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GREEK ISLANDS AND AGRICULTURAL LOGISTICS MANAGEMENT: PROSPECTS OF A NEW AGRO-LOGISTICS HUB

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ΠΕΡΙΛΗΨΗ

Η εκπόνηση της εν λόγω Μεταπτυχιακής Διπλωματικής Εργασίας έχει ως στόχο την ανάλυση της υφιστάμενης κατάστασης της παραγωγής αγροτικών προϊόντων στα Ελληνικά νησιά, καθώς και τη διερεύνηση των προοπτικών ενός νέου κέντρου εφοδιαστικής αλυσίδας για την υποστήριξή τους. Αρχικά, περιγράφονται όλες οι απαραίτητες θεωρητικές έννοιες που αφορούν τον αγροδιατροφικό τομέα και την παραγωγή των προϊόντων του, καθώς και οι έννοιες της εφοδιαστικής αλυσίδας και πιο συγκεκριμένα της αγροδιατροφικής εφοδιαστικής αλυσίδας. Εν συνεχεία, αναλύονται δεδομένα εξαγωγών αγροτικών προϊόντων για τα Ελληνικά νησιά, βάσει αξίας προϊόντων και χωρών προορισμού, ενώ παράλληλα εξετάζεται η προοπτική δημιουργίας ενός νέου κέντρου εφοδιαστικής αλυσίδας αγροτικών προϊόντων για την εξυπηρέτηση των Ελληνικών νησιών και των χωρών προορισμού των εξαγωγών τους. Επιπροσθέτως, αναλύεται η υφιστάμενη κατάσταση της περιοχής δημιουργίας του νέου κέντρου εφοδιαστικής αλυσίδας και εξετάζονται οι πιθανές επιπτώσεις που θα έχει η δημιουργία του στους παραγωγούς, στους καταναλωτές, στην εγχώρια οικονομία, το περιβάλλον και, τέλος, το κοινωνικό αντίκτυπό του στα Ελληνικά νησιά και, στη συνέχεια, σε εθνικό επίπεδο.

Λέξεις κλειδιά: Αγροδιατροφικός Τομέας, Αγροδιατροφική Εφοδιαστική Αλυσίδα, Κέντρο Εφοδιαστικής Αλυσίδας, Ελληνικά Νησιά, Εξαγωγές

ABSTRACT

The purpose of this Master's Thesis is to analyze the current state of agricultural production in the Greek islands, as well as to explore the prospects of a new agro-logistics hub to support them. Initially, all necessary theoretical concepts related to the agri-food sector and its products are described, as well as concepts of the supply chain and more specifically agrologistics and food supply chains. Subsequently, export data of agricultural products of the Greek islands are analyzed on the basis of value of products and countries of destination, while considering the prospect of establishing a new agrologistics center (hub) to support them and their export countries of destination. In addition, the current situation of the area where the new agrologistics hub will be developed is analyzed, as well as its impacts on producers, consumers, the domestic economy, the environment and, finally, its social impact on the Greek islands and, consequently, on a national level.

Keywords: Agricultural sector, Agrologistics, Agrologistics Hub, Greek islands, Exports

1. INTRODUCTION

The purpose of this thesis is to analyze the current state of agricultural production in the Greek islands, their exports to international markets, as well as to propose new ways to create better conditions for the exportability of their products and overall improvement of the agricultural sector, by the promotion of the agrologistics sector.

The agricultural production sector in Greece has always played a major role in the development of the country's economy, especially due to the country's favorable conditions (such as climate, the overall rural character of the country etc.). However, times are changing and, while Greece's economy has always had a close relation with agriculture, new issues are emerging in domestic and international markets. More specifically, demand in agricultural products does not only create the need for higher productivity, as the main issue that arises is that of product distribution, in order for the product to reach consumers on the best possible quality. In other words, it is not enough to simply be able to produce the needed amounts of product, but also to be able to distribute it, by achieving cost effectiveness, while also being able to offer the highest standard of service to a continuously growing market.

As the term "distribution" arises, it is clear that one of the most important aspects of this thesis is logistics and overall supply chain management. More specifically, the term "agrologistics" is used in this case, to describe the distribution of agricultural products, which is successfully operated by a set of management systems in order to achieve transportation for all kinds of agricultural products, on a food supply chain, while achieving cost effectiveness and offering the highest level of service, based on supply, demand and consumption (Kiladze, 2017). The aforementioned term is thoroughly analyzed on the first chapter of this Master's thesis, in order to better understand how an agrologistics management system operates, its affecting factors and overall relation with agricultural production and its impact on the agricultural sector as a whole.

It is important to determine the reasons for an agrologistics system to be necessary, especially in recent times, where health issues and food related diseases are emerging, while there is

also a continuous globalization in food production (Nepstad, 2006). These issues create the need for development on certain aspects such as traceability, freshness and overall quality of food products, which are considered major consumer concerns. As a result, the effectiveness of agrologistics in dealing with such issues is thoroughly analyzed, while its key objectives for achieving effectiveness are also described.

The agrologistics sector is a dynamic one, as continuous changes can occur, depending on time, external and internal environment factors and, of course, movement of products (Dabbene, 2008). The development of an efficient agrologistics system is a major issue in countries were agricultural production is scattered across many regions, such as Greece and its islands, where there are numerous islands and islets producing different volumes and different kinds of products, due to the unique characteristics of each region. In the case of Greek islands, unless production and distribution practices are coordinated through a central management system and better optimized for efficiency, certain negative economic, social, environmental and other issues will act as inhibiting factors in better developing the aforementioned regions' agricultural sector and, subsequently, the country's as well. In order to better determine prospects of development, extensive relevant literature in the agrologistics sector is provided (e.g. van der Vorst, 2011; Tonelli, 2012; Van Gogh, 2013), in regard with technological and infrastructure issues, the lack of effective agrologistics management systems, workforce related issues, financial resources and government support.

Moreover, the agricultural production of Greece is further analyzed on the next chapter. At first, a SWOT (Strengths – Weaknesses – Opportunites – Threats) analysis is performed, on the agricultural sector regarding Greek islands, in order to further identify areas of development and specific areas where the sector in these islands is further developed (or underdeveloped). In addition, to better evaluate the agricultural sector's strengths, in Greek islands, certain qualitative data are also taken into account, which show the value of exports of agricultural products by category and region, as well as the value of overall exports to specific countries of destination, by island region of origin. Agricultural products are sorted on certain categories, and are further sorted on categories by region of production, with the help of data collected from the study "Mapping Greece's export activity by region and

regional unit", conducted by the Institute for Export Research and Studies, which were made available for the purposes of this diploma thesis by the Greek Exporters Association (SEVE). The analysis of the aforementioned data is crucial, as qualitative data give insight on which Greek island regions are developed or underdeveloped, in matters of agricultural production and exports of their products, while also providing information on how the agricultural sector is developing in these islands on a four-year timeframe, from 2013 to 2017. It is worth noting that in the main chapters, these data are filtered and organized in such a way to give a better understanding on the issues assessed by the Master's Thesis and the complete data provided by SEVE for the Greek island regions and their values of exports to all countries of destination are shown on the Appendix.

As the effectiveness of an agrologistics management system is the basis for this study, the emergence of a new agrologistics hub and its impacts are also assessed. More specifically, conceptual definitions are given for logistics hubs (Europlatforms, 2004; Jorgensen, 2007), as well as criteria for their successful operation (Baluch, 2005) and aspects of examination (King & Keating, 2006). The development of the new agrologistics hub is an investment decision that takes into account all possible variables which may impact the hub's operations, but the most important one in the decision process is the choice of the optimal location, which is made on a basis of qualitative and quantitative criteria, gathered from numerous studies (Essaadi, 2016), as well as certain performance indexes which assess a country's performance on certain aspects, such as logistics performance, competitiveness, trade, governance and corruption, shipping connectivity and quality of life.

Effectiveness of agrologistics is also based on an effective transportation system. In order to better evaluate the possible effectiveness of a new agrologistics system in Greece, through the development of a new agrologistics hub, the transportation model of the new agrologistics system is also described, based on a transhipment model, specifically the "hub-spoke" model. The hub-spoke model is applicable to a variety of transport and distribution applications (Dobson, 1993) and in the case of Greek islands, where sea transport is necessary, the hub-spoke model can have significant impacts in faster product distribution, cost effectiveness and operations related to the new agrologistics hub.

In order for this transportation model to be as effective as possible for agrologistics in Greece, an analysis for determining the optimal location for the new agrologistics hub takes place. This analysis is possible with the help of Geographical Information Systems (GIS), which are utilized for the analysis of both spatial and quantitative data and result in visualizations which give insight regarding data, patterns, relations between points of origin and destination and, consequently, facilitate the decision making process of the study. As a result, the optimal location for the hub is identified, based on quantitative, qualitative and spatial data.

Lastly, the current conditions of development of the new agrologistics hub are assessed, based on the chosen location. The factors affecting the development of the agrologistics hub are further analyzed, as well as its possible impacts. Impacts of such an investment project are, of course, numerous and significant and not all of the impacts described are certain in time, but with correct management and coordination of the operations of the new agrologistics system, there could be even more possibilities than those mentioned by this Master's thesis.

2. AGRO-LOGISTICS

The term agro-logistics is composed of two Greek concepts. The first part of the term comes from the Greek word “agros”, which in its simpler form can be translated as a field or a cultivable part of land. The second term comes from another Greek word, that of “logistiki”, which can be interpreted as the science of calculation, which in most cases refers to the detailed organization and implementation of a complex operation. Taking into consideration the aforementioned terms, the term “agro-logistics” is, even in its literal form, strongly connected with the distribution of agricultural products, which is successfully operated by creating and managing the optimal system of movement for all kinds of agricultural products on a supply chain basis, by achieving cost effectiveness and the highest possible standard of service, on the basis of demand and consumption (Kiladze, 2017).

2.1. HISTORY OF AGROLOGISTICS AND SUPPLY CHAIN

The term “logistics” is said to have been used for the first time by the Byzantines considering the supply, catering and outfitting of the empire’s armies, while other historians claim that the first one to implement the term “logistics” was Alexander the Great. Based on this claim, Alexander the Great was considered the first “logistician”, because of his implementation of “logistics strategies” in supplying the troops of his empire, as well. Notably, the development of early Greek civilizations and subsequently of the Roman Empire was mostly based on innovative, for their time at least, development of transportation systems which is considered a vital, if not the most important, part in supply chain management.

In more modern times, supply chain is considered as a fully integrated network or system for value creation, which consists of highly correlated and cooperating business units, such as producers, retailers and consumers. Consequently, supply chain consists of a product flow from the original producer to the end user, or most commonly the consumer, while also consisting of the flow of information between members of the aforementioned supply chain. As a result, a more common and broadly accepted definition of supply chain states that “logistics is an integrated process of designing, implementing and controlling key processes that convert supplier input into products and services that add value to customers” (Lambert

D. , 2004). Based on the model of the aforementioned definition, the two basic processes for the successful integration of supply chain is the management of relations between the suppliers and consumers, while also consisting of processes regarding demand, overall customer service, order processing and completion and production management. In order to successfully connect clients and suppliers, the product and service development process must be thoroughly planned by taking into consideration inputs from suppliers as a starting point, while also taking into consideration client needs and expectations.

By implementing supply chain management strategies, the main goal is to successfully integrate and complete the design, procurement, production, warehousing, transportation and sales within and between businesses. As it is made quite clear, the objective of a supply chain management system is to increase the overall profitability along the chain, which consequently leads to an increase in the profitability of all parties, which is achieved by timely understanding and satisfying high quality customer needs and product offerings.

In order to better understand the term "logistics", the following definitions should be taken into consideration:

- The term "logistics" refers to the systematic strategic coordination of traditional business operations across the supply chain as a whole (Mentzer, 2001)
- Considering a more customer based definition, the overall effectiveness of supply chain collaborations is linked to the goal of creating customer satisfaction and in the final stage of delivering the finished products, in order to meet customer needs and expectations (Hines, 2004)
- Logistics also refers to the key and critical elements of the supply chain, related to suppliers and customers, which emphasize on successful collaborations, in order to reach the highest level of common goal fulfillment (Donald, 2012)
- Logistics refers to a model that specializes in the goals and roles within a broad customer satisfaction process (Porter, 1995)

Even though definitions of logistics in terms of supply chain are on common grounds a fact that is considered as a converged system for specific needs and purposes, the issue

of clearly defining logistics still was a pending issue in the beginning of the 21st century (Iakovou, 2007).

2.2. LOGISTICS AND AGRICULTURAL PRODUCTION

Agrologistics is the part of the agribusiness sector, which supports the operation of rural business parks for transportation, storage, certification of agricultural products and secondary produced products using modern logistics processes and operational management (logistics management). Actors involved are the producers and agricultural consultants, those responsible for transportation and storage, wholesalers, retailers and consumers.

The object of agrologistics is, of course, the development and transportation of agricultural products, at different stages of their life cycles, through a controlled system of material flows.

Logistics of agricultural products is a rapidly growing sector in Greece. The major goal of this sector is boosting the already developing rural economy of Greece, on the basis of sustainable development, while also improving the total income of Greek rural population and aiming to enhance their overall quality of life in the process, by increasing the quality of agricultural products. In order to be able to enhance overall quality in the agricultural sector, innovation is considered as one of the more pressing issues.

Agricultural supply chains often vary in complexity, but in most cases combine farming activities with processing (Du, 2016), while also embodying certain innovations, regarding differentiated products, introduction of new products to new locations and introducing new production and processing technologies. An agricultural supply chain, or more commonly a food supply chain consists of the total processes, operations and entities that play a role in taking an agricultural product from its raw material state to the end consumer (Samir, 2015). As it is made quite clear, a food supply chain begins with an agriculture focused producer, by whom raw materials are produced and moved through the processing stages, in order to reach the end of the food supply chain, which consists of the consumers. The whole transportation and movement of the products is made possible by logistics and transportation companies, which make sure that all food products will reach their destination (i.e. the consumer) on time and at the best possible quality.

As world population increases, so are the needs for more food production. Thus, as demand increases, food supply chains must be developed in such a way that they can meet consumers' needs, while also delivering the best possible quality of service. Not only does world population increase create a pressing issue in better designing food supply chains, but so do the overall changes in population needs, preferences and lifestyle. More specifically, as population in developing countries of the world receive higher wages, their food consumption preferences begin to differentiate significantly, which increases demand not in quantity, but overall food quality and variety. As a result, food product demand may increase in countries that were until now showing less demand for specific food variants, as food preferences begin to vary. This is the issue that arises regarding food supply chains, which in turn creates the need for the agro-logistics sector to be able to offer new services for new clients in different parts of the world. Bearing that in mind, while also taking into consideration all aforementioned definitions and aspects of the logistics sector, it is obvious that the most important issue arising for the agro-logistics sector is the need for every actor in a food supply chain to be able to offer the highest quality of service, which will lead to the successful movement of food products to consumers, in the best possible quality.

Benefits from the existence of a developed agrologistics system are numerous, while some of them are mentioned as following:

- Cost reduction strategies and overall cost efficiency
- Better overall product quality
- Quantity assurance
- Difference normalization between producer prices and final consumer prices (achieving the European average of 1 to 2, in comparison with the current average of 1 to 4)
- Better overall organization in the handling of food products
- Empowerment and encouragement of the model of organized producers
- Empowerment and encouragement to the model of contract farming

In order to create a successful agrologistics system, there are certain processes that must be integrated which consist of the following:

- Collection of products, which occurs at the optimum level of maturity of the product, in order to extend its life span to the maximum
- Transportation to packing stations, from the development area (field or greenhouse) to the station where packaging takes place
- Selection, which consists of a process where products that do not meet certain specifications (requirements) are excluded
- Quality control and classification, which consists of the separation of products based on size and quality characteristics, such as color
- Packaging, where at first products are packaged as a whole or in arrays of products and are ultimately grouped in bigger packages in order to create palettes, in order to achieve easier transportation
- Refrigeration and storage, where palettes of products are stored in cold chambers, in order for products to remain fresh for as long as possible
- Transportation and distribution, where palettes are loaded in transportation trucks through ramps and are distributed to retailers, wholesalers and consumers

As made clear, the successful implementation of an agrologistics system is vital in agricultural production and food products distribution. As food preferences and needs change, so does the need for greater quantities and greater quality of food products delivered to consumers and retailers or wholesalers, which in most cases presents the need of products being transported through various countries and conditions, in order to reach their destinations. Especially in the case of countries with major agricultural sectors, such as Greece, the need of establishing new agro-logistics routes, storage areas and hubs creates pressing issues in a continuously growing and competitive sector, where adapting to new realities is vital for sustaining change.

2.3. LOGISTICS ISSUES AND REQUIREMENTS OF FOOD SUPPLY CHAINS

The main issue concerning the logistics sector, especially in agrologistics is food security and quality, as well as food availability in different parts of the world. As defined by the World Food Summit of 1996, “food security exists when all people at all times have access to sufficient, safe, nutritious food to maintain a healthy and active life”, which requires

greater numbers of food production, as well as products of higher qualitative value, and a reduction of food losses in the supply chain.

Concerning health issues, because of food related diseases and globalization of food production (Nepstad, 2006), food origin and nutritional characteristics have become major concerns for consumers. As a result, aspects such as traceability, freshness and overall product quality arise as major consumer concerns, while the need to satisfy those consumer needs and desires has become a vital aspect of the overall productivity, regarding the producers' point of view, who as a result expand their products' quantities and varieties. It is clear that the need for food security, relocation of production and the needs for higher quality, quantity and overall value of the products increases the need for global product movement, which results in more complicated production and distribution processes, which in turn increase transportation costs.

However, even if the distribution process is more complicated in the recent years, technological developments help ensure product quality and overall safety. More specifically, containerization enables new means of transportation (via air, rail or trucks), while also increasing the total distance which the products are allowed to be transported in order to maintain their overall quality. Still, the need for overall efficiency in resource management and sustainable products requires logistics practices and systems that take into consideration several performance requirements, in order for the products to arrive to the consumer in the desired state.

In addition to traditional logistics management characteristics, such as cost reduction and service responsiveness improvement, sustainable agrologistics management should also consider all specific characteristics of food products and processes (van der Vorst, 2011), in the spirit of sustainability. Taking all the above into consideration, the key logistical objectives on sustainable agrologistics management can be classified as follows:

- Cost reduction and improved responsiveness
- Improved food quality and reduction of food waste
- Improved sustainability and traceability

Regarding cost reduction and responsiveness improvement, these are two of the main traditional performance issues in logistics management. Cost is defined as the total global network cost from the source of supply (production) to its final point of consumption (consumer). It is imperative to achieve the lowest cost possible in all supply chains, especially in regard to the recent economic crises and still ongoing globalization, as in recent times food industries are heading towards international markets, in order to achieve efficiency and completeness for their operations. As for responsiveness, it can be described as the time between placing and receiving an order and how quickly is the response of companies to the dynamics of the global marketplace (such as customers' unique and rapidly changing needs, new product insertions/introductions or changes of them, new sourcing opportunities etc.) (Beamon, 1998). Overall responsiveness and subsequently flexibility are considered as key issues to meet consumer needs and maintain their satisfaction in the food industry (Lambert D. M., 2000).

As for improved food quality and reduction of food waste, consumers require safe and high quality products with competitive prices throughout the year. In a food supply chain, the quality of the product dynamically changes by the time the raw material leaves production and by the time it reaches the end consumer (Dabbene, 2008). This change in quality (simply referred as degradation) creates the need of tracking and preserving perishable product quality along the food supply chain to optimize and increase freshness and overall quality. As a result, conventional supply chain practices and processes which do not take into consideration the factor of perishability cannot be applied in the case of a food supply chain. Temperature controls, quality decay (degradation) and waste reduction are factors and challenges that management approaches, models and practices must be able to cope with, in order to tackle the issue of perishability of products (Hammervoll, 2012). As well as in the case of cost reduction and responsiveness, in the case of improved food quality technological improvements (such as temperature controlled facilities and trucks) enable food supply chains to manage and maintain food quality throughout the chain, especially through concepts and practices of Quality Controlled Logistics, the implementation of which depends

on the availability of real time product quality information and the use of that information in advanced logistics decision making along the food supply chain (van der Vorst, 2011).

Additional issues that need to be taken into account to improve food quality and reduce food waste, apart from logistics issues from traditional indicators (Soysal, 2012) are as following:

- Batch homogeneity controls along the chain
- Dynamic inventory management that tracks the quality of products
- Dynamic control of goods flow that adopts conditions and logistics to optimize market fulfilment (such as redirecting products to other markets having lower quality requirements)
- Cold chain management that considers temperature or enthalpy controlled carriers and depots
- Multiple temperature consideration for multiple products
- Product interferences consideration (e.g. bananas produce ethylene, which accelerates the ripening process of other fruits)
- Monitoring temperature history for accurate quality predictions
- Customer requirements consideration for specific markets
- Use of specific quality decay models in logistics decision routines
- Waste management practices that consider food spoilages

Taking into consideration all the above key logistics issues can result in greatly improving quality, while also reducing food waste. Last but not least, improved sustainability and traceability are also major performance requirements of a successful food supply chain. Consumer consciousness towards environmental and societal issues increases pressure on companies to use as much as possible sustainable practices, since world population rises, climate change is ongoing and natural resources are gradually depleting. Societal issues such as child labor and employment conditions and nutritional contents of products are considered as major issues (Helms, 2004), while incentives and pressures for sustainability in supply chains arise, such as legislations, customer demands, response to stakeholders, competitive advantage, pressure groups and reputation loss (Seuring, 2008). It is clear that increasing sustainability awareness directly affects the logistics decision making process and operations

of a food supply chain. As a result, the concept of sustainable supply chain design has emerged, aiming to incorporate economic, environmental and societal factors in supply chain practices and processes design (Chaabane, 2012). Still, the environmental and social dimensions of sustainable food supply chain management must be taken into consideration with clear and explicit recognition of the economic goals of companies (Carter, 2008; Wognum, 2011).

