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Food Systems and Sustainability

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Food Systems and Sustainability

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THE MEDITERRANEAN DIET AS A SUSTAINABLE FOOD SYSTEM

Ricardo Lopes¹

ABSTRACT

Central theme in society these days, the diet went through several phases during the evolution of the human being. Currently human's advanced civilizational, deplete resources, develops forms of reproduction and rapid growth of animals, genetically alter plants to make them more resilient and artificially prolongs life. All these factors lead to an overload in nature and revolve to a group of environmentalists and animal rights.

Sustainability is part of everyday life of political and social discourse as the fundamental way to our relationship with the environment. Sustainable food systems are those that are able to survive over time, promoting sustainable use of resources and a balance in the economic, social and environmental aspects.

Changing diet to the Mediterranean Diet would bring benefits: on the health level, with better nutrition and increased use of some processed products; economic, by encouraging the consumption of local and national production of products; social, with the creation of jobs in agriculture; and environmental, using organic production and the reduction of transportation needs.

The Mediterranean Diet encourages a more balanced and healthy eating style, with great positive impact on the environment. With the globalization phenomena it was gradually lost, but is now being revived due to the awakening to health and ecological problems.

Keywords: Mediterranean Diet, Sustainability, Environment, Nutrition.

JEL Classification: Q01, Q56.

1. INTRODUCTION

Diet and food production are central themes in society these days because of its importance for health and the impact on the environment. It went through several phases during the evolution of humans (Almeida and Afonso, 1997), following the evolution of knowledge, such as the discovery of fire control. The development of agriculture allowed the establishment of the people in certain areas, so giving rise to the growth of societies. Cereals, vegetables and animals were produced for own consumption, enabling the growth of communities around the crop fields.

Currently humans in advanced civilizations deplete resources, develop forms of reproduction and rapid growth of animals (Singer, 2000), alter genetically the plants in order to make them tougher (Beaud, 1995) and artificially prolong life. This combination of factors leads to a massive overload in nature.

Society is changing, is becoming more aware of these aspects. Marine species that disappear due to overexploitation, the terrestrial species that go extinct due to deforestation,

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land worn by intensive cultivation (Beaud, 1995), all these events have a common point which is the production of food.

Consumption of natural products is gradually imposing itself in the society, thus beginning to proliferate macrobiotic and vegetarian restaurants. Even begin to arise fast food chains devoted to this type of diet, a sign that people are increasingly interested in other options in terms of food, either by environmental or health issues.

A change of diet is often indicated by health professionals, usually professionals from unconventional therapies. Simple changes such as decreased milk consumption and refined grains (Varatojo, 2010) are usual, getting more profound with the abolition of all animal products. Usually when we think of food, our idea simply goes to the ingredients and their production. But the chain is longer and more intricate than it seems.

In 1987, the report “Our Common Future” (WCED, 1987), also known as the Brundtland report, reached a definition that has become standard worldwide for sustainable development, being the “(...) development that meets the needs of the present without compromising the ability of future generations to meet their own needs.”. For us to guarantee the needs of the future generations, deep changes have to be made in diets and food production. The Mediterranean Diet is an example of what can be done to achieve sustainability.

2. CLIMATE CHANGE

The actions of human beings have always had a great influence on the environment, mostly negative. Food production is one of the main factors regarding changes in climate, raising various health concerns (Korkala, et al., 2014).

With the evolution of knowledge and especially with the industrial revolution, the impact on the environment began to have serious effects on the ecosystem balance. The increase in pollutant sources, the depletion of natural resources and the emission of harmful gases into the atmosphere are among the main problems arising from the action of man, namely the social and with particular attention to environmental, which usually are in the background regarding economic issues. However they appear listed in the Commission’s report (CEC, 2007), with the confirmation of impacts “in agriculture, fisheries, desertification, biodiversity, water resources, in mortality associated with the heat and cold, in coastal areas” and “(...) damage from flooding.”. Biodiversity loss is one of the real risks due to changes in climate, being now a reality much due to the direct action of man, either by over-hunting, by deforestation or by introduction of exotic species that naturalize and become invasive, thus unbalancing ecosystems and limiting the growth of other species. The imbalance in nature caused by anthropogenic sources should be considered with due importance, as these are situations that man has the ability to control.

