual President of Port of Sines, Actual President of the Association of Portuguese Ports, Member of EU ports Association, and others	Aveiro/Sines Portugal
S02	B	Member of the Board at Rangel, international logistics operator; Invited Auxiliar Professor at Católica Porto; ex-member of the board of Aveiro Port	Porto Portugal
S03	C	Member of the board of Nutre Farming Brazil SRL, experienced in farming management, silos logistics, export activities	S. Paulo Brazil
S04	D	Bunge cereals and bulk logistics manager in Romania; Ex-CerealCom international trader; graduated in management and logistics	Sofia Bulgaria
S05	E	Cargil international grains trader; ex-Bunge agribusiness director; ex-CHS international trader; graduated in economics	Gevene Switzerland

S06	F	Former Piro Foods - Head of the Global Trading & Risk Management Desk with the responsibility for identifying all Commodity and Foreign Currency Exposures across the Company - Worldwide; graduated in economics Porto	Porto Portugal
S07	G	Ex-CEO of BrasilAgro, leader agribusiness Brazilan groupe; Managing Director at Catalyst-Capital / AGT Partners; graduate in Economics Harvard	S.Paulo Brasil
S08	H	Actual CEO of Ascenza Romania, Agriculture chemicals supplier, Former Commercial trader of Prio Agriculture Romania,	Bucharest Romania
S09	I	CEO of Group Avril in North Africa and Maghreb region, former CEO responsible for EXPUR seeds extraction oils and Biodiesel, east Europe	Boston USA
S10	J	Key Account Manager of REAGRO, senior trader in food commodities in Portugal	Lisbon Portugal
S11	K	Secretary of Agriculture in Governo Estadual of Maranhao, Former General Manager of the Soya Farmers Association	São Luiz Maranhão Brazil
S12	L	CEO of ACEMBEX ,trading house of RAR Group, commodities leader in Portugal	Porto Portugal
S13	M	Senior trader in ACEMBEX, responsible for several markets and commodities	Porto Portugal
S14	N	Senior Commodities Trader in B3, responsible team leader for international commodities trade	S. Paulo Brasil

S15	O	DB Ports Senior Projects Manager - In charge of mega projects implementation within UAE, middle east and Africa region.	Dubai UAE, MENA
S16	P	Grains Storage Expert Sea & Oceania, Head of Business Unit at Buhler Asia Pte.Ldt - Singapore, reponsable for implementing large grain storage silos in port terminals around the globe, Buhler is a world leader in storage technology	Singapore Asia

8.2 Classification of the regional focus and area field of experiences

Showing the coverage of sample interviews group, considering reductant and exhaustive to enlarge the samples, an analysis was made on each of the professionals interviewed, some evaluation of the professional experience coverage by field of activity and regional knowledge and past experience in operations with the region, was made a rough classification, based in the personal knowledge and curricula of the participants.

		Professional EXPERIENCES along it's carrier - 1 to 10				
Name	**Source**	**Region**	**Logistic**	**Port**	**Trade**	**Agro**
A	01	Portugal	10	10	4	1
B	02	Portugal	10	9	5	1
C	03	Brazil	6	5	9	10
D	04	Portugal, BlackSea, MENA	10	10	10	8
E	05	Europe	8	8	10	10
F	06	World, Europe, BlackSea	8	10	10	10
G	07	Brazil	7	7	10	10
H	08	Portugal, BlackSea, MENA	6	6	10	10
I	09	USA, Europe, ME, Africa, Med	10	8	10	10
J	10	Europe, Brazil, Med	9	10	10	10
K	11	Brazil	9	10	9	10
L	12	Europe, Brazil, Med	9	10	10	10
M	13	Europe, Brazil, Med	9	10	10	10
N	14	Brazil, USA, Europe	6	6	10	10
O	15	ME, North Africa, Med	10	10	7	5
P	16	Asia , ME, North Africa, Med	10	10	3	6

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