The fact that consumers want to get more insight in the production processes, as well as what occurs to the product as it moves through the supply chain (Mogensen, 2009), places more emphasis on the environmental and societal aspects of sustainability. A well designed traceability system can greatly contribute to improved transparency by offering specific information regarding product and related processes to consumers, while government legislations and pressures from non-profit organizations can also stimulate improved supply chain transparency in food supply chains, which can also be achieved by intensified cooperation and collaboration between the actors of the food supply chain, while in addition improving monitoring of processes to achieve overall transparency, tracking and tracing of products and services throughout the chain (Fritz, 2009).

Additional logistics issues that need to be taken into account to improve sustainability and traceability are the use of impact assessment tools, sustainable food production consideration, sustainable inventory management consideration, sustainable food transportation management consideration and traceability possibility of products for improving transparency in food supply chains (Soysal, 2012).

2.4. PROSPECTS OF DEVELOPMENT

It is obvious that issues related with food supply chains and agrologistics need to be addressed. Regarding certain cases and relevant literature (e.g. Tonelli, 2012; Van Gogh, 2013), certain bottlenecks related to food supply chains are as following:

- Technology and infrastructure issues, such as:
    - Inadequate road infrastructure (in most cases highly degraded roads, which limit transit or increase transit times, by causing unnecessary delays)

- Transport can be slow in many cases, especially when long distances must be covered
- Current storage systems and processing equipment are in many cases insufficient or inadequate
- Transportation means are limited, due to lack of cold chain capacities/capabilities (regarding means, such as trucks and facilities, such as warehouses etc.)
- Insufficiency and inadequacy in appropriate packaging materials
- Inadequate information and communication systems

- Lack of effective agrologistics management systems
  - Transport costs in food supply chains are high, which increases overall costs and significantly impacts profits
  - Lack of practices to manage variability and quality of products' raw materials
  - Inadequate quality management systems and practices
  - Lack of information regarding market conditions and overall food supply chain transparency
  - Ineffective logistics planning strategies
  - Lack of overall improvement in supply chain logistics, due to ineffective collaboration of actors in supply chains
- Inadequate personnel, in terms of relevant skills and knowledge of managing and working in food supply chains
- Insufficiency regarding financial resources
- Insufficient government support
  - Complexity in trade regulations
  - Administration, policy and tax issues significantly increasing waiting times in border crossings
  - Insufficient resources and higher prices of them, especially in fuel

It is obvious that agrologistics and food supply chains have a lot of restrictions in their applications. However, there is of course a lot of room for improvement and innovative

practices that can be applied, in order to achieve efficiency and sustainability in food supply chains. Efficiency in food supply chains contributes greatly in safer food, more competitive sourcing (and outsourcing) in developing countries and greatly decreases food waste, while also promoting diversification and enhancing export opportunities in developing economies (e.g. in African countries). Technological standards have increased greatly due to foreign financial investments, which contribute in products of higher quality and security being produced and delivered to international markets from developing countries, although progress must also be made in terms of government support, in order to lift any trade barriers, while also collaborating with businesses in order to create better transport and communication networks to support food supply chains.

In order to achieve efficiency of a sustainable food supply chain, improving quality management is imperative. By improving overall product quality and post-harvest handling can greatly decrease food waste and increase turnover and overall yield. Another issue that must be addressed is the design of effective cold chains, which is directly correlated with constant and reliable power availability, where solutions such as solar energy are considered as options, especially in Greece where conditions are highly favorable regarding renewable energy sources. In addition, an important issue of food supply chains is the effective reduction of post-harvest losses.

There are, of course, many reccomendations that can be made, in order to achieve higher efficiency and sustainability in food supply chains. It is made clear from all the above that improving logistics infrastructure is vital in improving efficiency in food supply chains. First of all, improvements in transportation networks can directly improve logistics performance, as road and rail networks are of great importance throughout supply chains, due to the fact that through their use product flows are facilitated in the supply chain. In addition, infrastructures concerning facilities should also be taken into consideration for improving logistics infrastructure, such as investments concerning storage systems, cold chain facilities, electrical systems, cold storage facilities to support needs of all actors of the supply chain and in general infrastructure regarding logistics hubs throughout the supply chain. Apart from practical issues concerning infrastructure in equipment, facilities etc., information systems

should also be developed in such a scale that supply chain flows, traceability, management of product capacities and other factors of logistics performance are improved, in order to meet the needs of the actors of the supply chain.

Another area of improvement can clearly be considered the overall improvement of quality management practices. More specifically, product quality and its overall safety should be of the highest importance, as quality monitoring systems and traceability systems are considered as perquisites in order to better monitor and control the flows of the food supply chain. Regarding product safety, postharvest losses should be limited to the minimum, while collaborative initiatives should be supported across the food supply chain, in order to accelerate product flows and maintain product quality, due to the fact that these require the contribution and collaboration of all actors of the supply chain. In order to achieve better collaboration between the actors and overall efficiency in product quality improvement, changes in processes and practices should take place and especially in technologies implemented and the behavior of all actors.

Of course, the best practices differ from a country to another and in order to achieve efficiency, the most relevant ones should be implemented. Collaborations should not be limited to ones between the actors of the food supply chain and should be established with external actors as well, such as research institutions and investment and financial sources, in order to extend the knowledge concerning product quality and food waste reduction management, while also implementing the best possible practices and strategies with the support of the optimal combination of technological variables, such as equipment, facilities, infrastructure etc.

As stated above, a supply chain (and subsequently a food supply chain) cannot be efficient and sustainable without the support of external parties. More specifically, government interventions and overall support are vital aspects that must be taken into consideration regarding the agrologistics sector. Taxation, trade barriers, regulations etc. are all important setbacks that must be addressed, so that government policies can allow the allocation of resources to support the agrologistics sector by implementing the best possible practices which will facilitate overcoming issues regarding regulations. This can result in faster

throughputs of products in ports and border lines, while also improving overall product quality and improving cost effectiveness and, as a result, improve overall efficiency in the agrologistics sector.

Moreover, as mentioned above, alternative power supply solutions (such as solar or wind energy etc.) are vital in the planning of a sustainable and effective supply chain and in order to achieve that, investments in that aspect are of great importance. More specifically, investments in renewable energy sources can improve cost efficiency on issues regarding refrigerating transportation and cold chain management practices, while also attracting foreign investors and researchers in order to further improve infrastructure, management and practices in the agrologistics sector.

Effective food supply chains are vital in developing a country's impact on domestic and international markets. Improving food supply chain effectiveness and, thus, overall the agrologistics sector of a country requires strategic planning and practices implemented by the government. However, governments may not have a strategic plan in order to achieve effectiveness in the said sector, while initiatives should also be implemented in such ways so that there can be certain collaborations between them, in order to facilitate overcoming specific setbacks. Therefore, the development of an effective planning in the agrologistics sector is directly correlated with a government's ability to successfully create connections and collaborations between higher level planning (in most cases national) with lower level planning (regional, in the case of a specific country).

The fact that every country has its own conditions, dynamics and production line (especially in agricultural production) makes the strategic planning of an effective agrologistics system more difficult. As a result, it is of the utmost importance that more case studies should be conducted and analyzed, regarding agrologistics sectors of different countries, in order to correlate existing researches and better determine which practices should best be implemented in each case. In each case, research should be conducted with governmental support, so that specific data collection concerning transport costs, transit times, potential developments on exports, technological advancements and conditions of different countries can be facilitated. Results from said case researches should be compared in order to better

determine each country's strengths, weaknesses, opportunities and threats (by conducting a SWOT analysis), so that in the future the best possible strategies and practices can be implemented. In order to better understand all the above characteristics of a country, it is important to understand certain aspects concerning its agrologistics sector, such as the present situation regarding the sector, its cost efficiency practices and if there are ways (and which are the best ones to pursue) to improve the overall quality of services in order to improve overall efficiency in food supply chains and the agrologistics sector as a whole.

Considering all aforementioned factors, characteristics and areas of development concerning agrologistics, while also taking into consideration the aim of this thesis, the main goal is to address the current situation of agrologistics practices regarding production and distribution of products from Greek islands to domestic and international markets. On the next chapter, an analysis of the agricultural production of Greek islands follows, in order to better determine the needs of certain regions in future agrologistics developments.

3. AGRICULTURAL SECTOR IN GREEK ISLANDS

The agricultural sector is comprised of the agricultural production, the factors affecting it, product characteristics and specific features, their distribution through the food supply chain and its characteristics affecting product quality and safety. In this chapter, certain concepts of the agricultural sector in Greece are analyzed, such as production of specific areas of Greek islands, with the help of data from exports, since 2013. It is also important to note that all exports data were collected from the study "Mapping Greece's export activity by region and regional unit", conducted by the Institute for Export Research and Studies (IERS), which was established in 1990 by the Greek Exporters Association (SEVE).

3.1. AGRICULTURAL PRODUCTS AND THEIR INFLUENTIAL CHARACTERISTICS

Agricultural products are defined as material goods which are produced from plants or animals, by combining different factors of agricultural production, such as land (or animals), labor and capital (Kamenidis, 2010). These products can be categorized in specific categories, consisting of corn products, industrial plants, cotton products, sugar beet, oils, wine, fruits, vegetables and other categories of vegetable or animal production.

Some of the categories of agricultural products that their exports this thesis aims to assess are the following:

- Fish, shells and mollusks
- Beverages (alcoholic and non – alcoholic) and vinegar
- Miscellaneous products of animal origin
- Fats and oils
- Vegetable and fruit based products
- Corn – based products
- Vegetables
- Dairy products
- Meat and fish based products
- Meat
- Seeds and other fruit products

- Coffee, tea and spices
- Various nutritional products
- Plants
- Flour products
- Fresh fruits and nuts
- Cocoa and its concoctions
- Foods for animal needs
- Resin and vegetable extracts

Cereals and corn based products have a leading role in the world food market, as they form the basis of the human diet, both directly and indirectly as a basic raw material for many processed products. Certain types of cereals consist of common wheat, durum wheat, rye, barley, oats, maize, rice etc.

Industrial plant products are also produced in Greece. Such products include tobacco, cotton products and sugar beet. Other notable products include oils, wine, and organic products. The last category of agricultural production highly increases the past years, as organic farming requires the cultivation of agricultural products with lower capital intensive techniques and without the use of chemical fertilizers and pesticides. These techniques aim at preserving the natural and available resources, in order to better protect the environment and ensure the health of both producers and consumers.

Another area of alternative agricultural production is that of plants destined for energy uses. Specifically, as mentioned on the previous chapter, highly increasing energy needs, higher costs and the increasing concerns about global climate change due to greenhouse gases create more interest in renewable and alternate energy sources. One of them, biofuels, which are fuels produced from biomass receive special interest, as production technologies based on either starch, sugar and oily agricultural products (e.g. cereals, cane and oilseeds respectively) or forest products are relatively simple and their products, bioethanol and biodiesel, can be used as fuels on combustion engines with only minor modifications. Consequently, products related to the bioenergy sector are gaining increasing interest and have a direct and positive impact on the agricultural sector and its overall growth.

In addition, as consumer needs change and dietary preferences shift in different directions, demand for certain products increases. This is clear when taking into consideration fish and meat production of the Greek agricultural sector. All agricultural products from Mediterranean countries have a very important role in dietary preferences based on the Mediterranean diet and this is exactly the case with meat and fish production. More specifically, these specific two categories show great promise through the course of the last years and this is also clear when taking into consideration the agricultural production of Greek islands. Specific data indicating a highly increasing production will be thoroughly analyzed by the aforementioned export data for specific regions of Greek islands, however this highly increasing demand regarding those two categories is clear. For example, in the case of the Ionian islands, exports in fish and shells showed an increase of 644.6% from 2013 to 2017, while exports in meat products showed an increase of 252.3% from 2013 to 2017 as well.

There are, of course, certain factors affecting the agricultural sector. As mentioned on the previous chapter, distribution of products through the food supply chains is continuously differentiating, with new practices, technologies and other factors affecting the chains themselves. As a result, variables such as overall quality, cost of production, prices etc. dynamically change through the course of time. Quality of products is of the utmost importance, especially due to the fact that consumers pay more attention to product freshness, characteristics and ingredients used in their products. The more the attention to detail, the more the attention that must be given, not only at the time of production, but throughout the flow of the product in the food supply chain, as quality and freshness are factors that must remain as much as possible unaffected by internal or external threats. Greece and, in particular, its islands show high amounts of production and total exports in categories concerning meat, fish, fruits and vegetables, which are products that must remain as fresh as possible by the time they leave production sites and reach the end consumer.

Conditions that could affect that said quality and freshness of products are various, especially in the case of the aforementioned categories of products, as they have various unique features. Due to product decay being one of the major issues in food supply chain management, quality

of products depends highly on conditions such as seasonality, environmental conditions, adequate equipment and suitable facilities on production sites (Zuurbier, 1999). In addition, Greek fruit producers must pay more attention to detail, as fresh products are more fragile and can easily deteriorate when in contact with sharp surfaces, due to stiffness. This contact not only downgrades the product in terms of quality but can also cause health concerns, as bacterial infections are more likely (Chua, 2003).

Agricultural products are generally susceptible. Sensitive products are products that are highly difficult to maintain under normal environmental conditions for a relatively long time without undergoing any decay or quality deterioration. However, that degree of vulnerability varies between food products. For example, products such as fruits are highly susceptible, while products such as legumes do not face any quality deterioration for a significant amount of time. Of course, this differentiation in vulnerability not only makes their classification difficult, but also makes their distribution more difficult and costly. Therefore, sensitive products or products of degraded quality cannot be sold in large quantities in consumer centers, due to the fact that even if their selling price drops, consumers are still not likely to buy them, because of the more attention given to product quality, health concerns and food preferences.

This vulnerability of agricultural products creates the need of finding and exploiting more and bigger markets for their distribution. However, transport of susceptible products to distant markets poses its own issues, as the risk of them being damaged or decayed during transport is high, while in order to tackle the issue of product degradation more specialized and expensive equipment is used, as trucks are equipped with refrigeration units, specialized containers etc. Of course, this investment on more specialized equipment or different and faster means of transport (such as airplanes) increases the product's unit cost of transport.

3.2. AREAS OF INTEREST IN GREEK ISLANDS

Regarding the agricultural sector in Greece, it is clear that there are many areas of improvement. However, favorable conditions, product variety and quality are all considered positives which can, with the proper attention given and advancements made in other areas,

outweigh the sector's weaknesses. The best possible way to assess the current situation of the agricultural sector in Greece and also identify areas of improvement is a SWOT (Strengths – Weaknesses – Opportunities – Threats) analysis.

Regarding the strengths of the Greek agricultural sector, these are as follows:

- The satisfactory amount of natural resources
- The excellent weather and climate conditions, which can serve a wide range of production and variety throughout the year
- The higher quality of agricultural products, which are considered of high nutritional value
- The high demand of agricultural products that are essential for a consumer's daily diet (especially with the rise in popularity of the "Mediterranean" diet). This is also justified by the exports results that follow, as they show an increase in demand regarding international markets.
- Production regarding organic products can be facilitated, due to favorable weather, climate and terrain (soil) conditions, while they continue to rise in demand.
- The fishing sector, where Greece and Greek based companies have always been innovative, with the help of the necessary technologies, regarding products which show significant rises in demand and can especially bolster exports of Greek islands.

There are, of course, some weaknesses when considering the agricultural sector of Greek islands. Some of the most notable ones are:

- The "Polynesian" aspect of Greece, as there are numerous islands and islets (233 in total, of which 107 inhabited), which creates many difficulties on product distribution, as transportation networks in many cases are unique and complex.
- The existence of several small businesses, due to the inability and unwillingness of producers to unite their activities.
- The unsuccessful and passive adaptation to an ever changing common agricultural policy.

- The use of chemical enhancers in order to increase production or prolong the product's life, which results in unhealthy products that are in recent years avoided by consumers.
- The small extent of standardization of agricultural products and the inability to distribute them in international (or even European) markets.
- The lack of infrastructure concerning storage facilities, in order to prolong product life cycle and maintain freshness.
- The insufficient and inefficient infrastructure regarding product distribution, such as the insufficient port infrastructure to support larger vessels in many islands, while also the limited transportation options, in order for products to reach the inland and then be distributed to domestic and international markets.

Of course, there are certain opportunities that arise concerning the agricultural sector and the overall production of Greek islands. Such opportunities are:

- The considerable room for improvement regarding standardizing and diversifying high valued products and distributing them to promising emerging markets, such as Russia.
- The continuous developments in the production of organic products.
- The food biotechnology innovations, which are constantly evolving and enable the production of environmentally friendly products, in larger quantities as well.
- The unique characteristics of each region (and in this case of each island or group of islands) create great opportunities of diversification of products and help maintain a high variety of them.
- The favorable weather and climate conditions, which bolster the use of renewable energy sources (such as solar and wind energy) as alternate forms throughout the stages of the food supply chain.
- The privatization and development of Greek ports (such as these of Piraeus and Thessaloniki), attracting major financial investments which can be allocated to the development of their infrastructure. These developments can create favorable

conditions regarding the role of these ports as hubs, in order to better support the agrologistics sector.

Lastly, there are of course certain threats that need to be dealt with, in order to achieve sustainability and efficiency in the agricultural production and, consequently, in the agrologistics sector. Most notable of these threats are:

- The continuous rise of fuel prices, animal foods, fertilizers and equipment used on production and distribution stages.
- The difficulty of distributing Greek agricultural products to foreign markets, especially in cases where outdated techniques or harmful materials are used during production, as consumers pay much more attention to every detail of their dietary products.
- The various food scandals which undermine consumer confidence in agricultural products, while also raising their awareness on issues that seemed unnecessary to deal with in the past, such as product origin, ingredients and raw materials used and traceability.
- The dependence of Greek farmers on common agricultural policies, especially their need to depend on programs that do not ensure equal terms of competition with other competing producers from different countries.
- The continuous urbanization, which leads residents to leave Greek islands and promotes the phenomenon of their isolation, while also decreasing the number of able working staff on the agricultural production sector.
- The perceptions based on societal factors, affecting Greeks and promoting the belief of a "lesser" social status of people working in the agricultural sector, thus making the sector a rather unattractive choice of profession for many people.

Consequently, it is clear that there are certain pros and cons that need to be taken into consideration. Taking into account all the aforementioned elements of the above qualitative (mostly) SWOT analysis, there are certain factors that need to be addressed. Specifically, the agricultural sector should build on its strengths and take advantage of all existing opportunities, while also effectively limiting its weaknesses and dealing as fast as possible

with rising threats. Bearing all factors of the analysis in mind and, as mentioned before, the goal of this thesis is to provide an analysis of the sector when it comes to the case of Greek islands, which consist of unique cases of their own, regarding the discussed area. The major issue of the sector in Greek islands is clearly the way in which the products are transported from production sites to the end consumer, due to the fact that different means of transport must be used in order to do so.

As a result, any recommendations should be based on the logistics aspect, in order to improve as best as possible the agrologistics sector regarding Greek islands, by providing cost efficiency solutions, while maintaining high quality of service and, of course, products. In order to better address the issue and assess the current situation from an economic point of view at first, exports of certain categories of products from different regions of islands are analyzed.

3.3 EXPORTS OF GREEK ISLANDS TO INTERNATIONAL MARKETS

In order to better determine how strong is the agricultural sector of Greece and, specifically, of Greek islands there must be a more quantitative analysis on whether production from specific regions reaches domestic and international markets. As mentioned above, international markets show the most and toughest competition, in terms of end product quality, services provided and other important factors. The present diploma thesis uses exports of Greek islands as a way to better determine areas where the agricultural sector of these regions is strong or shows rise and areas where the sector either remains inactive or shows decreases in product exports.

As stated before, all export data were collected from the study “Mapping Greece’s export activity by region and regional unit”, conducted by the Institute for Export Research and Studies and were made available for the purposes of this diploma thesis by the Greek Exporters Association (SEVE). Data of the aforementioned study are categorized based on region, products and the countries to which products are exported. It is important to note that data concerning exports to specific countries on an international level consist of an overall report considering total exports of Greek islands and not of specifically agricultural products.

However, these quantitative data can still give insight of the level of impact an island region has on international markets and because of this they are included on the present thesis.

In addition, island regions of this research study are categorized in four distinct regions of groups of islands. However, one region consists only of the island of Crete, which is understandable, due to the larger size of the island, in comparison with other groups of islands (or islets) of the study. The other three island regions consist of the Northern Aegean, the Southern Aegean and the Ionian islands.

Regarding product types, the categories assessed by the study consist of several types of agricultural products. These types are:

- Fats and oils
- Vegetables
- Fruitage and fresh fruits
- Fish, crustaceans and mollusks
- Fruit and vegetable concoctions
- Dairy products
- Drinks, spirits and vinegar
- Meat and fish products
- Sugar and sugar concoctions
- Cereal and corn based products
- Various dietary products
- Seeds and varieties of fruitage products
- Flour products
- Coffee, tea and spices
- Resins and vegetable extracts
- Meat
- Plants
- Cocoa and its concoctions
- Miscellaneous products of animal origin
- Foods for animals

- Miscellaneous products of vegetable origin
- Live animals
- Cereal

3.3.1. EXPORTS OF CRETE

Crete has a large production of agricultural products. As already mentioned, its larger size highly contributes to that area, especially if the island is compared to other Greek islands. More specifically, the island of Crete covers an area of 8303 km^2, being the fifth largest island of the Mediterranean (only smaller to Sicily, Sardinia, Cyprus and Corsica), while its coastline extends up to 1046 km. In order to understand the considerable larger size of Crete, in comparison to other Greek islands (and therefore their overall agricultural production), Euboea covers only up to 3670 km^2 of area, while being the second largest island of Greece.