Raising animals for consumption has a significant effect in relation to GreenHouse Gas (GHG) emissions. According to the 2006 FAO report on the overall heating the livestock sector is responsible for 18% of greenhouse gas emissions globally, so the responsibility of this sector in terms of climate change is greater than the use of automobiles. This raises several questions about the direction of the power of human beings to the adverse effects of the action of man over nature.

3. AGRICULTURE

There are thousands of species used daily in food production across the globe and the development of transport allowed the import from all over the world. In Portugal is possible

to find with some ease the mango imported from Brazil, rice from India or orange from Morocco. Besides fresh foods, freezing allows the import of virtually all products.

Food globalization has brought an increased pressure to agriculture in several countries. Products have to be highly competitive for selling, even in their country. It is common to find imported fruit in supermarkets significantly cheaper than domestic. These differences relate, of course, to the cost of hand labor and also to the quality of the product itself. Speaking in particular of fruit, the import to be economically viable must be done by cheaper transportation, such as truck or boat. The transit time for such carriage prevents the harvest in the correct maturity, and consumers are then less likely to buy nutritionally complete foods than if the harvest and sale had been made correctly.

The intensive cultivation of plants comes with the need to introduce in the market products which satisfy several criteria, at appearance level, palatability and price. The major food distributors establish the criteria and the producers have to meet them if they want to have their products purchased. It is very rare to find up vegetables with large variations in size or color, because the market demands uniformity. All this consumer pressure, even if subtly ingrained in consumers, leads to the creation of farming methods more efficient economically, but poor at social, environmental and nutrition levels.

Large agricultural areas are designed to be monocultures. This allows the use of specific machinery towards the soil type, planting, fertilization and harvest. The human hand is becoming dispensable and the gets cheaper. Over time this depletes the soil, even with the turnover of cultivated species, requiring stronger composting so that profitability is maintained. Pests are fought with the use of increasingly effective pesticides for its control, but compromising the environment by both air and groundwater pollution.

4. LIVESTOCK

Industrialized countries change their consumption habits. Plant products were seen as “side dishes” rather than being the staple food. Meats essentially derived from birds, mammals and fish became the center of the meal. This led to a resounding increase in animal production needs, with serious damage to the environment, animals and humans.

Raising animals for food is done at this time in large farms with enclosed space where they breed, feed and grow. The conditions throughout the life of these living beings are deplorable, and even very difficult to maintain their health in the indicated level, having to resort to additives in their food, including antibiotics (Singer, 2000).

Livestock now has a great weight in consumption of environmental resources. A large share of the cereals grown worldwide are used for the production of animal feed, and the energy and economic exploitation in much smaller process than the batch were used for human consumption. The impacts of this industry is giant in terms of climate change, with all the complications arising therefrom.

The use of drinking water is also worrying. According to the UNESCO report (2010), consumption of water for the production of a gram of animal protein is on average 1.5 times required to produce a gram of legume protein. Beef is one that requires greater amount of drinking water, followed by swine and poultry. For meat eaters can enjoy 1kg of beef steak, for example, you need to spend on average 15,000 liters of water, unthinkable these days but a current reality. Compared to produce 1kg wheat or barley are needed 1300L of water, ten times less.

5. GENETICALLY MODIFIED ORGANISMS (GMO)

Science looks for its various means to address the many social demands as they arise. The food, essential basis for the survival of any living being, is no exception. There are several challenges, from the most noble, such as the eradication of hunger, to the more mercantilist, such as increasing the flavor of a particular agricultural product. These issues led to the appearance of transgenic foods produced using biotechnology that introduces interesting properties from an economic and production point of view. However this genetic manipulation is also attracting the attention of environmentalists, bringing several questions to the public on the effects in the medium and long term for the environment and human health.

GMOs have in Europe its main opponents, as consumers do not trust the security of such products. The 2005 Eurobarometer indicates that Europeans consider that the consumption of genetically modified food should not be encouraged because they are immoral and constitute a risk to society. On the contrary, in the United States, consumers are more accustomed to this type of product, not creating such resistance to them.

It is observed in the behavior of European consumers and American a difference in the perception of risk surrounding these products much by differences in legislation. European labeling rules require that GMOs present in the products are properly identified in the package, except in some cases (Moura, n.d.). In the United States the reality is different, with the majority of acreage devoted to GMO (60% against 0.5% in Europe (Moura, 2005)) and is not subject to identification products with GMOs, although there are some movements that seek to the contrary certification, absence of GMOs, like the label "The Project Verified Non-GMO" (Smith, 2012). Acceptance in the US is higher because the market penetration of these products is superior and the consumers relations to certain brands is already longstanding.

6. PROCESSING AND CONSERVATION OF FOOD

Taking into account the current lifestyle, food processing has become inevitable even desirable in many cases. The conservation before the onset of cold was essentially done through the use of salt, which removed the water reducing microbiological activity and extending the lifetime of the product. With the advent of refrigerators and freezers, it became the temperature to do the job of reducing the action of microorganisms and improving food preservation. However these tools are very energy-intensive (Zal, et al., 2014) and for its production are used metals, plastics and even chemicals. In addition to these environmental issues, they are costly devices in the purchase but also in use and are not always available in all locations.

To overcome the difficulties of preserving food before the onset of refrigerators and in some situations where these are not available, the industry has adapted to creating highly effective packaging to maintain consumable food that otherwise would perish rapidly, as is the case of cans. The food is processed, sterilized and kept from contact with air, preventing the reemergence of microorganisms in the product and its deterioration. However, this process is energy-consuming, both for the production of packages and for the production of heat needed for processing and pasteurization.

All food processing causes the chemical change thereof. Eg "canning is often viewed negatively by causing destruction of compounds sensitive to heat, such as ascorbic acid" (Zal, et al., 2014). However freezing, although in the short term preserve more nutrients, is very energy intensive and lead to losses over time. According to Zal et al. (2014), after six months of storage, the loss of ascorbic acid in frozen are similar to canned in the case of

green vegetables, and given that the frozen need to be cooked, the amount may well become smaller than in the case of canned.

Despite the use of refrigeration equipment be costly, has advantages over the use of canned. The devices are quite widespread, it is possible to preserve food through both refrigeration and freezing. The food retail industry has adapted to this reality by offering an endless variety of products in supermarkets. One can find some processed foods such as beans or mushrooms, and other more elaborate as ready meals. The little processed foods, chilled, are increasingly among the preferences of European consumers by its proximity to the fresh.

The raw material used in these cases is mainly high quality, especially at the microbiological level, to ensure food safety and proper preservation of the nutritional and organoleptic characteristics (Zal et al., 2014). This causes the consumer a sense of security associated with a lower risk while it has the advantage of being nutritionally balanced.

The major disadvantages of chilled or canned foods are, the production of waste that does not happen on the same scale in case of purchase of fresh ingredients that are then cooked and eventually stored in plastic boxes / bags or glass. Moreover the transportation needs, as they are produced in a factory. They need to be delivered to distribution points in the food retail industry, going after to stores for purchase by consumers. All this requires large amounts of energy and produces high levels of pollution, including emissions of greenhouse gas effect. Also the energy consumption, for all kinds of processing requires energy exchange, is cooking as in refrigeration. For energy production are needed natural resources that lead to the generation of pollution and emission of GHG, such as the burning of fossil fuels.

The Mediterranean Diet advocates indirectly the use of cooling as it seeks to encourage almost exclusively fresh produce. However to make their use feasible and even to reduce food waste, a cooling system is indispensable. However the use of canned goods and other, further away from the original state of the food product should be avoided, so this diet, as we shall see below, looking for sustainability at various levels and with the least possible impact on environment.

7. TRANSPORTATION

In terms of food consumption, the various activities associated with the same impact on the environment, more or less noticeable by the consumer (Moura, n.d.): Energy consumption in the “purchase, storage, preparation / cooking and cleaning”; transportation, distribution channel and the displacement by the consumer; waste production as organic matter and as packaging.