Taking the above factors into consideration, Crete is considered as one of the most vital islands of Greece, from an economic aspect. Its agricultural sector has been and still remains strong, while its export power shows a continuous and important rise, as shown on the export data of the island on the following tables.

CATEGORIES	**YEAR**				
	2013	**2014**	**2015**	**2016**	**2017**
Fats and oils	144,137,932	68,492,110	242,693,019	190,715,793	152,730,692
Vegetables	50,455,775	52,507,000	49,509,522	61,327,439	58,640,123
Fruitage and fresh fruits	20,621,261	20,822,258	20,927,087	22,356,742	21,760,625
Fish, crustaceans and mollusks	5,209,675	4,695,072	4,178,093	5,646,829	5,798,494
Fruit and vegetable concoctions	197,758	1,406,503	1,443,140	1,234,754	3,126,855
Dairy products	1,146,992	1,804,282	1,617,624	1,968,462	3,002,511
Drinks, spirits and vinegar	2,291,048	1,894,088	2,066,197	2,419,076	2,633,139
Meat and fish products	2,793,755	2,675,195	1,643,920	2,439,855	2,245,007
Sugar and sugar concoctions	3,353,893	3,673,889	2,761,063	2,580,205	2,073,225

Cereal and corn based products	739,558	1,107,861	1,622,112	1,788,851	2,047,672
Various dietary products	402,614	301,060	543,806	397,953	1,181,391
Seeds and varieties of fruitage products	212,608	633,363	258,653	681,096	743,580
Flour products	142,728	199,110	167,564	209,501	286,105
Coffee, tea and spices	27,744	108,071	74,278	61,475	201,523
Resins and vegetable extracts	173,106	137,424	170,412	130,259	194,585
Meat	614,684	316,609	79,065	260,095	165,482
Plants	84,045	50,804	97,162	104,285	118,613
Cocoa and its concoctions	913	5,071	7,175	12,288	63,218
Miscellaneous products of animal origin	0	2,820	1,445	21,000	21,050
Foods for animals	821	0	25,797	80,477	14,587
Miscellaneous products of vegetable origin	0	0	7,560	200	304
Live Animals	0	197,858	0	0	0
Cereal	5	0	3,394	145	0
TOTAL	**232,606,915**	**161,030,448**	**329,898,088**	**294,436,780**	**257,048,781**

Table 3.1. Crete exports of agricultural products by main category in value (EUR)
Source: "Mapping Greece's export activity by region and regional unit", IERS – SEVE

Crete, as made clear by the above results, has a very large share in the agricultural sector of the Greek islands. Even though total exports show a minor stagnation since 2013, there are certain product categories which show a lot of promise. Examples that show promise consist of categories such as the fruit and vegetable concoctions, the dairy products, the cereal and corn based products, various dietary products, seeds and varieties of fruitage products, coffee/tea and spices and cocoa and its concoctions. The latter can be considered as the most promising category as it shows a continuous annual increase in total value of exports, increasing by 414% in the 2016 – 2017 period, while already having increased its overall share by 455% in the 2013 – 2014 period. These changes in value of exports are shown on

the following tables, regarding annual percentage change in value of exports and annual change in absolute value of exports.

PRODUCT CATEGORY	ANNUAL CHANGE IN EXPORT VALUE (EUR)			
	2013 – 2014	**2014 – 2015**	**2015 – 2016**	**2016 – 2017**
Fats and oils	-75,645,822 €	174,200,909 €	-51,977,226 €	-37,985,101 €
Vegetables	2,051,225 €	-2,997,478 €	11,817,917 €	-2,687,316 €
Fruitage and fresh fruits	200,997 €	104,829 €	1,429,655 €	-596,117 €
Fish, crustaceans and mollusks	-514,603 €	-516,979 €	1,468,736 €	151,665 €
Fruit and vegetable concoctions	1,208,745 €	36,637 €	-208,386 €	1,892,101 €
Dairy products	657,290 €	-186,658 €	350,838 €	1,034,049 €
Drinks, spirits and vinegar	-396,960 €	172,109 €	352,879 €	214,063 €
Meat and fish products	-118,560 €	-1,031,275 €	795,935 €	-194,848 €
Sugar and sugar concoctions	319,996 €	-912,826 €	-180,858 €	-506,980 €
Cereal and corn based products	368,303 €	514,251 €	166,739 €	258,821 €
Various dietary products	-101,554 €	242,746 €	-145,853 €	783,438 €
Seeds and varieties of fruitage products	420,755 €	-374,710 €	422,443 €	62,484 €
Flour products	56,382 €	-31,546 €	41,937 €	76,604 €
Coffee, tea and spices	80,327 €	-33,793 €	-12,803 €	140,048 €
Resins and vegetable extracts	-35,682 €	32,988 €	-40,153 €	64,326 €
Meat	-298,075 €	-237,544 €	181,030 €	-94,613 €
Plants	-33,241 €	46,358 €	7,123 €	14,328 €
Cocoa and its concoctions	4,158 €	2,104 €	5,113 €	50,930 €
Miscellaneous products of animal origin	2,820 €	-1,375 €	19,555 €	50 €
Foods for animals	-821 €	25,797 €	54,680 €	-65,890 €
Miscellaneous products of vegetable origin	0 €	7,560 €	-7,360 €	104 €
Live Animals	197,858 €	-197,858 €	0 €	0 €
Cereal	-5 €	3,394 €	-3,249 €	-145 €
TOTAL	**-71,576,467 €**	**168,867,640 €**	**-35,461,308 €**	**-37,387,999 €**

Table 3.2. Annual change in value of exports by category in Crete

PRODUCT	ANNUAL PERCENTAGE CHANGE			
	2013-2014	2014-2015	2015-2016	2016-2017
Fats and oils	-52%	254%	-21%	-20%
Vegetables	4%	-6%	24%	-4%
Fruitage and fresh fruits	1%	1%	7%	-3%
Fish, crustaceans and mollusks	-10%	-11%	35%	3%
Fruit and vegetable concoctions	611%	3%	-14%	153%
Dairy products	57%	-10%	22%	53%
Drinks, spirits and vinegar	-17%	9%	17%	9%
Meat and fish products	-4%	-39%	48%	-8%
Sugar and sugar concoctions	10%	-25%	-7%	-20%
Cereal and corn based products	50%	46%	10%	14%
Various dietary products	-25%	81%	-27%	197%
Seeds and varieties of fruitage products	198%	-59%	163%	9%
Flour products	40%	-16%	25%	37%
Coffee, tea and spices	290%	-31%	-17%	228%
Resins and vegetable extracts	-21%	24%	-24%	49%
Meat	-48%	-75%	229%	-36%
Plants	-40%	91%	7%	14%
Cocoa and its concoctions	455%	41%	71%	414%
Miscellaneous products of animal origin	-	-49%	1353%	0%
Foods for animals	-100%	-	212%	-82%
Miscellaneous products of vegetable origin	-	-	-97%	52%
Live Animals	-	-100%	-	-
Cereal	-100%	-	-96%	-100%
TOTAL	**-31%**	**105%**	**-11%**	**-13%**

Table 3.3. Annual percentage change in value of exports by product category in Crete

Even though Crete shows a decrease in total value of exports, the island still has significant export strength, regarding the overall exports of Greek islands, with an overall value of exports at 257,048,781 €. It is important to note that categories which show no percentage change in certain cells (noted by "-" on the above table) do not remain unchanged, but only indicate that a percentage change result is not applicable in this case because the start data are zero and changes cannot be divided by the start number to show percentage change. In order to better evaluate opportunities regarding the exports of each island region, export data

regarding the destination countries of exports should also be analyzed. However, data of the aforementioned study regarding destination countries of exports for each island region show the overall exports of the corresponding region, instead of the exports of agricultural products. Still, these specific data should be taken into consideration, as Greek islands show a high percentage of total exports on European and Turkish markets (Turkey is taken into consideration because of its proximity to Greek islands, as a promising market for Greek exports). The percentage of total exports of Crete on these countries is 80.39%, while another 5% of total exports is destined for USA and Canada, as of 2017. As a result, regarding these market shares, in the case of Crete the study assesses the aspect of export shares mostly on European (Turkey included) and North American markets.

This consideration sets the basis for addressing the issue of international exports, while considering new opportunities for increasing overall market share, not only for Crete but for all regions of Greek islands. On the following table, total export percentages of Crete are shown, regarding destination countries.

DESTINATION COUNTRY	**TOTAL EXPORT SHARE PER YEAR**				
	2013	**2014**	**2015**	**2016**	**2017**
Italy	18.36%	7.17%	33.31%	26.04%	18.38%
Germany	14.40%	15.21%	13.11%	14.51%	17.04%
United Kingdom	1.94%	2.47%	4.08%	3.73%	6.02%
France	2.41%	3.33%	3.68%	4.10%	4.32%
Netherlands	2.36%	3.10%	2.99%	4.03%	4.22%
Spain	3.06%	1.65%	3.53%	2.94%	3.55%
Austria	2.06%	2.03%	3.31%	4.19%	3.26%
Cyprus	1.50%	1.50%	1.85%	2.23%	2.82%
Poland	0.99%	1.56%	1.67%	1.89%	2.42%
Russia	0.58%	0.49%	1.52%	2.25%	2.28%
Romania	0.70%	0.90%	1.28%	2.07%	2.25%
Bulgaria	1.96%	2.34%	2.04%	1.91%	1.88%
Republic of Ireland	0.08%	0.15%	1.17%	0.67%	1.37%
Czech Republic	1.39%	1.47%	1.36%	2.15%	1.22%

Malta	0.05%	0.03%	1.08%	0.86%	1.14%
Turkey	1.99%	1.48%	1.13%	1.18%	1.06%
Belgium	1.14%	0.75%	0.77%	0.78%	0.97%
Norway	0.13%	0.09%	0.73%	0.81%	0.84%
Switzerland	0.22%	0.22%	0.46%	0.60%	0.73%
Sweden	0.20%	0.24%	0.68%	0.79%	0.61%
Denmark	0.42%	0.44%	0.71%	0.72%	0.60%
Portugal	0.30%	0.30%	0.36%	0.36%	0.54%
Slovakia	0.19%	0.24%	0.27%	0.45%	0.45%
Hungary	0.14%	0.16%	0.17%	0.34%	0.44%
Lithuania	0.22%	0.18%	0.21%	0.29%	0.40%
Finland	0.15%	0.14%	0.22%	0.31%	0.28%
Serbia	0.14%	0.20%	0.24%	0.22%	0.24%
Croatia	0.18%	0.10%	0.12%	0.17%	0.22%
Slovenia	0.14%	0.16%	0.18%	0.19%	0.21%
Estonia	0.05%	0.08%	0.05%	0.09%	0.15%
Latvia	0.06%	0.06%	0.10%	0.07%	0.12%
Moldova	0.00%	0.00%	0.10%	0.12%	0.11%
Ukraine	0.13%	0.06%	0.09%	0.09%	0.07%
Luxembourg	0.01%	0.01%	0.03%	0.06%	0.06%
Belarus	0.00%	0.06%	0.06%	0.03%	0.05%
Iceland	0.02%	0.02%	0.02%	0.03%	0.03%
Albania	0.01%	0.00%	0.04%	0.01%	0.01%
Andorra	0.00%	0.00%	0.00%	0.00%	0.00%
TOTAL SHARE	**57.70%**	**48.41%**	**82.73%**	**81.29%**	**80.39%**

Table 3.4. Annual percentage of total exports of Crete by destination country
Source: "Mapping Greece's export activity by region and regional unit", IERS – SEVE

As shown above, Crete shows a significant export share on European markets and especially countries of the Western Europe (Germany, United Kingdom, France, Netherlands, Spain etc.). Due to this, the most pressing issue that must be addressed is clearly the distribution of products to these countries, in order for the products to reach the consumers without

significant delays, while also reaching them at the best possible quality. In order to better determine opportunities and solutions for this issue, exports of the other island regions must be analyzed as well, in order for the best possible solution for all of these regions to be proposed.

3.3.2. EXPORTS OF SOUTH AEGEAN

Another region which is analyzed is that of the South Aegean. This region of islands covers a total area of 5286 km^2 with a total population of 308.975 residents, as of 2011 (Population Census, Hellenic Statistical Authority, 2011). This group of islands is divided into thirteen regional units, which consist of the following thirty-four islands:

1) Andros
2) Anafi
3) Thira (Santorini)
4) Ios
5) Sikinos
6) Folegandros
7) Agathonisi
8) Astypalea
9) Kalymnos
10) Lipsi
11) Leros
12) Patmos
13) Karpathos
14) Kasos
15) Kea
16) Kythnos
17) Kos
18) Nisyros
19) Kimolos
20) Milos
21) Serifos
22) Sifnos
23) Mykonos
24) Amorgos
25) Naxos
26) Antiparos
27) Paros
28) Kastelorizo
29) Rodos
30) Symi
31) Tilos
32) Chalki
33) Ermoupolis
34) Tinos

In comparison to Crete, there are certain categories that were previously mentioned, although islands of the South Aegean lack exports in specific categories (such as the one of live animals). The islands' exports and their corresponding values in exports during the period between 2013 and 2017 are shown on the following table.

CATEGORY	**YEAR**				
	2013	**2014**	**2015**	**2016**	**2017**
Fish, crustaceans and mollusks	5,295,798 €	7,311,236 €	6,826,683 €	6,940,801 €	7,538,558 €

Drinks, spirits and vinegar	2,391,438 €	2,492,447 €	3,327,395 €	3,434,524 €	5,325,113 €
Miscellaneous products of animal origin	987,138 €	1,195,545 €	1,217,040 €	1,583,361 €	1,724,933 €
Fats and oils	3,303 €	- €	96,834 €	487,588 €	222,509 €
Fruit and vegetable concoctions	8,341 €	31,699 €	49,512 €	20,895 €	29,540 €
Cereal and corn based products	- €	12,999 €	24,365 €	29,285 €	23,746 €
Vegetables	2,390 €	8,909 €	8,403 €	9,924 €	20,897 €
Dairy products	679 €	81 €	4,500 €	- €	10,005 €
Meat and fish products	77,363 €	- €	- €	689 €	3,096 €
Meat	1,255 €	- €	2,403 €	18 €	675 €
Seeds and varieties of fruitage products	1,200 €	- €	- €	- €	427 €
Coffee, tea and spices	- €	- €	- €	- €	382 €
Various dietary products	25,291 €	26,474 €	2,268 €	360 €	274 €
Plants	- €	- €	1,450 €	- €	93 €
Flour products	- €	- €	- €	- €	45 €
Fruitage and fresh fruits	- €	- €	- €	24,150 €	- €
Cocoa and its concoctions	- €	90 €	- €	- €	- €
Foods for animals	130,447 €	- €	- €	1,413 €	- €
TOTAL	**8,924,643 €**	**11,079,480 €**	**11,560,853 €**	**12,533,008 €**	**14,900,293 €**

Table 3.5. South Aegean exports of agricultural products by main category in value (EUR)
Source: "Mapping Greece's export activity by region and regional unit", IERS – SEVE

In the case of annual percentage changes, categories which show no percentage change in certain cells (noted by "-") do not remain unchanged, but only indicate that a percentage change result is not applicable in this case because the start data are of zero value.

CATEGORY	YEARLY CHANGE IN VALUE OF EXPORTS			
	2013-2014	2014-2015	2015-2016	2016-2017
Fish, crustaceans and mollusks	2,015,438 €	-484,553 €	114,118 €	597,757 €
Drinks, spirits and vinegar	101,009 €	834,948 €	107,129 €	1,890,589 €
Misc. products of animal origin	208,407 €	21,495 €	366,321 €	141,572 €
Fats and oils	-3,303 €	96,834 €	390,754 €	-265,079 €
Fruit and vegetable concoctions	23,358 €	17,813 €	-28,617 €	8,645 €
Cereal and corn based products	12,999 €	11,366 €	4,920 €	-5,539 €
Vegetables	6,519 €	-506 €	1,521 €	10,973 €
Dairy products	-598 €	4,419 €	-4,500 €	10,005 €
Meat and fish products	-77,363 €	- €	689 €	2,407 €
Meat	-1,255 €	2,403 €	-2,385 €	657 €
Seeds & various fruitage products	-1,200 €	- €	- €	427 €
Coffee, tea and spices	- €	- €	- €	382 €
Various dietary products	1,183 €	-24,206 €	-1,908 €	-86 €
Plants	- €	1,450 €	-1,450 €	93 €
Flour products	- €	- €	- €	45 €
Fruitage and fresh fruits	- €	- €	24,150 €	-24,150 €
Cocoa and its concoctions	90 €	-90 €	- €	- €
Foods for animals	-130,447 €	- €	1,413 €	-1,413 €
TOTAL	**2,154,837 €**	**481,373 €**	**972,155 €**	**2,367,285 €**

Table 3.6. Annual change in value of exports by category in South Aegean

CATEGORY	YEARLY PERCENTAGE CHANGE IN VALUE OF EXPORTS			
	2013-2014	2014-2015	2015-2016	2016-2017
Fish, crustaceans and mollusks	38%	-7%	2%	9%
Drinks, spirits and vinegar	4%	33%	3%	55%
Miscellaneous products of animal origin	21%	2%	30%	9%
Fats and oils	-100%	-	404%	-54%
Fruit and vegetable concoctions	280%	56%	-58%	41%
Cereal and corn based products	-	87%	20%	-19%
Vegetables	273%	-6%	18%	111%
Dairy products	-88%	5456%	-100%	-
Meat and fish products	-	-	-	349%
Meat	-100%	-	-99%	3650%
Seeds and varieties of fruitage products	-100%	-	-	-
Coffee, tea and spices	-	-	-	-
Various dietary products	5%	-91%	-84%	-24%

Plants	-	-	-100%	-
Flour products	-	-	-	-
Fruitage and fresh fruits	-	-	-	-100%
Cocoa and its concoctions	-	-100%	-	-
Foods for animals	-100%	-	-	-100%
TOTAL	**24%**	**4%**	**8%**	**19%**

Table 3.7. Annual percentage change in value of exports by product category in South Aegean

As shown on the above tables, islands of the South Aegean do not show significant amounts of exports, at least in comparison with Crete. However, the South Aegean still shows a lot of promise, especially in product categories such as fish, drinks spirits and vinegar, fruits and vegetables and products of animal origins.

It is clear that the export share of the South Aegean is rather small. However, total exports of the region have been significantly increased in value, with an overall 67% rise from 2013 to 2017. As a result, even though export share of the region remains small regarding other regions of islands, South Aegean shows great promise regarding the increase of its total exports to international markets. The following table shows overall exports (not only agricultural products) of South Aegean by country of destination in Europe (Turkey included). These results do not clearly show how the agricultural sector of this region performs, but can still give insight on where exports of the region go to.

Destination Country	**2013**	**2014**	**2015**	**2016**	**2017**
United Kingdom	0.30%	0.63%	10.04%	10.67%	12.89%
Italy	4.18%	7.45%	8.41%	8.35%	11.55%
Germany	0.83%	2.21%	5.35%	9.20%	8.53%
Republic of Ireland	0.00%	0.01%	6.94%	3.76%	5.35%
Malta	0.00%	0.00%	2.02%	4.22%	4.43%
Netherlands	0.06%	0.15%	2.71%	3.80%	3.63%
Sweden	0.01%	0.01%	0.68%	2.93%	3.10%
France	0.09%	0.37%	2.05%	2.33%	2.62%
Poland	0.01%	0.00%	1.48%	2.11%	2.51%
Austria	0.22%	0.37%	0.80%	0.93%	2.05%
Belgium	0.09%	0.09%	0.75%	1.76%	1.68%

Spain	0.10%	0.15%	1.44%	1.01%	1.62%
Denmark	0.42%	0.47%	1.28%	2.75%	1.56%
Turkey	0.88%	1.62%	2.06%	2.39%	1.48%
Cyprus	0.69%	2.26%	1.87%	2.61%	1.37%
Czech Republic	0.06%	0.15%	1.98%	1.29%	1.34%
Norway	0.36%	0.39%	0.69%	1.21%	1.25%
Russia	0.52%	0.04%	0.46%	2.36%	1.25%
Switzerland	0.01%	0.13%	0.35%	1.01%	1.15%
Romania	0.19%	0.01%	0.54%	0.65%	0.81%
Ukraine	2.95%	0.48%	0.21%	0.17%	0.66%
Lithuania	0.00%	0.00%	0.94%	1.02%	0.62%
Portugal	0.00%	0.02%	0.23%	0.33%	0.54%
Bulgaria	0.06%	0.20%	0.06%	0.49%	0.53%
Iceland	0.00%	0.00%	0.00%	0.40%	0.40%
Finland	0.00%	0.00%	0.02%	0.28%	0.38%
Latvia	0.00%	0.00%	0.34%	0.33%	0.27%
Hungary	0.03%	0.04%	0.11%	0.15%	0.21%
Slovenia	0.00%	0.01%	0.08%	0.10%	0.18%
Serbia	0.01%	0.07%	0.15%	0.14%	0.13%
Slovakia	0.00%	0.01%	0.14%	0.05%	0.12%
Luxembourg	0.00%	0.00%	0.13%	0.14%	0.10%
Moldova	0.00%	0.00%	0.35%	0.11%	0.09%
Croatia	0.00%	0.00%	0.02%	0.18%	0.03%
Albania	0.01%	0.01%	0.02%	0.07%	0.03%
Belarus	76.81%	86.55%	94.16%	94.70%	93.41%
Estonia	0.00%	0.00%	0.00%	0.02%	0.01%
TOTAL	**12.08%**	**17.34%**	**54.69%**	**69.30%**	**74.44%**

Table 3.8. Annual percentage of total exports of South Aegean by destination country
Source: "Mapping Greece's export activity by region and regional unit", IERS – SEVE

The above results show a clear change in exports of the South Aegean to international markets. In a four-year span, from 2013 to 2017, exports of the South Aegean to European markets increased by 62.36%, while at the same time, exports to the US and Canada increased

by a total of 6.12%, with exports to the US consisting of 8.97% (5.25% in 2013) of total exports and exports to Canada consisting of 7.53% (5.13% in 2013) of total exports by 2017. Consequently, a total of 90.94% of total exports reach European and North American markets from the South Aegean. As in the case of Crete, this result shows the influence of mostly European markets to the exports of this island region as well, which makes the issue of product distribution even more significant when considering these island regions.