Worldwide transport is an important environmental issue and Portugal is no exception. Transport has a significant impact mainly on the climate and air quality. According to the Portuguese Environment Agency (2013) has been given a reduction in the use of public transport at the expense of light passenger use, already having a weight of 85% in people's choices, higher than the European average. However the use of biofuels in Portugal was higher than the European average (APA, 2013), which shows some concern for the environment.

8. MEDITERRANEAN DIET – A SUSTAINABLE CHOICE

The Mediterranean diet is considered one of the healthiest in the world because it gives primacy to plant foods, based on grains, vegetables, fruits, legumes and oilseeds. The consumption of animal products is restricted to two to three doses per week, except the meat, especially red, which is only occasionally consumed. It is also considered as a sustainable

food regime in its essence, by promoting local economic, social and environmentally friendly development. The Mediterranean diet also encourages healthy eating habits and lifestyles.

Portugal competed in 2013, along with other countries, for the inscription of the Mediterranean diet on the list of the Intangible Heritage of Humanity by UNESCO. This movement is more than the apology of a diet, it is movement that promotes a lifestyle that seeks closer to nature. It is based on ten principles (Barros et al, 2013), Simple kitchen; High consumption of plant products; Vegetables locally produced, fresh and seasonal; Consumption of olive oil as the main fat; Moderate consumption of dairy products; Use of herbs; Higher consumption of fish and meat reduction; Moderate wine consumption; Water as main beverage; Conviviality at the table.

All of these feature points of the Mediterranean Diet can easily integrate the concepts of health and sustainability. Simple cooking is followed and the Mediterranean diet is the use of simple cooking methods such as baking, and simple ingredients, such as olive oil. Meals become more economic and able to preserve the nutritional value of the ingredients. The high intake of vegetables promotes better use of energy, reducing losses in the food chain (eg, by meat consumption.) (Moura, n.d.) in addition to the nutritional importance. The choice of local produce is essential in a sustainable and balanced diet. It reduces transportation needs, increases the nutritional value of food as they may mature naturally and leads to better support to small local farmers. Olive oil is the fat of excellence for the Portuguese people. Although nowadays are usual monocultures with olive groves, most of the oil consumed in Portugal is of national production, providing employment for Portuguese citizens and reducing transportation needs. It is usually packaged in glass bottles, with less impact on the environment than plastic. In addition to the environmental benefits, health benefits are indisputable and is a food that is part of our culinary heritage. The consumption of dairy products, in addition to being controversial from a social and scientific point of view, in fact is part of our cultural habits. Although it is very subject to a food industry marketing pressure, especially with regard to cow milk and its byproducts, its consumption should be fairly moderate. Milk production is an intensive industry, with severe damage to animals and the environment (Singer, 2000). The use of herbs greatly reduces the need for salt and also the use of spices imported from elsewhere in the world. Our country is rich in such plants and has always used them in food preparation or for direct consumption. Portugal is one country that possesses a large maritime area. It makes sense that the fish is the main animal protein to consume during meals. This is not what is observed today, however is nutritionally better balanced and has better properties for healthy meals. The fish consumption is also more sustainable especially if we consider the non-intensive / destructive fishing, such as the trawler. Artisanal fishing is still the livelihood of many families and even entire communities. With Portugal (and most Mediterranean countries) large wine production extensions, it is normal that the Mediterranean diet assume consumption of this drink. However scientists advocate moderate consumption and never isolated. Water is the main drink in any diet, particularly since it is essential to life. All foods are rich in water and even soft drinks are made primarily of water. Characteristic of temperate countries, socializing is essential. Cook without haste and take the meal quietly, exchanging a chat with family and friends, it is something that helps a fuller and happier life.

Sustainability advocated by the Mediterranean Diet is based on the very use of local agricultural products. These products are generally found in traditional, municipal markets, where producers promote a direct sale to the consumer. Small farmers are often owners of organic production, even without such certification or official name. They produce as a source of income, with the family consuming the surplus of production, so they usually have special attention to the chemicals they use and the quality of products. This ensures, informally, greater attention to the environment and health of people and animals. To be

fresh, not packaged, reduce significantly the production of waste. The perception of risk associated with these products is also different compared to fresh supermarket products (less chemical and absence of GMOs), which usually leads to a better use of all food.