3.3.3. EXPORTS OF NORTH AEGEAN

This region, along with the one of the South Aegean, consist of all major Greek islands of autonomous administrative regions in the Aegean Sea. This administrative region consists of the islands of Ikaria, Lesvos (or Mytilene), Limnos, Samos and Chios, which cover a total area of 3836 km^2, with a population of 199231 residents (Population Census, Hellenic Statistical Authority, 2011).

As for the aforementioned regions, in this case there are certain product categories exported. These categories, their corresponding export values, changes in value of exports and percentage changes in value of exports are shown on the following tables.

CATEGORY	**YEAR**				
	2013	**2014**	**2015**	**2016**	**2017**
Fish, crustaceans and mollusks	119,043,367 €	123,101,173 €	138,614,727 €	137,764,856 €	144,303,376 €
Fats and oils	13,633,124 €	2,417,866 €	5,688,846 €	10,930,028 €	13,326,899 €
Drinks, spirits and vinegar	8,003,818 €	10,608,803 €	9,479,923 €	12,534,737 €	10,341,341 €
Resins and vegetable extracts	8,360,156 €	8,821,994 €	9,383,991 €	8,931,000 €	8,842,674 €
Dairy products	1,400,173 €	738,749 €	892,531 €	2,045,413 €	1,704,571 €
Sugar and sugar concoctions	1,370,855 €	1,195,907 €	1,210,949 €	1,261,976 €	1,008,607 €
Fruit and vegetable concoctions	698,185 €	1,450,448 €	898,253 €	692,189 €	591,763 €
Meat	3,220 €	11,605 €	- €	- €	162,567 €
Various dietary products	170,053 €	100,307 €	142,769 €	90,118 €	103,987 €
Plants	7,295 €	5,972 €	76,285 €	6,659 €	13,535 €

Meat and fish products	136,521 €	- €	29,145 €	50,748 €	8,380 €
Miscellaneous products of animal origin	- €	- €	- €	- €	2 €
Live Animals	757,688 €	- €	- €	- €	- €
Vegetables	5,526 €	1,948 €	162 €	- €	- €
Fruitage and fresh fruits	1,000 €	- €	- €	- €	- €
Coffee, tea and spices	- €	3,216 €	117 €	- €	- €
Miscellaneous products of vegetable origin	- €	121 €	30 €	- €	- €
Cocoa and its concoctions	464 €	696 €	7,510 €	1,065 €	- €
Cereal and corn based products	1,818 €	- €	- €	- €	- €
Foods for animals	- €	- €	361,942 €	822,331 €	- €
TOTAL	**153,593,263 €**	**148,458,805 €**	**166,787,180 €**	**175,131,120 €**	**180,407,702 €**

Table 3.9. North Aegean exports of agricultural products by main category in value (EUR)
Source: "Mapping Greece's export activity by region and regional unit", IERS – SEVE

CATEGORY	**YEARLY CHANGE IN VALUE OF EXPORTS**			
	2013-2014	**2014-2015**	**2015-2016**	**2016-2017**
Fish, crustaceans and mollusks	4,057,806 €	15,513,554 €	-849,871 €	6,538,520 €
Fats and oils	-11,215,258 €	3,270,980 €	5,241,182 €	2,396,871 €
Drinks, spirits and vinegar	2,604,985 €	-1,128,880 €	3,054,814 €	-2,193,396 €
Resins and vegetable extracts	461,838 €	561,997 €	-452,991 €	-88,326 €
Dairy products	-661,424 €	153,782 €	1,152,882 €	-340,842 €
Sugar and sugar concoctions	-174,948 €	15,042 €	51,027 €	-253,369 €
Fruit and vegetable concoctions	752,263 €	-552,195 €	-206,064 €	-100,426 €
Meat	8,385 €	-11,605 €	0 €	162,567 €
Various dietary products	-69,746 €	42,462 €	-52,651 €	13,869 €
Plants	-1,323 €	70,313 €	-69,626 €	6,876 €
Meat and fish products	-136,521 €	29,145 €	21,603 €	-42,368 €
Miscellaneous products of animal origin	0 €	0 €	0 €	2 €
Live Animals	-757,688 €	0 €	0 €	0 €
Vegetables	-3,578 €	-1,786 €	-162 €	0 €
Fruitage and fresh fruits	-1,000 €	0 €	0 €	0 €
Coffee, tea and spices	3,216 €	-3,099 €	-117 €	0 €

Miscellaneous products of vegetable origin	121 €	-91 €	-30 €	0 €
Cocoa and its concoctions	232 €	6,814 €	-6,445 €	-1,065 €
Cereal and corn based products	-1,818 €	0 €	0 €	0 €
Foods for animals	0 €	361,942 €	460,389 €	-822,331 €
TOTAL	**-5,134,458 €**	**18,328,375 €**	**8,343,940 €**	**5,276,582 €**

Table 3.10. Annual change in value of exports by category in South Aegean

CATEGORY	**YEARLY CHANGE IN VALUE OF EXPORTS**			
	2013-2014	**2014-2015**	**2015-2016**	**2016-2017**
Fish, crustaceans and mollusks	3%	13%	-1%	5%
Fats and oils	-82%	135%	92%	22%
Drinks, spirits and vinegar	33%	-11%	32%	-17%
Resins and vegetable extracts	6%	6%	-5%	-1%
Dairy products	-47%	21%	129%	-17%
Sugar and sugar concoctions	-13%	1%	4%	-20%
Fruit and vegetable concoctions	108%	-38%	-23%	-15%
Meat	260%	-100%	-	-
Various dietary products	-41%	42%	-37%	15%
Plants	-18%	1177%	-91%	103%
Meat and fish products	-100%	-	74%	-83%
Miscellaneous products of animal origin	-	-	-	-
Live Animals	-100%	-	-	-
Vegetables	-65%	-92%	-100%	-
Fruitage and fresh fruits	-100%	-	-	-
Coffee, tea and spices	-	-96%	-100%	-
Miscellaneous products of vegetable origin	-	-75%	-100%	-
Cocoa and its concoctions	50%	979%	-86%	-100%
Cereal and corn based products	-100%	-	-	-
Foods for animals	-	-	127%	-100%
TOTAL	**-3%**	**12%**	**5%**	**3%**

Table 3.11. Annual percentage change in value of exports by category in South Aegean

Reviewing the above results, it is clear that islands of the North Aegean show great opportunities regarding agricultural exports. Fish, crustaceans and mollusks are products that show significant rise during the four-year span of the research, with an overall rise of 21% from 2013 to 2017. Other product categories which show continuously high numbers are those of drinks, spirits and vinegar and resins and vegetable extracts, while the latter shows

significantly higher value of exports in comparison with other island regions, due to the high production of the highly popular Chios mastic.

Islands of the North Aegean show great rises in total value of their exports, with continuous and stable increases and an overall 17% increase from 2013 to 2017 (an increase of 26,814,439 € on total value of exports of agricultural products). The agricultural sector of the North Aegean is vital for its exports, as 95% of its total exports corresponds to agricultural products (189,722,330 € in total value of exports, 180,407,702 € in total value of exports of agricultural products), which results in a much easier analysis on the countries of destination for the region's exports shown on the following table, as data from total exports and data from agricultural products exports show only a small difference.

DESTINATION COUNTRY	2013	2014	2015	2016	2017
Italy	23.84%	24.66%	26.80%	24.81%	27.86%
France	14.63%	17.93%	15.82%	17.07%	18.23%
Spain	8.41%	8.20%	9.04%	10.66%	11.57%
Germany	5.42%	7.87%	9.66%	9.48%	10.20%
Portugal	7.82%	7.39%	8.19%	6.12%	6.49%
United Kingdom	5.39%	6.06%	7.15%	8.98%	4.78%
Netherlands	2.63%	2.77%	3.24%	3.61%	2.87%
Romania	1.91%	2.39%	2.19%	2.82%	2.72%
Bulgaria	1.33%	2.08%	2.06%	2.33%	2.20%
Ireland	0.32%	0.37%	0.32%	0.49%	1.73%
Cyprus	0.65%	1.54%	1.81%	2.37%	1.38%
Turkey	1.01%	1.72%	1.50%	1.04%	0.79%
Belgium	0.86%	0.88%	0.86%	1.05%	0.73%
Croatia	0.18%	0.18%	0.45%	0.30%	0.51%
Luxembourg	0.40%	0.45%	0.51%	0.24%	0.27%
Norway	0.01%	0.02%	0.40%	0.19%	0.25%
Austria	0.29%	0.25%	0.22%	0.39%	0.14%
Denmark	0.11%	0.10%	0.45%	0.10%	0.12%
Sweden	0.59%	0.17%	0.84%	0.88%	0.12%
Czech Republic	0.05%	0.04%	0.04%	0.13%	0.11%
Poland	0.16%	0.14%	0.10%	0.81%	0.08%
Slovenia	0.18%	0.46%	0.33%	0.07%	0.07%
Switzerland	0.02%	0.03%	0.04%	0.02%	0.06%
Serbia	0.00%	0.02%	0.01%	0.02%	0.04%

Slovakia	0.01%	0.01%	0.02%	0.05%	0.03%
Hungary	0.00%	0.01%	0.03%	0.02%	0.03%
Lithuania	0.26%	0.39%	0.25%	0.39%	0.01%
Finland	0.02%	0.02%	0.12%	0.02%	0.01%
Albania	0.00%	0.01%	0.01%	0.00%	0.01%
Malta	0.00%	0.00%	1.39%	0.04%	0.00%
Ukraine	0.00%	0.00%	0.00%	0.00%	0.00%
Russia	0.08%	0.03%	0.01%	0.04%	0.00%
Estonia	0.00%	0.02%	0.02%	0.01%	0.00%
Latvia	0.25%	0.34%	0.29%	0.13%	0.00%
Moldova	0.00%	0.00%	0.00%	0.00%	0.00%
TOTAL	**76.81%**	**86.55%**	**94.16%**	**94.70%**	**93.41%**

Table 3.12. Annual percentage of total exports of South Aegean by destination country
Source: "Mapping Greece's export activity by region and regional unit", IERS – SEVE

It is clear that islands of the North Aegean show significant increase of exports to European markets. In addition, North American markets (USA and Canada) also show a significant increase in total exports percentage, with exports to the US increasing from 1.17% in 2013 to 2.90% in 2017, while exports to Canada also show an increase from 0.27% in 2013 to 0.44% in 2017, creating a 3.34% share of total exports to North American markets. In this case, as well as the aforementioned ones, European and North American markets play a significant role on Greek islands' exports, with export shares of more than 80% in each case.

Consequently, islands of the Aegean and Crete all show increases on exports towards European markets. Since destination countries do not vary significantly, as highest market shares are mostly located in European countries, exports from the Aegean (and Crete for that matter) should be better organized so that products are distributed through certain supply chain routes, in order to create more efficient transportation systems, in order to achieve better quality of service and faster responses in demand of products.

3.3.4. EXPORTS OF IONIAN ISLANDS

The last region of islands analyzed on the present thesis is that of the Ionian islands. This region consists of all islands of the Ionian Sea, where major islands are Kerkyra, Paxi, Zakynthos, Ithaca, Kephallonia, Lefkada, Kythera, Kalamos and other smaller islands.

The case of the Ionian islands is unique and complex, regarding the issue addressed by the present thesis. All aforementioned groups of islands are located on the Aegean Sea and issues regarding the distribution of their products to international markets (mainly European) are addressed as a whole, in order to propose the best possible solution. However, in the case of the Ionian, exports to international markets can be facilitated, due to the islands' favorable location close to Italy and other European countries, in contrast to islands of the Aegean and Crete. In order to better evaluate the importance of exports of the Ionian islands, exports of different product categories and countries of destination for total exports are analyzed in this case, as per previous island regions. The following tables show the Ionian islands' value of exports by product category, their annual changes (in absolute value and percentage change), as well as export shares (of total exports) by country of destination.

CATEGORY	YEAR				
	2013	2014	2015	2016	2017
Fish, crustaceans and mollusks	3,918,679 €	22,302,102 €	26,365,485 €	27,287,670 €	29,176,576 €
Fats and oils	17,727,178 €	6,246,300 €	17,339,474 €	20,685,519 €	19,897,584 €
Drinks, spirits and vinegar	150,306 €	143,092 €	205,480 €	202,939 €	275,095 €
Meat and fish products	73 €	265 €	9,125 €	198,724 €	245,139 €
Vegetables	20,718 €	23 €	1,138 €	46 €	238,294 €
Meat	29,749 €	812 €	21,215 €	8,990 €	104,794 €
Plants	1 €	- €	- €	6,455 €	10,429 €
Fruitage and fresh fruits	48 €	4,278 €	9,701 €	7,432 €	9,004 €
Coffee, tea and spices	17,585 €	2,960 €	5,363 €	41,271 €	4,703 €
Sugar and sugar concoctions	417 €	13 €	382 €	7,189 €	2,755 €
Dairy products	4,739 €	8,355 €	6,769 €	72,733 €	861 €
Cereal and corn based products	1,938 €	1,072 €	6,232 €	6,118 €	131 €
Various dietary products	2,612 €	318 €	2,106 €	3,267 €	131 €
Cocoa and its concoctions	22 €	321 €	2,771 €	10,926 €	66 €

Fruit and vegetable concoctions	15,789 €	871 €	2,476 €	5,390 €	20 €
Cereal	16 €	- €	17 €	101 €	- €
Flour products	19 €	15 €	386 €	603 €	- €
Seeds and varieties of fruitage products	2 €	- €	- €	2 €	- €
Resins and vegetable extracts	- €	- €	2 €	- €	- €
Foods for animals	17 €	- €	4 €	1,017 €	- €
TOTAL	**21,889,908 €**	**28,710,797 €**	**43,978,126 €**	**48,546,392 €**	**49,965,582 €**

Table 3.13. Ionian islands exports of agricultural products by main category in value (EUR)
Source: "Mapping Greece's export activity by region and regional unit", IERS – SEVE

CATEGORY	**YEAR**			
	2013-2014	**2014-2015**	**2015-2016**	**2016-2017**
Fish, crustaceans and mollusks	18,383,423 €	4,063,383 €	922,185 €	1,888,906 €
Fats and oils	-11,480,878 €	11,093,174 €	3,346,045 €	-787,935 €
Drinks, spirits and vinegar	-7,214 €	62,388 €	-2,541 €	72,156 €
Meat and fish products	192 €	8,860 €	189,599 €	46,415 €
Vegetables	-20,695 €	1,115 €	-1,092 €	238,248 €
Meat	-28,937 €	20,403 €	-12,225 €	95,804 €
Plants	-1 €	- €	6,455 €	3,974 €
Fruitage and fresh fruits	4,230 €	5,423 €	-2,269 €	1,572 €
Coffee, tea and spices	-14,625 €	2,403 €	35,908 €	-36,568 €
Sugar and sugar concoctions	-404 €	369 €	6,807 €	-4,434 €
Dairy products	3,616 €	-1,586 €	65,964 €	-71,872 €
Cereal and corn based products	-866 €	5,160 €	-114 €	-5,987 €
Various dietary products	-2,294 €	1,788 €	1,161 €	-3,136 €
Cocoa and its concoctions	299 €	2,450 €	8,155 €	-10,860 €
Fruit and vegetable concoctions	-14,918 €	1,605 €	2,914 €	-5,370 €
Cereal	-16 €	17 €	84 €	-101 €
Flour products	-4 €	371 €	217 €	-603 €
Seeds and varieties of fruitage products	-2 €	- €	2 €	-2 €
Resins and vegetable extracts	- €	2 €	-2 €	- €

Foods for animals	-17 €	4 €	1,013 €	-1,017 €
TOTAL	**6,820,889 €**	**15,267,329 €**	**4,568,266 €**	**1,419,190 €**

Table 3.14. Annual change in value of exports by category in the Ionian islands

CATEGORY	**YEAR**			
	2013-2014	**2014-2015**	**2015-2016**	**2016-2017**
Fish, crustaceans and mollusks	469%	18%	3%	7%
Fats and oils	-65%	178%	19%	-4%
Drinks, spirits and vinegar	-5%	44%	-1%	36%
Meat and fish products	263%	3343%	2078%	23%
Vegetables	-100%	4848%	-96%	517930%
Meat	-97%	2513%	-58%	1066%
Plants	-100%	-	-	62%
Fruitage and fresh fruits	8813%	127%	-23%	21%
Coffee, tea and spices	-83%	81%	670%	-89%
Sugar and sugar concoctions	-97%	2838%	1782%	-62%
Dairy products	76%	-19%	975%	-99%
Cereal and corn based products	-45%	481%	-2%	-98%
Various dietary products	-88%	562%	55%	-96%
Cocoa and its concoctions	1359%	763%	294%	-99%
Fruit and vegetable concoctions	-94%	184%	118%	-100%
Cereal	-100%	-	494%	-100%
Flour products	-21%	2473%	56%	-100%
Seeds and varieties of fruitage products	-100%	-	-	-100%
Resins and vegetable extracts	#DIV/0!	-	-100%	-
Foods for animals	-100%	-	25325%	-100%
TOTAL	31%	53%	10%	3%

Table 3.15. Annual percentage change in value of exports by category in the Ionian islands

DESTINATION COUNTRY	**YEAR**				
	2013	**2014**	**2015**	**2016**	**2017**
ITALY	32.31%	21.81%	42.09%	47.67%	35.95%
GERMANY	1.02%	1.59%	10.07%	8.53%	10.79%
UNITED KINGDOM	0.02%	0.01%	14.87%	6.94%	8.31%
REPUBLIC OF IRELAND	0.00%	0.00%	0.36%	13.09%	6.93%
FRANCE	0.29%	2.26%	7.50%	5.04%	5.09%
POLAND	0.01%	0.01%	3.31%	1.78%	2.97%
SWEDEN	0.00%	0.00%	1.45%	0.43%	2.87%
BULGARIA	0.17%	0.79%	0.90%	0.79%	2.87%
SPAIN	4.67%	0.18%	1.56%	1.35%	2.79%
RUSSIA	7.18%	3.63%	3.89%	4.70%	2.63%

NETHERLANDS	0.07%	0.02%	2.58%	1.90%	2.50%
CZECH REPUBLIC	0.03%	0.01%	1.12%	1.07%	2.31%
DENMARK	0.00%	0.00%	0.02%	1.35%	2.18%
MALTA	0.00%	0.00%	0.48%	0.12%	1.85%
CYPRUS	0.00%	0.00%	0.02%	0.65%	1.58%
BELGIUM	0.03%	0.01%	1.27%	0.41%	1.29%
AUSTRIA	0.14%	0.07%	0.77%	0.33%	1.23%
LITHUANIA	0.00%	0.00%	1.00%	1.01%	0.87%
ROMANIA	0.00%	0.00%	1.25%	0.09%	0.75%
FINLAND	0.00%	0.00%	0.00%	0.01%	0.51%
LUXEMBOURG	0.00%	0.00%	0.08%	0.13%	0.48%
LATVIA	0.00%	0.00%	1.03%	0.29%	0.42%
PORTUGAL	0.00%	0.00%	0.62%	0.00%	0.28%
HUNGARY	0.00%	0.00%	0.05%	0.08%	0.24%
NORWAY	0.00%	0.01%	0.26%	0.21%	0.23%
SWITZERLAND	0.07%	0.02%	0.15%	0.18%	0.21%
SEBRIA	0.01%	0.01%	0.09%	0.21%	0.18%
SLOVAKIA	0.01%	0.00%	0.05%	0.05%	0.18%
UKRAINE	0.00%	0.00%	0.00%	0.00%	0.17%
SLOVENIA	0.00%	0.00%	0.16%	0.02%	0.13%
ESTONIA	0.00%	0.00%	0.11%	0.15%	0.09%
BELARUS	0.00%	0.00%	0.09%	0.07%	0.07%
ALBANIA	0.34%	0.02%	0.03%	0.02%	0.04%
MOLDOVA	0.00%	0.00%	0.00%	0.00%	0.03%
ICELAND	0.00%	0.00%	0.00%	0.00%	0.02%
TURKEY	0.00%	0.03%	0.06%	0.00%	0.01%
CROATIA	0.00%	0.02%	0.01%	0.08%	0.01%
MONTENEGRO	0.03%	0.00%	0.00%	0.00%	0.00%
TOTAL	**46.41%**	**30.51%**	**97.27%**	**98.75%**	**99.07%**

Table 3.16. Annual percentage of total exports of Ionian islands by destination country
Source: "Mapping Greece's export activity by region and regional unit", IERS – SEVE

Exports of the Ionian islands show great potential, which is clear by reviewing the above tables. Value of exports has increased significantly during the four-year span between 2013 and 2017, by a total of 128% (28,075,674 € in value of exports), which is the highest increase, in comparison with the other three island regions. Most product categories show an overall increase, with some categories showing the most promise, such as fish, crustaceans, mollusks, fats and oils and, lately, meat and fish products. Similar to the North and South Aegean, the fishing sector is the strongest one of the Ionian islands, with a 58% share of total

agricultural production by 2017 (only 18% in 2013) and a phenomenal rise in value of exports, with an overall increase of 645% from 2013 to 2017 (25,257,897 € in absolute value of exports).

In addition, the Ionian islands show another significant rise to their overall exports to European markets. In 2013, only 46.41% of total exports of the Ionian islands was destined for European countries, while in 2014 that share dropped to 30.51%. However, in 2015 this export share to European markets reached a significant high of 97.27%, while in 2017 the share of total exports to European markets is over 99% (specifically 99.07%). Consequently, as shown on the other island regions, exports are mainly headed to European countries in this case, whereas export shares to North American countries are rather small (in 2017, 0.24% to the US and 0.02% to Canada).

However, the case of the Ionian islands is a complex one, as their location does not create the same condition in product distribution to European markets. For example, it is clear that distribution to Italian markets (where there is an export share of 35.95% in 2017) is much easier for the Ionian islands than for islands of the Aegean or Crete. In order to better support the Greek agrologistics sector, a proposition supporting exports of all these island regions should be made, which should efficiently address issues concerning the food supply chains and distribution from these regions to international markets.

As a result, a more thorough analysis follows, regarding the emergence of a new agrologistics hub to support these regions, by its placement on a strategic location to meet islands' needs for product storage and distribution.

3.3.5. TOTAL AGRICULTURAL PRODUCTS EXPORTS OF GREEK ISLANDS

In order to better determine the current situation of agricultural products exports to international markets, island regions' export share must be evaluated. In general, no region of islands analyzed on the present thesis shows an overall decline during the four-year span of the study, although Crete is the only island showing a rise in export value from 2013 to 2015 but also a decrease from 2015 to 2017. However, its value of agricultural exports still remained higher in 2017, than what it was in 2013.

However, Crete has one of the largest export shares to international markets, compared to the other regions. More specifically, Crete has been dominant in exports regarding agricultural products, with more than 50% of the overall exports of Greek islands, while dropping under 50% only in 2014, with an export share of 46.10%. The second most successful region in value of exports is the North Aegean, which shows continuous rise in absolute value of exports, although remaining stable considering its export share in comparison with other Greek islands.

The most promising aspect of agricultural product exports is the case of the Ionian islands. Every island region of this study increased both their total value of exports regarding agricultural products and their export shares to developed markets (such as many European countries). However, as mentioned before, the Ionian islands show the greatest opportunities, as their exports to European markets increased more than 50%, while their absolute value of exports increased by 128%. Regarding agricultural product export shares of Greek islands to international markets, these are shown on the following table.

ISLAND REGION	**YEAR**				
	2013	**2014**	**2015**	**2016**	**2017**
CRETE	55.78%	46.10%	59.74%	55.49%	51.17%
SOUTH AEGEAN	2.14%	3.17%	2.09%	2.36%	2.97%
NORTH AEGEAN	36.83%	42.50%	30.20%	33.00%	35.91%
IONIAN ISLANDS	5.25%	8.22%	7.96%	9.15%	9.95%

Table 3.17. Agricultural product export share of each island region to international markets

The above table shows each region's export share of agricultural products to international markets, based on the data from the study "Mapping Greece's export activity by region and regional unit" conducted by IERS – SEVE. From 2013 to 2017, this table shows an overall decrease of Crete's export share by 4.61% and an additional 0.92% decrease of North Aegean's export share. On the other hand, export share of the South Aegean increased by 0.83%, while the export share of the Ionian islands showed an overall increase of 4.70% from 2013 to 2017. These results do not necessarily mean that export share has shifted from Crete

and North Aegean to the Ionian island, but actually further show the significant increase in value of exports of agricultural products in the Ionian islands.

These results, along with all aforementioned ones and data from the study of IERS further reinforce the notion that exports of these island regions can be better supported, in order to increase even more in the next years. Consequently, as mentioned above, this study further assesses the need for a new agrologistics hub to support food supply chains from these island regions to their markets of destination.

4. EMERGENCE OF A NEW AGROLOGISTICS HUB

In this chapter, the need for a new agrologistics hub is evaluated. More specifically, given the fact that exports of agricultural products are continuously increasing, the need for more efficient supply chain and logistics strategies is increasing as well. In order to better determine whether a new agrologistics hub will present new opportunities for the Greek agricultural sector and its impact on international (and domestic) markets, conceptual definitions should be given, while an analysis of the changes in product distribution through the hub is as important.

4.1 CONCEPTUAL DEFINITIONS, CHARACTERISTICS AND FACTORS AFFECTING DEVELOPMENT OF LOGISTICS HUBS

Logistics hubs are very well established in many countries, with many successful examples of their emergence being vital in supply chains. Definitions of a logistics hub are as following:

- Logistics hubs are integrated centers for transshipment, storage, collection and distribution of goods (Jorgensen, 2007).
- Logistics centers can be defined as the hub of a specific area where all activities relating to transport, logistics and goods distribution (both for national and international transit) are carried out on a commercial basis, by various operators (Europlatforms, 2004).

Taking both definitions into consideration, a logistics hub is a center which can facilitate numerous and different modes of transport. Transport through the hub is managed in a way to simplify transportation and distribution processes, while also being as cost efficient as possible. Logistics activities are facilitated as well, such as storage and transshipment, while value added solutions are provided, enhancing overall quality of service.

Surely, logistics hubs give a rather significant regional advantage to the city/region where they are located and areas close to them. However, when considering international markets, a strategically located logistics hub not only creates more opportunities for specific regions, but for the country where it is located as well.

There are numerous examples of successful logistics hubs in the world. In order for a logistics hub to be successful, though, there are certain aspects that must be established (Baluch, 2005). Some of these characteristics of a successful logistics hub are as follows:

- The existence of adequate and sufficient multi-modal transportation systems
- The existence of good communication and information technology systems
- Adequate cargo and container handling facilities
- In case of container terminals or transshipment ports, the existence of numerous berths servicing various vessel sizes, capable of handling different kinds of commodities, dangerous cargo etc.
- Availability in sufficient road and rail infrastructure, linking the logistics hub with local consumer, industrial areas, international markets etc.

Regarding logistics infrastructure as a whole, there are certain aspects from which a logistics hub can be examined (King & Keating, 2006), such as:

- Transportation and storage industries
- Workforce related issues
- Highway accessibility
- Road and bridge infrastructure
- Road density, congestions etc.
- Vehicle taxation and overall cost
- Railway infrastructure
- Proximity to main domestic and international markets and ease of distribution
- Location being away from highly populated residential areas
- Cost effective development and systems maintenance
- Sea borne cargo related infrastructure
- Air cargo related infrastructure

However, the aforementioned requirements and aspects of development are considered general rules in the development of a strategically located hub. Each case has its own conditions and differentiates in many aspects, especially since different countries show

differences in almost every one of the above aspects, from workforce conditions to transportation modes' infrastructure and geographical characteristics (e.g. the existence of ports and sea borne trade is not possible for all countries, whatever their economy conditions may be).

It is clear that choosing the best possible location for establishing a logistics hub is a strategic decision made after evaluating both qualitative and quantitative criteria (Essaadi, 2016). Essaadi, Grabot and Fénies (2016) gathered all criteria selected by numerous studies (Oum, 2004; Lu, 2006; Tongzon, 2007; Lee, 2007; Teng, 2007; Botha, 2008; Skowron-Grabowska, 2008; Eskilsson, 2010; El-Nakib, 2010; Munoz, 2010; Kayikci, 2010; da Silva Portugal, 2011; Awasthi, 2011; Long, 2012; Uysal, 2014; Żak, 2014; Roso, 2015; Yang, 2016;) in the past, regarding issues on national and subnational levels. Some of these criteria are as follows:

- National Criteria:
    - Availability and quality of infrastructure
    - Connectivity
    - Border administration efficiency
    - Openness to trade
    - Geographic location
    - Land availability
    - Domestic market size
    - Availability of skilled labor
    - Labor market flexibility
    - Customs barriers
    - Port and airport charges
    - Labor cost
    - Input cost
    - Transport and distribution cost
    - Land price
    - Political stability

- Macro – economic stability
- Safety and security
- Country resilience
- Corruption Control
- Property rights
- Regulation transparency
- Burden of regulation
- Incentives availability

- Subnational Criteria
  - Quality and availability of infrastructure
  - Land availability
  - Location and land cost
  - Availability of skilled labor
  - Market size
  - Labor cost
  - Proximity to consumption market
  - Proximity to manufacturing market
  - Proximity to port and airport
  - Availability of regional incentives
  - Pollution
  - Safety and security
  - Life cost and economic development
  - Extra services
  - Transportation Cost
  - Congestion level

Apart from the above mentioned criteria, there are also certain indexes, published by various international organizations, which assess the attractiveness of countries for foreign investments, such as is the development of logistics by establishing logistics hubs. Some of these indexes are:

- **Logistic Performance Index (LPI**): Developed by the World Bank, this index ranges from 1 (low performance) to 5 (higher logistics performance). Evaluation is based on the trade logistics performance of a country, by worldwide surveys of logistics providers. The criteria assessed are the efficiency of customs and border management clearance, quality of trade and transport infrastructure, ease of arranging competitively priced shipments, competence and quality of logistics services, ability to track and trace consignments and frequency with which shipments reach consignees within scheduled or expected delivery times.
- **Global Competitiveness Index (GCI)**: Developed by the World Economic Forum, this index evaluates overall competitiveness of countries and ranges from 1 to 7. It aims to identify and overcome hindrances connected to a country's overall competitiveness and covers criteria and sub-criteria, with the main of them being the public and private institutions, infrastructure, macroeconomic environment, health and primary education, higher education and training, market efficiency, labor market efficiency, financial markets development, technological readiness, market size and innovation.
- **Enabling Trade Index (ETI)**: Developed by the World Economic Forum, this index evaluates the ability of a country to benefit from trade, ranging from 1 to 7. Main criteria covered are market access, border administration, infrastructure and operating environment and aims at providing insight regarding investment decisions.
- **Worldwide Governance Index (WGI)**: Developed by the World Bank, this index assesses the governance of 200 countries, while assessing criteria such as voice nad accountability, political stability and absence of vionelce, terrorism, government effectiveness, regulatory quality, rule of law and control of corruptio.
- **Corruption Perception Index (CPI)**: Developed by Transparency International, this index indicates how corrupted public sectors of countries are, from 0 (which indicates a highly corrupt public sector) to 100 (very clean public sector).
- **Liner Shipping Connectivity Index (LSCI)**: Developed by the United Nations Conference on Trade and Development (UNCTAD), this index assesses how

countries are connected to global shipping networks, from 0 to 100, while taking into consideration maritime transport criteria, such as number of ships, container carrying capacity, maximum vessel size, number of services and number of companies that deploy container ships in a country's port.

- **Better Life Index (BLI)**: Established by the Organization for Economic Co-Operation and Development (OECD), this index assesses the well-being and quality of life level on a country, on a scale from 0 to 10.

As of 2018, Greece is also ranked by the above mentioned indexes. Results considering the country's ranking by index, are shown on the following tables.

Ranking of Greece by index and year					
INDEX	**LPI (2018)**	**GCI (2018)**	**ETI (2016)**	**CPI (2018)**	**LSCI (2019)**
SCORE	3.2	62.1	4.6	45	60.92
RANK	42/160	57/140	52/136	67/180	21/178

Table 4.1. Greece's ranking by index and year

Sources: https://lpi.worldbank.org/international/global/2018
http://reports.weforum.org/global-competitiveness-report-2018/competitiveness-rankings
http://reports.weforum.org/global-enabling-trade-report-2016/economy-profiles/#economy=GRC
https://www.transparency.org/cpi2018
https://unctadstat.unctad.org/wds/TableViewer/tableView.aspx?ReportId=92

Greece's Worldwide Governance Index Percentile Rank by Variable in 2018	
VARIABLE	**RANK**
Control of Corruption	55.8
Government effectiveness	65.9
Political Stability and Absence of Violence/Terrorism	50.0
Regulatory Quality	64.4
Rule of Law	59.1
Voice and Accountability	75.4

Table 4.2. Greece's WGI Index by Variable in 2018

Source: https://databank.worldbank.org/source/worldwide-governance-indicators

Greece's BLI index by topic in 2016 (0 – 10 scores)	
Housing	4.8
Income	1.5
Jobs	1.8
Community	0.7
Education	6.1
Environment	3.7
Civic Engagement	4.1
Health	8.2
Life Satisfaction	2.2
Safety	7.1
Work – Life Balance	7.1
OVERALL	**5.4 (Average score is 6.5)**

Table 4.3. Greece's BLI index by topic in 2016
Source: http://www.oecdbetterlifeindex.org/countries/greece/

It is clear that in the case of selecting the optimal location for a hub, either on a national or a sub-national level, certain variables should be taken into consideration, as mentioned above. In the case of the aforementioned indexes, the most important ones are LPI, GCI, ETI and LSCI, when taking into consideration issues such as distribution and transportation of products, with the support of a logistics hub. WGI and CPI indexes mostly refer to opportunities or threats regarding external factors, such as political stability and government regulations, while BLI index mostly refers to issues regarding workforce and the labor market.

Apart from the aforementioned characteristics regarding establishing and operating a logistics hub, an agrologistics hub must be able to operate by taking advantage of all technological advancements, equipment and state of the art facilities, in order to maintain product quality and safety. It is already made clear that the highest priority in agrologistics is food quality and overall safety throughout the food supply chain. Surely, all

aforementioned factors must be assessed with as much attention as possible, but should also be weighted, as not all of them are as significant as others when taking into consideration the agrologistics sector. As mentioned before, the less degraded and more fresh a product that arrives to the end consumer, the more the satisfaction by the latter and, thus, the more successful the food supply chain operation as a whole. However, assessing the best possible route for a product to reach consumers can be frustrating, as the best possible route may not meet all aforementioned criteria (in the case of Greece for example, island port infrastructure and inland transportation infrastructure can be pressing issues in supply chain management). As a result, in many cases various issues often overshadow other aspects that should also be taken into consideration in logistics.

Consequently, this thesis aims to address the issue of agrologistics regarding Greek islands from a market demand perspective. More specifically, as exports have been analyzed for each Greek island region, these export data will be used in order to identify the optimal location for establishing an agrologistics hub to be able to provide the best possible quality of service and meet the needs of the Greek island regions, while also meeting demand from international markets, which in this case are mostly European markets.

4.2. TRANSPORTATION MODEL OF THE LOGISTICS SYSTEM

The emergence of a logistics hub can be based on transportation models, such as transshipment models (where transshipment is possible). From an operational standpoint, all transshipments follow the same practice, which is transferring containers from one ship to another using a port as a “meeting point”. However, transshipment models are differentiated in three distinct forms, all serving certain purposes.

The first form of a transshipment model is called “hub and spoke” transshipment. This form of transportation connects short distance feeder lines (ports as well) with long distance sea lines, thus connecting regional and global shipping networks. In this case, the transshipment hub is located on a central location, in order to better service a region of interest. The second form of transshipment is “intersection transshipment”, where a transshipment hub acts as a point of interchange between numerous long distance shipping routes, involving cargo transfers between larger vessels. The third form involves relay transshipment, where the hub

connects different shipping routes along the same region, while at the same time servicing different port calls. Considering all three different forms, hub and spoke transshipment is the most commonly implemented form of transshipment.

It is clear that transshipment describes the transportation of products (or containers) to an intermediate destination and then to the final destination (or another intermediate). A major reason for transshipment to be implemented is the fact that modes of transport differ during the journey of a product from production to consumers, as for example in the case of products of Greek islands, which must be transported by sea from the inland and then by road or rail. Of course, the main goal of a transshipment model is to achieve cost effectiveness.

The best way to better understand how cost effectiveness is achieved by the development of an agrologistics center, a hub and spoke form of transshipment model can be used as an example. On a node system of "n" nodes, the number of possible connections is equivalent to $\frac{n\cdot(n-1)}{2}$, while if a hub and spoke system is implemented (with the emergence of a central hub) that number of possible connection is reduced to only *n-1*. It is clear that in a case where numerous points of origin and points of destination exist, such as is the case of this study, a hub and spoke model reduces necessary connections significantly.

However, when applying a hub and spoke system, all factors related to the system must be taken into account, as certain factors can be associated with various restrictions that may apply. An example of a restriction in this case can be the inefficiency of transport network connectivity, especially at sea with smaller and more isolated islands. In a hub and spoke system (along with various other transport systems), a central storage area, from which service routes of a business or several businesses start, is of significant (if not the utmost) importance. The most important issue for businesses is the location of the hub to ensure optimum distribution, by covering demand by delivery in the shortest possible time at the lowest possible cost. In recent years, with the rapid introduction of new technologies, where combined transport systems are implemented, it is highly important to take advantage of all possible modes of transport (road, rail, maritime, air) to ensure rapid and cost effective distribution, with logistics hubs being of strategic importance for business competitiveness.

The hub and spoke system is applicable to a variety of transport and distribution applications, but also to many other cases, such as network design of any form, while being particularly applicable to air transportation systems (Dobson, 1993).

In the case of products from Greek islands, where transportation by sea is necessary, the best possible solution for a logistics hub is for it to be located at a port, or in close vicinity to it. As a result, when choosing the optimal location of a logistics hub for this study, major ports servicing short sea shipping (at least) vessels must be taken into consideration. However, a major issue arising when evaluating trade options of Greek islands is vessel availability, port infrastructure and shipping routes. More specifically, ports of smaller islands lack the necessary infrastructure and equipment to service bigger container vessels. Consequently, most vessels serviced by islands' ports are RoPax vessels, carrying both passengers and vehicles (e.g. trucks) on liner shipping routes.

It is clear that a transshipment model can facilitate trade, as different modes of transport are necessary for product distribution. Even though port infrastructure in Greek islands does not facilitate trade by larger container vessels, products that reach an intermediate destination (i.e. an agrologistics hub in this case) can reach their final destinations on various different modes of transportation. For example, regarding a specific point of origin, products destined for Northern European markets (such as Germany) can be transported by road or rail, while products destined for Eastern European or Asian markets (such as Russia or Turkey) can either be transported by road/rail or by sea, through the Sea of Marmara and the Black Sea.

Moreover, even though RoPax vessels are mostly the ones following shipping routes to most Greek islands, in the case of a transshipment model, transportation by other larger vessels from the intermediate destination to the final one is in many cases necessary. As a result, if a port (or an area in its vicinity) is considered an optimal location for the development of an agrologistics hub, this port should additionally act as a container terminal. It is already clear that two main issues arise from the aforementioned cases, when considering an optimal location of an agrologistics hub in a transshipment model. These issues are:

- How to transport products from the origin (i.e. the aforementioned Greek island regions) to the transshipment point (which ideally should both act as and agrologistics hub and a transshipment port)
- How to transport products from the transshipment point to the final destination (i.e. the consumers)

In order to be able to deal with these major issues, which consist of the basis for a transshipment problem, their connecting variable must be evaluated. In the case of the transshipment problem, the variable setting the basis for the problem is the transshipment point. More specifically, points of origin, especially in agricultural production of Greek islands, can be considered somewhat stable, as production may rise, but not always products as a whole. As for the final destinations, in the last years a significant rise has occurred in terms of exported products from Greek islands to European markets, which shows higher demand from European markets to the agricultural products of Greek islands. Consequently, final destinations (consumers) are starting to stabilize as well, with European markets importing more than 80% of Greek islands' products.

Therefore, in better implementing a transshipment model, the last issue left to be evaluated consists of the transshipment point. It is already made clear that location is a significant factor when assessing a successful implementation of a said model, in order to achieve efficiency in logistics. It is also clear that the selection of an optimal location for establishing an agrologistics hub is made in such a way so that cost efficiency on storage and transportation is achieved, while also ensuring product safety and quality. The latter is also a pressing issue in the choice of location for an agrologistics hub, as product flow from production to consumers cannot deviate as much as it could with products that do not face quality degradation on a level as high as do agricultural products.

Consequently, an assessment of the optimal location for the development of a new agrologistics hub is paramount for the successful implementation of a transshipment model. This study aims to evaluate all aforementioned limitations and factors regarding the location of a transshipment station for its agrologistics hub, while also taking into consideration export shares from each island region regarding product value and country of exports. Based on the

above mentioned variables, a spatial analysis follows, in order to better assess possible locations of an agrologistics hub development.

4.3. SPATIAL ANALYSIS PROCESS

In order to better determine the optimal location for establishing the new agrologistics hub, spatial analysis techniques are used. In order to do so, there are two sets of data needed to visualize the results of the study. With the help of GIS (Geographic Information Systems) and specifically the free and open-source desktop cross-platform QGIS, available data of the study of SEVE were used and joined with spatial data (more commonly called "layers" on GIS platforms), in order to provide the basis for further spatial analysis. Data concerning Greek regions, countries of destination of the study and all other spatial data used were gathered by various open data sources, either Greek ones (geodata.gov.gr), or European/International ones (e.g. Eurostat).

At first, datasets were available in two specific, but different categories. The first consisted of data of specific geometry, which are of course the "spatial data", containing geographical related information. The second category consisted of non-spatial data, or more easily described as data with no specific geometry, which are of course the spreadsheet data which resulted from the SEVE – IERS study. For spatial analysis applications to be possible, these two datasets must be joined and, as a result, non-spatial data must be joined with spatial data available on the GIS platform. In this case, spatial data (i.e. layers) of the study are polygon layers, consisting of each country of destination as a dedicated (individual) polygon. The result is an overall layer, containing polygons which show each country of destination on the GIS platform, with their corresponding locations based on a Coordinate Reference System (CRS).

However, the aforementioned layer containing the countries of destination does not contain the non-spatial information needed for successfully conducting spatial analysis. As a result, these information need to be joined on the polygon layer containing geographical information of the countries studied. This is achieved by sorting data regarding countries of destination and their share on each region's exports, based on regions of origin on different data tables.

The result of this sorting are four different tables of data (spreadsheets) for each region of origin (i.e. Greek island regions), containing data of exports (export share) to each country.

In order for the joining procedure to be successful, it is highly important that there are common columns, both on the spatial and non-spatial data attribute tables. In this case, it is obvious that these columns are the ones containing the names of countries of destination, both on the spatial data (polygon layer containing all countries) and on the non-spatial data tables (spreadsheets) for each island region of origin. As a result, with the help of the "Join" tool, attributes are transferred from one layer or table to another, based on spatial and attribute relationships. More specifically, the attributes transferred are the export shares of each region of origin to each country of destination from the spreadsheets to the spatial data attribute table, based on the attribute (column) of countries of destination. The result is an overall polygon layer, with an attribute table containing all countries of destination with their corresponding share, based on each island region of origin.

As the needed dataset is now complete, focal points of destination can be created for each region's exports. This is achieved with the help of the "Mean Coordinates" tool, which calculates the mean of the coordinates of a layer, based on a specific field (column) of the attribute table. Of course, the selection of a specific field is optional, however in this case it is highly important, because the creation of the mean centers for each region needs to be conducted through specific data of export shares to each country. Therefore, the "Mean Center" created for each region is more of a "weighted" focal point, based on each region's exports to their countries of destination. It is important to remind at this point that the polygon vector layer containing all countries of the study consists of an attribute table of fields (columns) which are: the country's name and four more fields containing exports of island regions to the corresponding country of destination. Therefore, the "Mean Coordinates" tool will be used four times, once for each exporting region, based on its corresponding export share to each country, resulting in the creation of the weighted focal points (mean centers) for each region.

Then, the same procedure is conducted to identify the focal point of the aforementioned mean centers, in order to determine the exact point of destination of overall exports. As mentioned

before, each island region has a certain share of exports, regarding overall exports of agricultural products of all island regions (for example, as of 2017, Crete had a share of approximately 51%). The created mean centers of the aforementioned procedure now consist of a new point layer of points of destination for each region's exports. This layer's attribute table is modified, with a new field (column) created, containing data about each region's export share between all other regions. As a result, this point layer consists of the points of destination for each of the four island regions' exports, while its attribute table will contain two distinct fields (columns) of information. The first will provide information about the region's name (Crete, North Aegean, South Aegean, Ionian islands) and the second will provide information regarding the export share of each island region. As a result, the aforementioned point layer (containing points of destination for each region) consists of a 4X2 attribute table, where fields (columns) consist of the region's name and its export share between all island regions and attributes (lines) consist of the island regions and their corresponding share. By conducting the same exact procedure that was applied before, a new mean center is identified, based on each region's point of destination and their corresponding export share acting as a "weighted field" for this procedure. The result is a new overall weighted mean center, acting as an overall focal point of destination for all island regions' exports.

As points of destination are now better determined, while points of origin are already known (i.e. the Greek island regions), the intermediate point acting as the new agrologistics hub must be found. The first condition regarding the establishment of the agrologistics hub is, of course, that it must be situated somewhere in Greece. This specific condition makes it quite easy to better determine the location of the hub, as it is will definitely be inside a closed polygon layer (i.e. Greece). The second condition consists of the fact that the new hub should be as close to the overall focal point of destination as possible, which creates the necessity of spatially analyzing the relation between point of destination and possible points of origin, which in this case is taken into account as the agrologistics hub. In order to better understand where this intermediate point will be located, one way to do so is determining the minimum distance between the point of destination and the Greek borders.

However, calculating distances between certain points can only be achieved if both layers analyzed are point layers. In this case, the first layer regarding the overall exports' focal point of destination is already a point layer, but the area of Greece is a polygon layer. In order to determine the closest point on the Greek borders, the aforementioned polygon layer must be transformed to a point layer, which will in turn consist of all points on the outer lines of the mainland and the Greek islands. This is achieved by utilizing the "Extract Nodes" geometry tool on the QGIS platform, which transforms all lines of the polygon to points. The result is a new point layer which contains all points (nodes) that existed on the polygon layer of Greece. Of course, as the point of destination analyzed is outside the Greek borders (due to the fact that international markets are analyzed as points of destination), the closest point to the focal point of destination will be somewhere on the Greek border. As a result, points created that exist not only on the borderline but also on smaller polygons, such as islands or points on the mainland, are not necessarily sorted, in order for only points on the borderland to remain.

After this procedure, it is possible to better determine the closest point of the borderline to the point of destination. To do that, the "Distance Matrix" tool is used, which creates a square matrix containing the distances between the elements of a set. In this case, the two datasets both contain point features, while the first one contains an individual point feature, which is the overall exports' point of destination. Consequently, when applying the "Distance Matrix" tool, distances will be calculated between this individual point to all points of the second dataset, which in this case are the points created by the polygon of Greece, with some of them being points on the Greek borderline. The result of this procedure is the aforementioned distance matrix which contains all distances between the point of destination and the points consisted of the polygon layer of Greece, while also the unique "ID" of each node analyzed. After sorting attributes of the distance matrix based on distance, the point ID with the minimum distance from the point of destination is the one that is identified as the closest to the aforementioned point. It is important to mention at this point, that the closest point to the point of destination is also located, as hypothesized, on the borderline of Greece.

In conclusion, the aforementioned techniques and practices used to spatially analyze the relationships between the destination countries and the regions of origin are not the only alternative. There are numerous other ways of spatial analysis that could have resulted in the same conclusions as to the procedures of this study. However, these processes are fairly easy to implement and lead to the desired result relatively quickly and efficiently. Results of the processes implemented are more thoroughly described on the following chapter, according to this specific case study.

4.4. OPTIMAL LOCATION FOR A NEW AGROLOGISTICS HUB

The goal of this diploma thesis is to analyze the concept of agrologistics and the factors affecting the sector. As agricultural production and exports of agricultural products have been analyzed, it is important to determine the optimal location for establishing an agrologistics hub.

Therefore, as mentioned on the previous chapter, spatial analysis techniques are used, with the help of Geographical Information Systems (GIS) programs. The main reason for the use of such programs is the ease with which spatial data can be analyzed, so that an analysis can result in visualizations (such as maps or 3D products), giving locational insight regarding data, patterns, relationships and facilitate the decision making stage of a study.

Export data analyzed indicate both the point of origin and countries of destination. As a result, not only is it possible to identify and analyze trade routes, but also to better determine higher market shares, by point of origin, which in this case is an island region. By analyzing export shares of most countries showing high demand (mostly European countries in this case), it is possible to identify a general point of destination for all countries of destination, depending on their share.

More specifically, every country in our study with a significant share on an island region's overall exports will affect the final point of destination. Changes in a country's imports will of course alter the location of the focal point of overall exports. In order to find the focal point regarding exports to specific countries, the share of each country is analyzed, and all shares are weighted, in order to identify the location of the focal point of exports to European

markets. For example, if only France and Germany were analyzed, with import shares of 50% each, then the focal point would be located in the middle of these countries, by measuring their central points' (centroids of a polygon, which is the country) distance and resulting in the focal point being located in the exact middle of that imaginary line. This method of identifying a mean center with the help of a weighted field (i.e. import share of each country, by island region of origin) is quite helpful, as numerous points of destination are now visualized as one specific point. However, this method is useful for smaller regions (e.g. a country) or even a larger but clearly specified region, such as Europe, but not larger areas, such as the whole world or larger continents, like Asia.

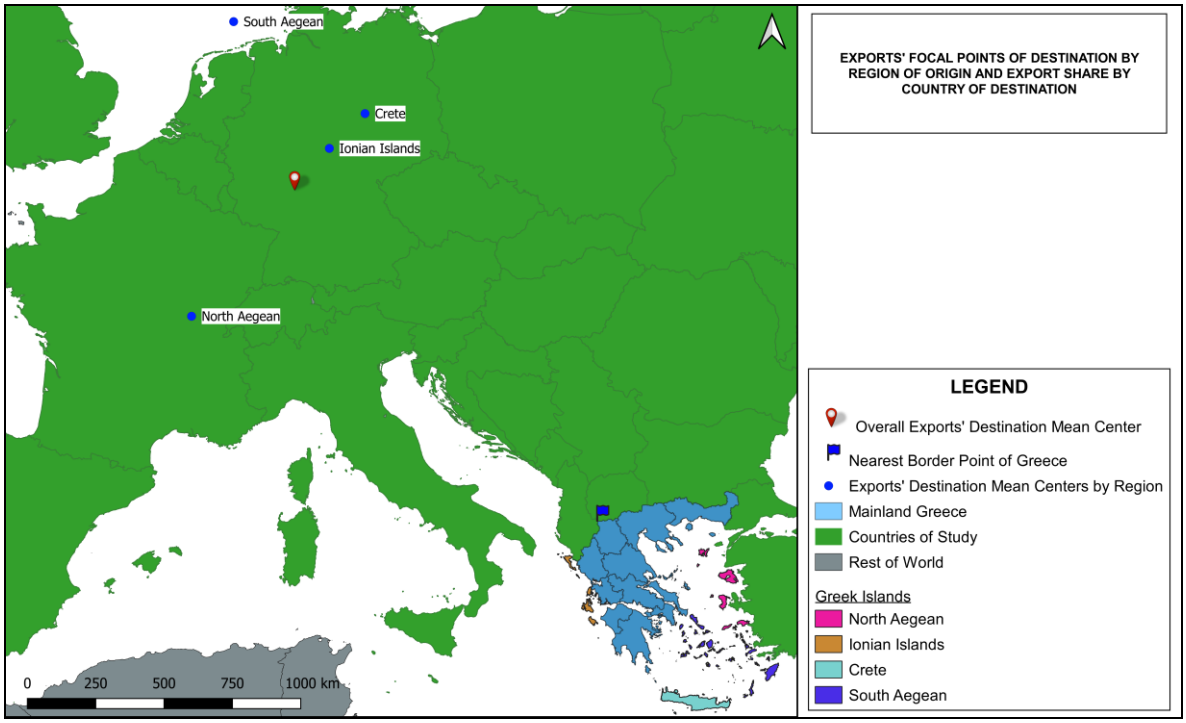
Regarding the specific case, exports for European countries have been categorized by point of origin, which is one of the four island regions analyzed on chapter 3. However, as exports from each region to European markets reach significant shares (more than 70% in all regions), these percentages need to be normalized to better determine how a country affects the focal point of destination to European markets. As a result, all export shares of the aforementioned island regions to European markets have been normalized to depict a 100% share of exports to European markets, so that results of the spatial analysis methods used are more precise, since the basis for it are only European countries, where exports by value are higher than zero.

After the aforementioned normalization, data of export shares are matched according to their countries. Consequently, an analysis of a "weighted mean center" is made, with the help of GIS programs and focal points of destination for each island region of origin are created. Subsequently, as four focal points of destination are created for each point of origin, four distinct locations are created. These four distinct locations are all located on areas of Northern and Western Europe, as follows:

- Focal point of destination for exports from the South Aegean is located north of Netherlands and southwest of Denmark
- Focal point of destination for exports from the North Aegean is located in France
- Focal point of destination for exports from Crete is located in Germany
- Focal point of destination for exports from the Ionian Islands is located in Germany

These “weighted mean centers”, of course, do not actually show the optimal location for another intermediate hub, even if this is an approach worth evaluating. However, they give more of an insight on the exact point of destination, as if all countries of destination were to be evaluated as one point of destination, with their corresponding share on imported value from the analyzed Greek island regions. With the help of the four new focal points of destination for exports by island region, an overall focal point of destination for all four island regions can be created, following the same steps as described above. In this case as well, not all island regions affect exports in the same way as others. For example, as mentioned before, Crete consists of 51.17% of overall exports of products from all island regions analyzed, as of 2017. Consequently, it is clear that Crete will affect the result of the “weighted mean center” more than all the other island regions, as its exports are more in value than all other three island regions combined, while almost four times more than the value of exports from the Ionian Islands and the South Aegean.

Consequently, an overall focal point of destination is created, which gives more insight on which areas most export share is headed from the island regions to European markets. This focal point is located in the Western part of Germany and with its location it is also possible to identify the minimum distance from it to the Greece’s border and identify another point of interest in Greece. These two points show the least possible distance, from the overall focal point of destination to the country of origin, which is Greece. These results are better visualized on the following map.



Map 4.1. Exports' focal points of destination by region of origin and export share by country of destination

It is clear that based on distance, the nearest point to the countries of interest would result to a location on the Northern border of Greece. This is justified because of the fact that countries which import higher shares of products from Greek islands are located on Northern and Western Europe, which is clearly shown by the location of the focal points, regarding value of exports of products from Greek islands to countries with significant import shares on the said products. However, even in the case of the Ionian islands, where most exports are headed to Italy, the weighted mean center for the specific region is located in Germany, which is something that further justifies the need for an agrologistics hub being located as close as possible to points of destination.

However, even if destination criteria give an insight on the optimal location of establishing an agrologistics hub to service both producers (in this case, the ones of Greek islands) and consumers (taken into consideration as countries of destination), there are several more criteria to be considered. These criteria have been mentioned above, with some of the most important ones being transport infrastructure regarding inland modes of transport (road and rail infrastructure), overall location infrastructure and availability of space for development

and, ideally, areas where transshipment is possible. Therefore, the optimal location should not only meet criteria regarding total distance travelled to reach points of destination, but should also create opportunities so that as many modes of transport as possible are available for the distribution of products.

Such an area that can meet most of the aforementioned criteria can be a transshipment port. In Greece, the largest transshipment ports are the Port of Piraeus and the Port of Thessaloniki. Connectivity in most islands of the Aegean is facilitated mostly by the Port of Piraeus with sea routes serviced mostly by RoPax vessels, although there is also the possibility of shipping products to the Port of Thessaloniki, especially in the case of islands of the North Aegean, where transit times are significantly reduced. Considering the aforementioned ports, both can service islands of the Aegean efficiently, while road and rail networks connecting both ports are sufficiently developed for product transportation.

However, in the case of the Ionian islands, none of the aforementioned ports can service the islands and possible ports of destination are either the Port of Patra or the Port of Igoumenitsa. Although the Port of Patra can facilitate transportation of products to Piraeus, the Port of Igoumenitsa can also facilitate product transportation to the Port of Thessaloniki, with small differences in transit times, because of the highly developed road network in Northern Greece (e.g. by the Egnatia Motorway).

Consequently, the decision of the optimal location for establishing an agrologistics hub is mostly between the two major ports of Piraeus and Thessaloniki. However, in this case the Port of Thessaloniki poses as the more viable solution, as it not only acts as a major transshipment port, but its strategic location in the northern part of Greece offers more opportunities regarding transportation of products to European and Asian markets as well (such as Turkey). Apart from this, the Port of Thessaloniki is also the closest to the focal points of destination for all island regions shown on the above maps, which is of major importance when having to deal with agrologistics and the transportation of agricultural products from points of origin and intermediate points to points of destination, thus ensuring transportation cost effectiveness, food quality and safety.

Therefore, the Port of Thessaloniki and Thessaloniki as an area of development for the new agrologistics hub to service Greek islands, is thoroughly evaluated in terms of port infrastructure, transportation infrastructure and overall connectivity of the area with other major ports and cities, in order to efficiently distribute products to aforementioned markets.

4.5. DEVELOPMENT OF A NEW AGROLOGISTICS HUB IN THESSALONIKI

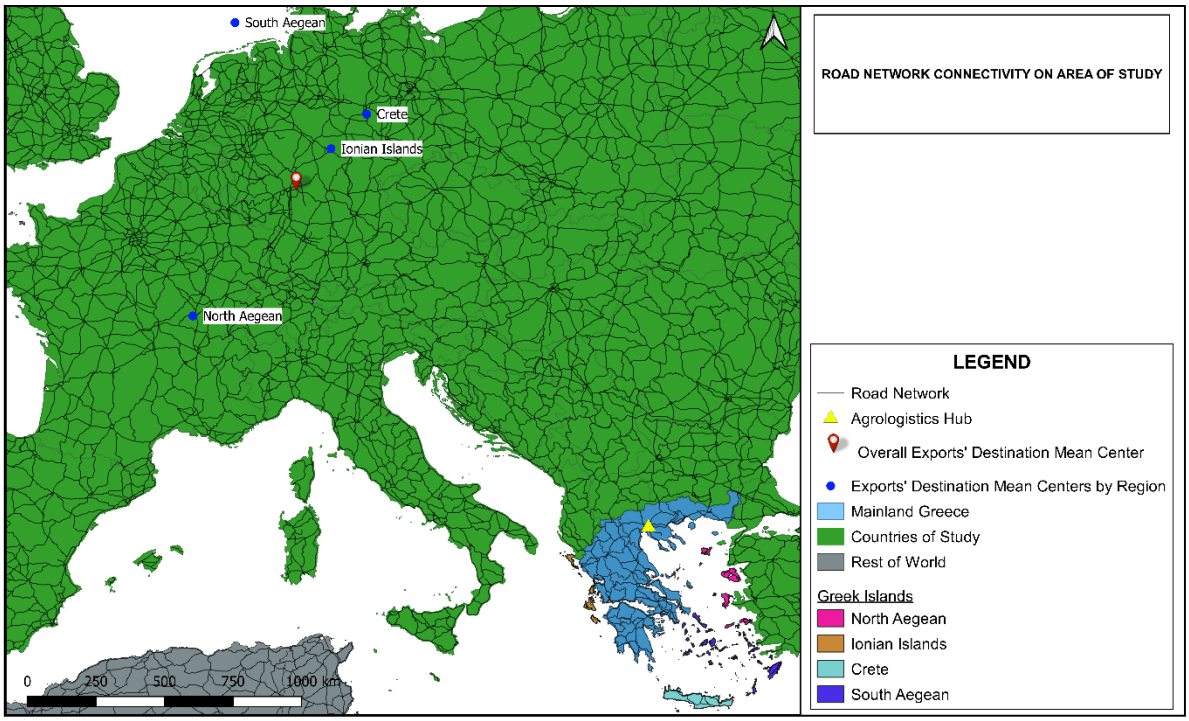
Regarding the city and port of Thessaloniki as optimal locations for the development of a new agrologistics hub, there are many opportunities for the specific location. At first, it is highly important that a large area is available for the development of the agrologistics hub, which can be a complicated issue when taking into consideration areas of the Thessaloniki Port Authority.

Various options are available, such as the highly discussed "Ziaka" former army barracks, which consists of a total area of 125 km^2. For this specific option, preliminary and feasibility studies have already been assigned, with construction expected to begin in 2020.The total cost of the investment is estimated over 50 million euros, which will be covered in equal shares by the Central Markets of Athens and Thessaloniki, as reported in recent articles (55, 56). Regarding this option, the area is strategically located in only a small distance by railroad connection, with direct access to the road network. In addition, the Port of Thessaloniki is located in the vicinity of the area, at just 4 km, while the Airport of Thessaloniki (Airport "Macedonia") is located 24 km from the former army barracks.

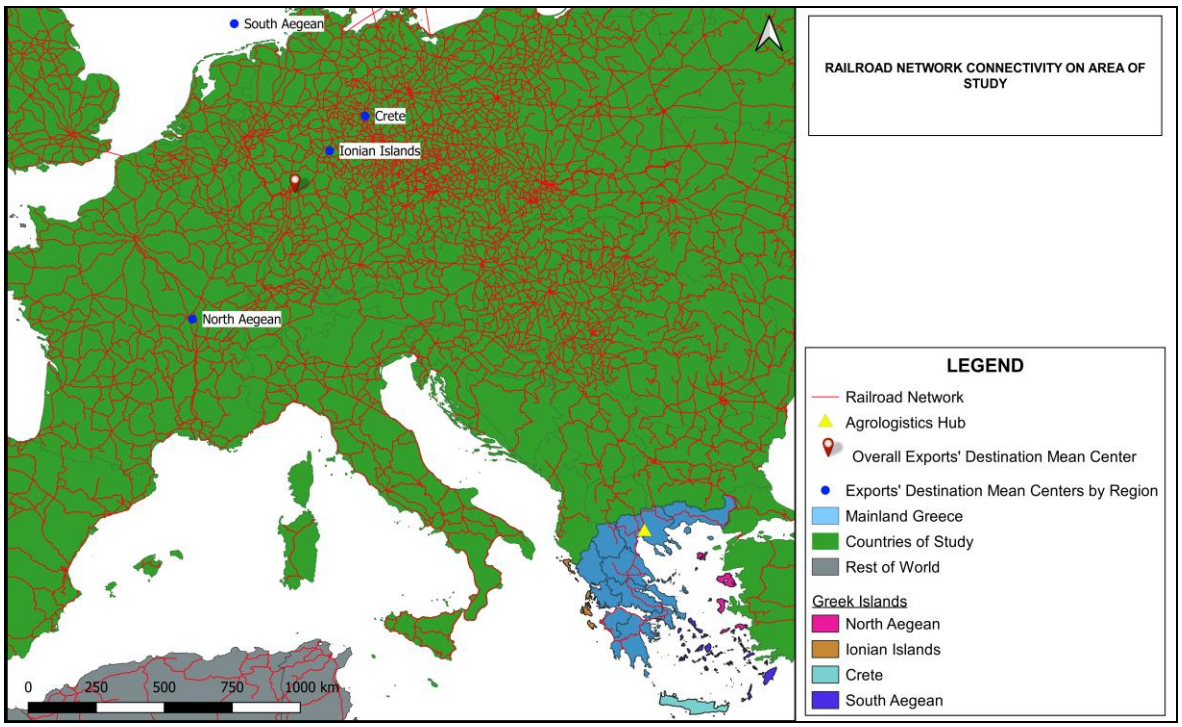
It has been clearly justified above that in the case of the agricultural sector of Greek islands, the emergence of a new agrologistics hub in Northern Greece and especially near the Port of Thessaloniki will positively impact total islands' exports. Therefore, such an investment will not only have a positive impact on regional level, but overall on a national level, as exports to European markets (mostly) will be highly facilitated. It is clear that, from a transportation cost effectiveness point of view, costs are cut significantly as product distribution is redesigned, with less transport routes needed to service the same areas of destination.

Not only is it possible for the agrologistics hub to be located in the city of Thessaloniki with direct access to various modes of transport, but the city itself is connected with a sufficient

road and railroad network. The overall transportation network connectivity of the city of Thessaloniki with other major ports and cities is one of its biggest strengths, as distribution of products can be facilitated from and to the agrologistics hub to various points of destination. The following maps show the road and railroad network connectivity of Thessaloniki with European markets.



Map 4.2. Road network connectivity on area of study



Map 4.3. Railroad network connectivity on area of study

The city of Thessaloniki is ideally located, as overall connectivity with major European cities is possible by road or railroad, while travel distance to other major cities or ports does not pose a threat to product distribution by road or rail. For example, travel distances from certain cities are as follows:

- Belgrade (Serbia): 609 km
- Bucharest (Romania): 608 km
- Skopje (North Macedonia): 219 km
- Sofia (Bulgaria): 280 km
- Istanbul (Turkey): 578 km
- Odessa (Ukraine): 1258 km

It is clear, however, that even with a railroad network that is quite developed and can facilitate product distribution, road network connectivity still remains one of the strongest aspects when considering connectivity with major markets. Although road network connectivity could suffice to meet product distribution needs of businesses, railroad network connectivity is an aspect that should be taken into account and must be further developed, in order for the

region and the country as a whole to be competitive with other countries with agrologistics hubs, offering similar services to continuously growing markets.

It is clear that the strategic location of the city of Thessaloniki can favor the development of the new agrologistics hub. Not only does the city show great hinterland network connectivity with other major cities, which facilitates distribution to European markets, but it also operates as the focal point of connection between the Balkans, the Black Sea and Asian markets on the eastern parts of the Mediterranean. The fact that the port is not yet as highly developed as other ports of the Mediterranean (e.g. ports in Italy) can also work on its favor, as the port is in a position to offer more attractive tariffs and overall lower transit fees.

On the other hand, however, the area shows weaknesses in some aspects. For instance, one of its weaknesses consists of the underdeveloped railway network, connecting the port with other major ports and major cities. This underdevelopment comes as a contradiction to hinterland connectivity conditions of other major ports and, more specifically, ports of Italy (Genoa, La Spezia, Trieste) which have highly developed hinterland transport networks supporting them. In addition, one of the major issues regarding investments in logistics in Greece is the highly unstable political environment and extensive unionization. Such external factors create a volatile environment which can affect the transport sector, through frequent strikes and other occurrences affecting the operation of the agrologistics hub. This is also true in the case of passenger vessels, as such external factors tend to affect transport operations of these vessels. This, of course, can affect the distribution process of products of Greek islands, as routes can unexpectedly change, leading to the increase of transit times.

Nevertheless, Thessaloniki shows a lot of promise as a location for establishing an agrologistics hub, in terms of possibilities for its overall development. In terms of overall operating area of service, an agrologistics hub in Thessaloniki can act as a focal point for all countries of the Eastern Europe and specifically the Balkans, while also servicing other eastern countries, such as Turkey. The emergence of an agrologistics hub can significantly reduce transport cost effectiveness for these countries, as product distribution can be more organized, while necessary trade route movements can be limited as well. The highly developed road network connecting Thessaloniki with most neighboring countries can also

positively affect the development of the agrologistics hub, as this presents an opportunity for it to act as an intermediate point of destination for exports of other countries of Europe, which are destined for other countries of the Mediterranean, Asia or Africa, where transshipment is necessary through the Port of Thessaloniki.

The role of Thessaloniki as an intermediate point of destination for many products through their respective food supply chains can be better understood if transit times from various ports and cities are evaluated. For instance, transit times compared between Thessaloniki and Istanbul from Jebel Ali (in the United Arab Emirates) show a significant difference of up to 6 days, while the same trip from Thessaloniki to Istanbul by road takes about 7 hours, which gives a significant advantage to Thessaloniki, as product flows are facilitated. In order to better understand the effectiveness of the developed road network in the area, in another case, transit times from Singapore to the Port of Thessaloniki take up to 24 days, while to the Port of Varna up to 35 days (approximately), while the same trip by road takes about 9 hours. It is clear that the overall road network connectivity of the area is an important factor which should be taken into account when developing the new agrologistics hub. By continuously monitoring and improving its overall infrastructure, operations of the new agrologistics hub and especially distribution processes can be facilitated.

The emergence of the hub, however, will also create the need for more improvement. This improvement will not only be necessary for infrastructure on its vicinity, such as infrastructure regarding road and railroad network connectivity, but also on the city of Thessaloniki itself. More specifically, the fact that in the future the city will act as a focal point for agrologistics, at least on a national level, surely creates more opportunities but also new needs in logistics operation throughout the city. It is clear that transportation networks and their overall infrastructure must be optimized in such a way to support agrologistics operations, so that more rapid distribution of products can be made possible, which is a major issue in food supply chains.

With that in mind, it is clear that connectivity of the Greek islands with the Port of Thessaloniki is a pressing issue that must be addressed. More specifically, by the development of the new agrologistics hub, new needs arise from a transportation point of

view. As mentioned above, in the case of most of the Greek islands, connectivity with the mainland is achieved through the Port of Piraeus, by specifically scheduled routes of passenger ships. As a result, products also need to be transported by road (mostly by trucks) from the Port of Piraeus to the agrologistics hub in Thessaloniki. It is clear that in this scenario transit times can be increased, which should be avoided, as this is one of the major factors affecting product quality and freshness of agricultural products. Therefore, in order for the agrologistics hub to be as competitive as possible and operate efficiently, connectivity between the Port of Thessaloniki and the Greek islands must be improved. Consequently, product supply of each island must be thoroughly monitored in the future, in order to provide the basis for redesigning (or optimizing) the transport network which will efficiently connect the Greek islands with the agrologistics hub.

The development of a new agrologistics hub in the area of Thessaloniki is, of course, an investment with many opportunities. The development of the hub as an intermediate point of destination for the distribution of agricultural products of Greek islands already shows promise, especially when cost effectiveness and efficiency of transport and trade routes are taken into account. Still, even if the conditions for the development of the hub are considered more favorable and convenient (such as area of development, transportation network connectivity etc.) than in other regions, there are certain areas of improvement. Consequently, on the development stages of an agrologistics hub, especially with it being a complex issue, all related factors of internal and external environment must be considered, in order to achieve efficiency in an agrologistics system that in the future may not only service Greek islands, but Greece as a whole.

5. IMPACTS OF THE NEW AGROLOGISTICS HUB

In the previous chapters, it has been made clear that agrologistics hubs are significant mechanisms that create a consistent and reliable supply of agricultural products. On the production side, an agrologistics hub collaborates with producers in order to implement sustainable production strategies, more efficient production planning, packaging, branding, overall food safety and quality and, of course, the distribution of products. On the demand side, agrologistics hubs work with distributors, processors, buyers (either wholesale or retail buyers), by coordinating practices so that agricultural products reach their points of destination as fast as possible and with the use of adequate equipment and modes of transport, thus ensuring the best possible quality.

It is important to assess the impact of the development of a new agrologistics hub, on various aspects. The development of the new agrologistics hub in Thessaloniki, to support food supply chains of Greek islands and, in the future, of other regions as well, can have significant positive impact on various aspects, such as:

- Agricultural production impacts
- Economic impacts
- Job creation and rural workforce impacts
- Social and environmental impacts
- Access to healthy and fresh food
- Implementation of environmentally sustainable production practices
- Reduction in energy use and waste management

The main goal in the development of an agrologistics hub is to be able to better coordinate food supply chain logistics. This can be possible by investing in agricultural product distribution infrastructure, in order to facilitate the process. As the hub acts as an intermediate drop off point for producers and pickup point for distribution actors of the supply chain, products will likely be in storage for most of the time. As a result, agrologistics hub facilities must include dry/cold storage facilities, grading, packaging, labeling and light processing

activities, in order to ensure that products leaving the hub destined for consumers can meet their preferences and purchasing standards.

It is clear that the existence of an agrologistics hub in a food supply chain can significantly optimize operations of all actors of the chain. As equipment and infrastructure investments occur, transport systems alter and more opportunities in operations arise, it is obvious that the development of an agrologistics hub can have positive impacts on all the aforementioned sectors, which are further discussed.

5.1. IMPACT ON AGRICULTURAL PRODUCTION

Producers are continuously facing the lack of adequate infrastructure on distribution and the production stage. Especially in Greek islands where production is rather small, in comparison to the mainland regions of Greece, producers face the issue of having to distribute their products by various modes of transport, as transport by sea is necessary. The development of a new agrologistics hub will provide support, as producers, through the hub, will gain more access to retail and wholesale buyers, while also to markets where demand for agricultural products is continuously increasing.

Producers of small regions, such as the Greek islands, have to face certain inhibiting factors in the development of food supply chain systems. One of these issues is the limited market options and revenue generated by current food supply chains, where producers have to deal with the issue of transporting products from their production sites (points of origin) to consumers or buyers (points of destination). In regional markets, surely a direct approach on producer – consumer relationship has significant advantages, although on a national or even international level, this direct approach is not even possible. In addition, producers from small and isolated regions (such as the Greek islands), often follow this direct approach, as it is easier to generate revenue, even smaller than what it would be on other non-regional markets. As a result, the emergence of the agrologistics hub gives this opportunity to smaller and mid-sized producers (which are numerous in Greece) to be able to distribute their products to markets that were before unknown to them. By creating collaborations with other regional producers, producers will be able to be more competitive in order to efficiently enter new markets and generate revenue, by increasing the value of their products.

Economic inhibitors also create limitations for producers of Greek islands. In many cases and especially in the recent years due to the economic crisis, producers often lack the available capital and access to facilities and equipment to distribute their products. As a result, due to economic difficulties, lack of experience and workforce issues, producers are not always able to even try to develop business relationships with other actors of the food supply chain and develop their own strategies for the effective distribution of their products. The new agrologistics hub aims to do exactly that, by coordinating operations of the food supply chains and develop business relationships with producers, in order to aid them in supplying their products to new markets, by being the intermediary between them and the consumers or buyers.

In addition, wholesale buyers tend to purchase products from distributors or large sized producers, as purchases from different and numerous producers can be costly and complex. Consequently, the agrologistics hub can function as an effective way to overcome this issue and create the necessary opportunities for small and mid-sized producers to be able to diversify on numerous new (for them) markets, while also growing on an operational level. It is clear that the development of the agrologistics hub will not only create new opportunities for producers from Greek islands, but all smaller and mid-sized producers on a national level, as coordination of product storage and distribution operations will be more efficiently achieved by the agrologistics hub functioning as the focal point for all producers of agricultural products.

Therefore, the agrologistics hub will offer a combination of production, distribution and marketing services. These will allow producers to enter additional markets, which would be difficult or even impossible to access on their own, but also optimizing their operations on markets where they are already exporting their products. For larger producers, the agrologistics hub can provide insight on product-differentiation and marketing strategies to ensure the best possible revenue generated, by increases in the value of their products. In addition, buyers (wholesalers or retailers), distributors and other customers will now be able to purchase larger volumes of products from the agrologistics hub, with much lower procurement costs, due to the fact that a single point of purchase (the agrologistics hub) with

consistent, reliable and large supply of agricultural products can contribute to cost effectiveness by limiting product transportation costs.

5.2. ECONOMIC IMPACTS AND JOB CREATION

Agrologistics hubs provide significant opportunities from an economic point of view. Especially in the case of more local and regional producers, such as the producers of Greek islands, the emergence of an agrologistics hub can provide local/regional food product supply on a larger scale, whilst creating jobs and increasing revenue throughout the island regions, as production continuously increases on a regional level.

As demand is shown to continuously rise, especially when taking into account the overall increases in value of exports and overall exports to international markets, so does the need for increase in product supply. Therefore, a more indirect impact from the development of the new agrologistics hub will be a significant increase in new jobs, not only in distribution or transport networks, but also on the Greek agricultural sector, as more working hands will be needed to provide the required supply of products for their markets of destination. These economic impacts, regarding revenue increase and job creation are highly important, as there are several cases were impacts regarding local economies are clear.

For instance, in Northeast Ohio, a study found that if the whole region of Northeast Ohio was to meet 25% of its need for food with local production, this would result in 27664 new jobs (Masi, 2010). These new jobs could potentially help 1 in 8 unemployed residents, while also increasing the annual regional output by $4.2 billion and increase state and local tax collections by $126 million. In addition, a food hub feasibility study conducted in southern Wisconsin estimated that a food hub operating at full capacity could create 400 jobs, while increasing overall revenue of the local economy by $60 million (Dane County Planning and Development Department, 2011). Furthermore, 50 small farm businesses in the region would be able to be served by the hub, with a potentional increase in their overall revenue by $900,000 to $1.8 million.

It is clear that for a country such as Greece, where the majority of the agricultural production is consisted of small to mid-sized producers, the economic impacts from the development of

an agrologistics hub are numerous. As mentioned before, the new agrologistics hub will give access to new markets, while also increasing supply to existing markets for exports. As more jobs are created, unemployment begins to decrease and more revenue is being generated in the agricultural sector of Greece. Moreover, not only does revenue increase but as more jobs are created on the agricultural sector, so does its overall development. The more developed an agricultural sector, the more investments can be attracted, which are favorable for the sector itself, the regions they affect and, in time, on a national level as the economy continues to develop as well, especially in Greece where solutions are needed to better manage the economic issues of the recent years.

As agrologistics hubs operate efficiently and become even more successful at increasing production and distribution of food products, economic gains tend to increase in communities where production occurs and where food hubs operate. Regarding local economies, more revenue is generated within the local economies, within the agrologistics hub's area of operation itself and, of course, positive impacts exist for businesses or consumers that buy the said products.

As mentioned, one of the most positive impacts that the new agrologistics hub will have is the creation of new jobs. This is even more significant if Eurostat data are taken into account, where in the case of Greece by June 2019 unemployment rates were still high at 17%, especially in comparison with other neighboring countries such as Turkey (14%) and Italy (9.7%). Moreover, an agrologistics hub can create jobs by two ways, directly and indirectly. Direct creation of jobs occurs for the operation of the hub itself, while indirectly the hub creates jobs as a supportive facility for job opportunities in the region where it is located and in regions that are directly related to it, by business relations.

One of the major goals of an agrologistics hub is to retain agricultural jobs, while aiming to make agricultural production more profitable. In order to do so, various operations are taking place, such as production, distribution, sales, accounting, purchasing etc. All of these operations have a significant impact on each other, although in the food supply chain where an agrologistics hub is present, facilitating and better organizing after-production processes mostly affects the production stage. This happens due to the fact that the development of an

agrologistics hub mostly alters operations that are directly connected to the hub itself (such as distribution) and not production itself, especially in the case of Greek islands, where the regions of production are located on another region than the proposed location of the hub. As a result, as new opportunities arise in agrologistics, by the development of the hub, the ones that are surely affected by them are producers.

The agrologistics hub must, of course, operate as an intermediary that will work with producers and buyers directly and in advance, to better coordinate production planning and pricing, by taking into account the anticipated demand. This practice can clearly help producers, as it will be possible for them to better plan production quantities for the upcoming demand periods with much greater confidence that their products will end up on ready markets at acceptable prices, which will ultimately provide them with more economic security. In addition, producers will be benefited from the existence of the hub, as they will be better prepared to establish their businesses, knowing that they will have an experienced and reliable partner for delivering their products to buyers. This will not only bolster the overall confidence of producers and efficiency of the production planning as a whole, but also directly create job opportunities as agricultural businesses will continue to grow.

A major goal of the agrologistics hub is to offer Greek producers the profitability and viability that is lacking from their businesses, especially as of recent years. By offering producers large sale volumes, stable sources of income and higher revenue, the agrologistics hub will provide opportunities for producers to expand and diversify production, which will lead to increased profitability and longer viability of agricultural operations. However, an agrologistics hub can be more than just an economic partner for producers. Through the agrologistics hub, access to training opportunities for the production workforce can be made possible, in order to provide more support to producers in terms of job creation and development of their workforce.

As product diversification and increase in supply are important areas of development when partnering with an agrologistics hub, producers must also better organize and train their staff. A competent staff will make all the difference when needs for increased product supply and product diversification are the deciding factors for making an impact to current or newly

accessed markets, which creates the need for better performance of the workforce in production stages. Overall workforce performance can, of course, be enhanced by continuously training and developing staff in production related issues, new technologies in the agricultural sector, post-production handling issues, agricultural planning and other areas to improve production performance.

Consequently, while an agrologistics hub can significantly increase revenue, which is one of the most important issues in the Greek agricultural sector and the Greek economy as a whole, job creation and workforce related issues are also important for the development of the sector.

5.3. SOCIAL AND ENVIRONMENTAL IMPACTS

An agrologistics hub can have considerable impact on local economies, while they also have significant impacts on a social and environmental aspect. As mentioned above, agrologistics hubs can provide training and professional development for people interested in pursuing a career in the agricultural sector, or expanding their already existing businesses.

This can be achieved by increasing the availability of fresh and healthy food produced and sold to international or domestic markets, while promoting the adoption of sustainable and environmentally friendly practices on agricultural production. By adopting new practices based on environmental sustainability, not only will producers expand and improve their overall production and post-harvest handling, but also increase sales which will result in increasing total revenue. Moreover, in order to implement new practices, workforce development is important, as mentioned before, which will provide workers with the necessary training to bolster their capabilities and subsequently make them more capable in terms of job demands, new opportunities and dealing with possible threats.

The agrologistics hub can act as a meeting point not only for products across the islands and, in time, Greece as a whole, but also as a meeting point for producers from different regions. The idea is for the agrologistics hub to serve as an area where producers can provide mutual support and assistance to each other, by conducting producer meetings, workshops and other activities. This will give new producers or new to sustainable production methods the opportunity to receive specialized practical training in a field which they would be unfamiliar

with until now. Therefore, the agrologistics hub can also host other types of informative and training events, with the opportunity for interested producers to be able to attend and be certified on specific areas of agricultural production, by taking into account each region of production, as differentiation and diversification are key for producers to be more competitive with each other and producers of other countries as well.

In time, the agrologistics hub can begin new business collaborations with organizations that support the agrologistics sector. These business relationships can in turn help smaller producers or those that wish to enter the agricultural sector, by providing land, equipment, irrigation and storage facilities, while also supporting them in terms of planning and development, with the help of already established producers in the sector. Programs provided by business partners of the agrologistics hub will benefit all sides, as product supply will rise or differentiate, which will add more value to exported products and, of course, increase total revenue of all parties.

Through these initiatives, producers will be better trained and capable of providing the agrologistics hub with new, differentiated and healthier products. In addition, as production practices will shift to more organic and sustainable ones, products can, in time be less expensive to produce, while being more valued than others, in terms of consumer preferences. The agrologistics hub, through its business partners, will provide important services, such as insurance, quality control, easier and faster ways of distribution, traceability and, most importantly, will establish direct relationships between buyers, which will eliminate all barriers through the food supply chain, which would consist of inhibiting factors for producers to meet the requirements and needs of buyers.

The agrologistics hub can also provide underserved communities with a constant supply of fresh and healthier products. More specifically, products that reach the agrologistics hub can be sorted and distributed in such a way that all products meet most of their consumers' needs, as not all have the same needs, preferences and options, while products headed for consumption on facilities of greater interest must be as fresh and healthy as possible. For instance, products destined for schools, hospitals and other sensitive groups of consumers do not meet the same requirements as products destined for domestic or regional markets, where

consumption is occurring almost directly as the product leaves the producer and the hub. Moreover, this is also the case when taking into account areas where agricultural product and specifically food access is limited, as the agrologistics hub may not be directly supplying fresh and healthy products to these communities, but will work with organizations that are aiming to increase food access in those areas. In terms of domestic markets, the agrologistics hub can be able to directly sell products to consumers, or with minimum delays, as demand and supply are better coordinated. As a result, products become even more accessible to consumers.

In addition, an agrologistics hub can also take action in supporting food assistance organizations. These organizations, which are often operated by hunger relief organizations or food banks can benefit from the aforementioned "sorting" activities of the agrologistics hub, by taking into advantage second grade products. The term "second grade", however, does not refer to degraded or unhealthy products, but to products that may not meet standard retail or food service requirements, which in most cases do not have to do with the true quality of the product, but more with the appearance or size of the products, especially in cases of food products. These products are, therefore, harder to sell in most fresh markets and instead of never reaching any market, it is in both the hub's and the organizations' best interests to reach a market supported by these hunger organizations, as the hub will benefit from such a transaction, while the organizations will have access to fresh and healthier products than what they would normally receive from donations or other sources.

Moreover, regarding environmentally friendly and sustainable production practices, the new agrologistics hub can help promote them in various ways. For instance, sustainable production can be promoted by the agrologistics hub if the latter prefers to choose products from producers that implement forms of environmentally friendly practices, such as integrated pest management or organic production practices and restrict producers that implement non environmentally friendly practices. Sustainable production can also be promoted by providing training, technical assistance and production planning to producers, while encouraging them to implement sustainable production practices by providing various kinds of incentives for them. Another way to promote sustainable production is by branding

products from certain producers that implement environmentally friendly practices, which will add more value to these specific products, giving them a clear advantage in terms of sales, as lately consumers tend to prefer organic products or ones that are produced with sustainable production practices. By this way, producers will be more likely to conform with certain standards set by the agrologistics hub management, as branding products with a certain trademark or protocol will give a more premium character to their products, thus increasing their overall value and in turn increase producers' revenue.

Another important environmental impact of the new agrologistics hub is the reduction of energy use and waste in their operations. The agrologistics hub must, of course, be highly concerned with its environmental impact and implement strategies that will reduce waste, energy use, while promoting cost efficiency in their operations. The first and most obvious way to do so is by planning and implementing an efficient recycling program, while other ways to do so is by implementing composting practices and energy saving programs. Moreover, as mentioned before, an agrologistics hub will act as an intermediate point for producers and consumers or buyers, which will significantly reduce the number of trips for product distribution from producers to the consumers, leading in fuel saving and cost reduction, especially for producers.

In order to further justify this, an example of the "hub-spoke" model should be brought to mind, which as mentioned before creates a more cost efficient way of planning necessary transport routes in a system of given nodes. For instance, in a system of 100 nodes (points of origin and destination), without an agrologistics hub functioning as an intermediate point, there would be $\frac{n\cdot(n-1)}{2} = 4950$ possible connections (or transport routes), but with the emergence of an agrologistics hub as an intermediate point these possible connections now are $n - 1 = 99$. As a result, with the emergence of an agrologistics hub and the implementation of a hub-spoke model, these "connections" or transport routes are significantly limited (in the specific example by 98%). This reduction in total trips needed not only reduces fuel costs, but also if larger trucks in full capacity are used, the fuel usage per product used is significantly reduced as well.

Consequently, an agrologistics hub has a significant impact on environmental and social aspects as well. These impacts, however, are not one sided, due to the fact that from promoting new practices in production, optimizing distribution and transport routes and creating more job and workforce opportunities, economic impacts are also possible. As a result, the emergence of an agrologistics hub, while being a serious and complex investment which requires thorough planning and coordination of activities can, in time, create opportunities for both the Greek economy and Greek producers, distributors and the workforce of the agrologistics sector as a whole. Considering the fact that the agricultural sector in Greece is continuously growing, which is clear by the value of exports to international markets, the need for more improvement and competitiveness for the sector is of the highest importance.

In addition, job creation is not to be considered as a trivial matter, especially when taking into account unemployment rates in Greece, which are still high. Last but not least, it is also important to take into consideration the fact that the development of an agrologistics hub can, in time and with careful planning, create new opportunities in sustainable ways of production, which will indirectly have an important positive impact on the environment itself.

6. CONCLUSIONS

The purpose of this Master's thesis was to analyze the concept of agrologistics and how the agrologistics sector can operate, in order to better service the agricultural production of Greek islands. During this study, conceptual terms and aspects regarding logistics, agrologistics and the agricultural production in Greece and specifically in Greek islands were analyzed, in order to better determine the operational possibilities of the newly proposed agrologistics system.

This newly proposed agrologistics system will operate on the basis of a new agrologistics hub. Therefore, all aspects analyzed in the chapters of this Master's Thesis aim towards creating a better understanding as to where this new agrologistics hub should be located. The methods and criteria used, in order to identify the optimal location for the emergence and development of the new agrologistics hub are of both qualitative and quantitative nature.

At first, certain definitive aspects relating to the agrologistics hub and its operations are thoroughly described. These theoretical aspects, such as terms and conceptual definitions of agrologistics and the agricultural production in Greece, are vital in evaluating key factors affecting the development and operation of a new agrologistics hub, which in turn provide more insight on issues addressed by this Master's Thesis, such as the best choice of location for the development of the hub. There are, of course, other methods to identify and evaluate all factors affecting an agrologistics hub and its operations, with either a positive or a negative impact, which can be used to address the specific issue. However, as Greek islands and their agrologistics operations are considered the basis for the main issue addressed in this Master's Thesis, their agricultural production and distribution consist of the main issues of the study.

Addressing an issue such as the agrologistics operations of a country or a specific region is a complex issue and in the case of Greek islands, where transport requires the use of liner shipping services, this issue becomes even more complicated. In order to better evaluate the agrologistics system and its areas of improvement, both agricultural production and distribution of products must be analyzed. In this study, however, export data of all analyzed island regions are used due to the fact that, to some extent, they can be helpful to analyze

both production and demand for product distribution, as exports are key to identify whether a large investment in a new agrologistics hub is purposeful.

Conclusions drawn from analyzing agricultural product export data of the Greek islands show a continuous rise in exported value of products in all island regions. More specifically, during the four-year timeframe, from 2013 to 2017, Crete shows an overall increase in value of agricultural product exports by 11% (24,441,866 €), the South Aegean by 67% (5,975,650 €), the North Aegean by 17% (26,814,439 €) and the Ionian islands by 128% (28,075,674 €), while during that four-year period, total value of agricultural product exports for all Greek island regions was 2,351,488,164 €. It is clear that agricultural production and exports of the Greek islands to international markets are showing an important rise in recent years, especially when taking into account the overall progress made by smaller regions, such as the South Aegean and the Ionian islands. Although an overall 20% rise in value of agricultural product exports from 2013 to 2017 may seem significant, if absolute value is taken into consideration (85,307,629 € from 2013 to 2017) then it is obvious that there is still considerable room for improvement regarding exports of these regions to international markets.

The aforementioned numbers can certainly improve and the total revenue increased. As this study analyzes possible impacts from the emergence of an agrologistics hub, one of its main objectives is exactly this, which can be achieved by achieving cost efficiency in all operations related to the hub, throughout the food supply chain, starting from the producers and ending with consumers. This is possible, as mentioned before, through the optimization of the agrologistics system servicing the Greek islands, by the development of the new agrologistics hub in Thessaloniki, as it will serve as an intermediate point of destination for all products of Greek islands destined for international and even domestic markets.

Moreover, the emergence of a new agrologistics hub can positively impact the Greek islands in many aspects, such as economic or social ones. However, as the agrologistics system based on which these islands are distributing their products will change, in order to include a new intermediate focal point for its operations, so do the needs for more research on issues regarding agrologistics and all related issues, which can help the Greek economy in numerous

ways. As a result of this, the purpose of this Master's Thesis was not to address all issues related to the agrologistics sector in Greece and determine the needs in redesign and optimization of transportation systems to support the sector, but only to provide the basis for further studies, by justifying the importance and numerous impacts of a new, strategically located agrologistics hub.

As the choice of location in this study is clearly justified based on quantitative and qualitative criteria, as shown on previous chapters, further studies must be conducted on this basis. In order for the agrologistics sector to operate with maximum efficiency, there must be as much support as possible from all related sectors. More importantly, Greece is a country of many islands and smaller islets, in which accessibility is achieved with the combination of various modes of transport (road and/or rail, sea, air). One major issue of Greek islands, that should be addressed in further studies is the issue of isolation of some, as liner shipping services are limited on certain regions. Consequently, any new study that examines transport systems supporting the agrologistics sector in Greece should take this into consideration, as well as identifying such isolated islands with significant areas of improvement in terms of agricultural production and exports.

Furthermore, as new studies can address the issue from a transport systems optimization perspective, other studies must also be conducted, with the purpose of assessing the governmental impact and support on such an important investment. Such studies can contribute greatly, as more insight can be given on the necessary level of support needed from governmental sectors on development and, later, operation of the agrologistics hub. As new investments will arise from this initial investment and new business partners will emerge, governmental bodies must be in a position to facilitate these new business partnerships, with actions that promote economic and other incentives for all sides, while also being in a position to coordinate regulatory oversight and ensure transparency of operations. Therefore, it is highly important to assess the impact of the government sector to the investment and development of the hub, the possible partnerships and operations, due to the fact that, as mentioned, the Greek government sector is sometimes concerned to operate in ways which provide limitations to new investments and potential new business partners.

In addition, studies should also be conducted in regard to new technologies and practices implemented to the operations of a state of the art agrologistics hub. Determining and proposing the optimal location for an agrologistics hub, while also developing the facility itself should only be the first step towards its successful and efficient operation. As technological developments and innovations are continuous, new studies should focus on technological aspects of the operations of the agrologistics hub, with regard to newly developed technological practices related to production, storage, handling and distribution, with the main objective of optimizing operations to ensure the best possible quality from production to consumption, while also providing the highest level of service to all sides of the food supply chains.

It is clear that analysis of the agrologistics sector and the operations of an agrologistics hub, especially in the case of Greece, where numerous islands exist is a more complicated issue than in other countries where transport is more straight-forward. As the agricultural sector is being affected by both internal and external environment factors, it is important to continuously monitor and efficiently coordinate operations of the agrologistics hub, so that new opportunities and threats are rapidly identified, which will result in successfully managing the hub and creating better conditions for all contributing actors of supply chains. Studies should be conducted to gather all relative case studies of different agrologistics hubs around the world, with the main objective of proposing ways to efficiently monitor and assess performance of the hub's operations, so that identification of underperforming sectors can be facilitated, thus creating needs for their improvement and subsequently increasing performance of operations as a whole.

In addition, the case of Greek islands creates certain issues in determining distribution of products from points of origin to points of destination. Due to this fact, further analyses should also focus on each island region's exports to individual countries, in order to create more efficient ways for distributing products. For instance, as mentioned in the case of the Ionian islands, where approximately 36% of exports (as of 2017) are headed to Italian markets, product distribution can be facilitated directly from the islands (or through a port that services them) to Italy. As a result, future studies should further analyze the relation

between each specific point of origin to its corresponding countries of export, in order to provide a more detailed point of view, as to which countries can be serviced through the hub and which by other more efficient ways of distribution. Moreover, as different ways of effectively distributing products from specific points of origin to specific countries of destination can be analyzed, the need for further analysis on different ways of transport arises. Because of the fact that there are regions that can distribute their products to specific countries either through the hub, or through alternate direct routes as well, further studies should emphasize on the various modes of transport to achieve effectiveness in product distribution, such as short sea shipping and multimodal transport.

As mentioned before and on previous chapters, there are numerous ways from which the operations of an agrologistics hub can be addressed. From technical related issues, such as transportation systems infrastructure, to social related issues, the operation of an agrologistics hub is an issue requiring a multi-criteria analysis to fully understand its characteristics, affecting factors and room for improvement. This study has made clear that developing an agrologistics hub is not merely an issue of developing it on a strategically located area, which would service all business partners. Due to the fact that numerous sides are involved, it is obvious that all of them must cooperate in such ways to ensure that the agrologistics system as a whole operates efficiently and that development of a specific sector and improvement of a side (e.g. producers, distributors etc.) will further improve all cooperating business partners of the system. However, as every side operates on specific ways with unique characteristics, any further analysis is best to focus exclusively on improving a specific side of the agrologistics system and not address all aspects as a whole, due to the fact that each study should be conducted by researchers of expertise on each individual sector, to create the necessary conditions so that the development of each sector and side is made on the most efficient way possible. As a result, studies should be conducted on various aspects, such as consumption, production, technological improvements and most importantly in developing ways to further develop the product distribution process.

In conclusion, as mentioned before, this Master's Thesis did not aim to assess all issues regarding efficiency in operations of an agrologistics hub and an agrologistics system as a

whole. The main objective of this study is to provide a basis for future studies, by an assessment of qualitative and quantitative criteria and data, which provide insight on the selection of the best possible location for the development of an agrologistics hub, which was conducted by specific methods and for certain aforementioned reasons. Consequently, based on this Master's Thesis, future studies should also be conducted, to provide further insight on improving the development of an agrologistics system not only for supporting production of Greek islands, but also agrologistics all over Greece, as well.

REFERENCES

1. Awasthi, A. C. (2011). A multi-criteria decision making approach for location planning for urban distribution centers under uncertainty. *Mathematical and Computer Modelling, 53*((1-2)), 98-109.
2. Baluch, I. (2005). *Transport logistics: past, present, and predictions.* Winning Books.
3. Beamon, B. M. (1998). Supply chain design and analysis: Models and methods. *International journal of production economics, 55*(3), 281-294.
4. Botha, M. &. (2008). Logistic hubs: an integration of transport infrastructure. Proceedings of the 27th Southern African Transport Conference (SATC 2008).
5. Carter, C. D. (2008). A framework of sustainable supply chain management: moving toward new theory. *International journal of physical distribution & logistics management, 38*(5), 360-387.
6. Chaabane, A. R. (2012). Design of sustainable supply chains under the emission trading scheme. *International Journal of Production Economics, 135*(1), 37-49.
7. Chua, P. Y. (2003). Robotic manipulation of food products–a review. *Industrial Robot: An International Journal, 30*(4), 345-354.
8. da Silva Portugal, L. M. (2011). Location of cargo terminals in metropolitan areas of developing countries: the Brazilian case. *Journal of Transport Geography, 19*(4), 900-910.
9. Dabbene, F. P. (2008). Optimisation of fresh-food supply chains in uncertain environments, Part I: Background and methodology. *Biosystems Engineering, 99*(3), 348-359.
10. Department, D. C. (2011). Retrieved October 1, 2019, from https://pdf.countyofdane.com/Purchasing/RFI__111101_Packing_House_Study.pdf
11. Dobson, G. &. (1993). Airline scheduling and routing in a hub-and-spoke system. *Transportation Science, 27*(3), 281-297.

12. Donald, J. B. (2012). *Supply chain loigistics management.* New York: McGraw - Hillbook.

13. Du, X. e. (2016). Economics of agricultural supply chain design: A portfolio selection approach. *American Journal of Agricultural Economics, 98*(5), 1377-1388.

14. El-Nakib, I. (2010). Egyptian firms' location preferences for logistics hubs: focus on the Southeast African region. 8th International Conference on Supply Chain Management and Information Systems.

15. Eskilsson, C. &. (2010). *Finding optimal logistical hubs for Swedish export.* Sweden: Luund University Publications.

16. Essaadi, I. G. (2016). Location of logistics hubs at national and subnational level with consideration of the structure of the location choice. *IFAC-PapersOnLine, 49*(31), 155-160.

17. Europlatforms, E. E. (2004). *Logistics Centres Directions for Use.* A Report By Europlatforms EEIG.

18. Fritz, M. S. (2009). Tracking, tracing, and business process interests in food commodities: A multi-level decision complexity. *International Journal of Production Economics, 117*(2), 317-329.

19. Hammervoll, T. J. (2012). Criteria for temperature alerts in cod supply chains. *International Journal of Physical Distribution & Logistics Management*.

20. Helms, M. (2004). Food sustainability, food security and the environment. *British Food Journal, 106*(5), 380-387.

21. Hines, T. (2004). *Supply chain strategies: Customer driven and customer focused.* Oxford: Routledge.

22. Iakovou, E. V. (2007). An analytical methodological framework for the optimal design of resilient supply chains. *International Journal of Logistics Economics and Globalisation, 1*(1), 1-20.

23. Jorgensen, A. (2007). A Perspective on Freight Transport in South Africa. Johannesburg: Notes prepared by the author.

24. Kayikci, Y. (2010). A conceptual model for intermodal freight logistics centre location decisions. *Procedia-Social and Behavioral Sciences, 2*(3), 6297-6311.

25. Kiladze, A. (2017). Agrologistics in the agriculture system: from history to the prospects. *Revista ESPACIOS, 38*(32).

26. King, B., & Keating, M. (2006). The top 50 logistics cities in the United States. *Logistics Today, 47*(10).

27. Lambert, D. (2004). The eight essential supply chain management processes. *Supply Chain Management Review, 8*(6), 18-26.

28. Lambert, D. M. (2000). Issues in supply chain management. *Industrial marketing management, 29*(1), 65-83.

29. Lee, K. L. (2007). Analyzing the competitive relations among the location in the Asia-Pacific region for developing the re-export type of global logistics hub. *Journal of Marine Science and Technology, 15*(3), 187-200.

30. Long, S. &. (2012). A strategic decision model for evaluating inland freight hub locations. *Research in Transportation Business & Management, 5*, 92-98.

31. Lu, C. S. (2006). Comparison of investment preferences for international logistics zones in Kaohsiung, Hong Kong, and Shanghai ports from a Taiwanese manufacturer's perspective. *Transportation Journal*, 30-51.

32. Masi, B. S. (2010). *The 25% shift: The benefits of food localization for northeast ohio & how to realize them*. Retrieved October 1, 2019, from http://www. neofoodweb. org/sites/default/files/resources/the25shift-foodlocalizationintheNEOregion. pdf

33. Mentzer, J. T. (2001). Defining supply chain management. *Journal of Business logistics, 22*(2), 1-25.

34. Mogensen, L. H. (2009). Life cycle assessment across the food supply chain. *Sustainability in the food industry*, 115-144.

35. Munoz, D. &. (2010). Development of Panama as a logistics hub and the impact on Latin America. Doctoral dissertation, Massachusetts Institute of Technology.

36. Nepstad, D. C. (2006). Globalization of the Amazon soy and beef industries: opportunities for conservation. *Conservation biology*, *20*(6), 1595-1603.

37. Oum, T. H. (2004). Multinational firms' location preference for regional distribution centers: focus on the Northeast Asian region. *Transportation Research Part E: Logistics and Transportation Review*, *40*(2), 101-121.

38. Porter, M. E. (1995). Green and Competitive: Ending the Stalemate. *Harvard Business Review*, *73*(5), 120-134.

39. Roso, V. B. (2015). Inland intermodal terminals location criteria evaluation: the case of Croatia. *Transportation journal*, *54*(4), 496-515.

40. Samir, D. (2015). *Food supply chain management and logistics: From farm to fork.* Kogan Page Publishers.

41. Seuring, S. M. (2008). From a literature review to a conceptual framework for sustainable supply chain management. *Journal of cleaner production*, *16*(15), 1699-1710.

42. Skowron-Grabowska, B. (2008). Development of logistics centres in Poland. Czestochowa University of Technology.

43. Soysal, M. B.-R. (2012). A review on quantitative models for sustainable food logistics management. *International Journal on Food System Dynamics*, *3*(2), 136-155.

44. Teng, J. Y. (2007). A fuzzy multicriterion Q-analysis model for international logistic-park location selection. *Journal of Marine Science and Technology*, *15*(2), 89-103.

45. Tonelli, M. D. (2012). The role of transport infrastructure in facilitating the survival and growth of micro-enterprises in developing economies. Fremantle, WA: University of Notre Dame.

46. Tongzon, J. (2007). Determinants of competitiveness in logistics: implications for the ASEAN region. *Maritime Economics & Logistics, 9*(1), 67-83.

47. Uysal, H. &. (2014). Selection of logistics centre location via ELECTRE Method: a Case Study in Turkey. *International Journal of Business and Social Science, 5*(9), 2014.

48. van der Vorst, J. G. (2011). Towards a diagnostic instrument to identify improvement opportunities for quality controlled logistics in agrifood supply chain networks. *International journal on food system dynamics, 2*(1), 94-105.

49. Van Gogh, J. B. (2013). *Feasibility of a network of excellence postharvest food losses: combining knowledge and competences to reduce food losses in developing and emerging economies* (Report No. 1402 ed.). Wageningen: Wageningen UR-Food & Biobased Research.

50. Wognum, P. N. (2011). Systems for sustainability and transparency of food supply chains–Current status and challenges. *Advanced Engineering Informatics, 25*(1), 65-76.

51. Yang, Y. C. (2016). Determinants of global logistics hub ports: Comparison of the port development policies of Taiwan, Korea, and Japan. *Transport Policy, 45*, 179-189.

52. Żak, J. &. (2014). The selection of the logistics center location based on MCDM/A methodology. *Transportation Research Procedia, 3*, 555-564.

53. Zuurbier, P. J. (1999). Supply chain management in the fresh produce industry: A mile to go? *Journal of Food Distribution Research, 30*(856-2016-57418), 20-30.

54. Καμενίδης, Χ. (2010). *Μάρκετινγκ Αγροτικών Προϊόντων.* Θεσσαλονίκη: Εκδόσεις Αφών Κυριακίδη.

55. *Κεντρική Αγορά Θεσσαλονίκης: Δημιουργία Κέντρου Agrologistics μαζί με την Κεντρική Αγορά Αθηνών στο πρώην στρατόπεδο Ζιάκα*. (2019, October 1). Retrieved from thesseconomy.gr:

https://thesseconomy.gr/%CE%BA%CE%B5%CE%BD%CF%84%CF%81%CE%B9%CE%BA%CE%AE-%CE%B1%CE%B3%CE%BF%CF%81%CE%AC-%CE%B8%CE%B5%CF%83%CF%83%CE%B1%CE%BB%CE%BF%CE%BD%CE%AF%CE%BA%CE%B7%CF%82-%CE%B4%CE%B7%CE%BC%CE%B9%CE%BF%CF%85%CF%81/

56. *Κέντρο Agrologistics, στο πρώην στρατόπεδο Ζιάκα, δημιουργούν οι Κεντρικές Αγορές Θεσσαλονίκης και Αθηνών*. (2019, October 1). Retrieved from www.metaforespress.gr:
https://www.metaforespress.gr/logistics/%CE%BA%CE%AD%CE%BD%CF%84%CF%81%CE%BF-agrologistics-%CF%83%CF%84%CE%BF-%CF%80%CF%81%CF%8E%CE%B7%CE%BD-%CF%83%CF%84%CF%81%CE%B1%CF%84%CF%8C%CF%80%CE%B5%CE%B4%CE%BF-%CE%B6%CE%B9%CE%AC%CE%BA%CE%B1/