The local shops, usual in municipal markets, avoids a series of intermediaries, improving the financial return of the producer, reducing prices to the consumer, but also reducing energy losses caused by the distribution circuit - producer-wholesaler-distributor-retailer -consumer. These markets are usually located in central areas of cities, which allows consumers living in the neighborhood, do not have to make large journeys to buy the products they need. However, according to Moura (n.d.), if we approach the issue of “shopping month” that include various types of products, from groceries to detergents and cleaning products, is in supermarkets and hypermarkets that 79.8% are purchased. Thus, by this point of view, the supermarkets although not the best option for the purchase of agricultural products “sustainable” can be advantageous for reducing the energy and time requirements for several trips and is also more convenient for providing adequate infrastructure.

What can be seen today is a wide divergence in the daily diet of most people due to the evolution of society and eating habits. After all, there is increasing interest in sustainable behavior, especially by a more balanced and natural food that is environmentally friendly and health. However, as mentioned Moura (n.d.), concern for the environment does not always translate into more sustainable food choices. Although economic issues are often the reason for not adopting more sustainable behaviors, for the most part is an “excuse” that masks the related convenience both to the place of purchase (supermarkets and hypermarkets to gain the preferences to have a little all), as with the connection to a particular product or brand, suspicious of other less common in their purchasing choices.

9. CONCLUSION

Food production and consumption has had several changes over time, driven by the evolution of the human being. Lately there was a gradual withdrawal of people from rural areas. Many children, teenagers and even adults, especially in the large population centers, away from the field, keep unaware of the origin of the food they consume, or how they are produced. For this current picture to be changed, better education on these issues is needed, so that all consumers can make informed and conscious choices. The awareness that is appearing gradually has resulted in changes in eating patterns and the type of preferred choice products. The Mediterranean Diet encourages a more balanced and healthy eating style, with great positive impact on the environment. Redirection of vegetables and cereals for human consumption associated with lower intake of animal products has a major impact in terms of natural resources. This diet, more natural and simple, was characteristic of the Mediterranean region, shared in essence by people bordering the Mediterranean Sea. With the globalization phenomena was up losing, gradually, now being revived due to the new awakening to health and ecological problems.

The Mediterranean diet is familiar in Europe and easily accepted by people. With simple changes can be the option for a sustainable behavior, able to improve the lives of each of us and the environment significantly.

REFERENCES

Almeida, M. and Afonso, C. (1997). *Princípios Básicos de Alimentação e Nutrição*. Universidade Aberta. Lisboa.

- Agência Portuguesa do Ambiente (APA). (2013). *Relatório do Estado do Ambiente 2013*. Accessed in 30th of november 2016 in: https://www.apambiente.pt/_zdata/DESTAQUES/2014/REA_2013_Final_30dezembro.pdf
- Barros, V., Carrageta, M., Graça, P. Queiroz, J. and Sarmento, M. (2013). *Dieta Mediterrânica – Um património civilizacional partilhado. Turismo de Portugal*. Accessed in 30th of november 2016 in: http://www.turismodeportugal.pt/Portugu%C3%AAs/turismodeportugal/publicacoes/Documents/Dieta%20Mediterranea_por.pdf
- Beaud, M., Beaud, C. and Bouguerra, M. (1995) *Estado do Ambiente no Mundo*. Instituto Piaget. Lisboa.
- CE (2005). *The attitudes of European citizens towards environment*. Special Eurobarometer.
- CE. (2000). *Eurobarometer*. 52.1.
- CE. (2005). *Eurobarometer*. 64.3.
- Comission of the European Communities - CEC (2007). “*Comunicação: Limiting Global Climate Change to 2 degrees Celsius: The Way Ahead for 2020 and Beyond.*”. Accessed in 30th of november 2016 in: <http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:52007DC0002>
- Cloutier, M. and Adamson, E. (2006). *The Mediterranean Diet*, HarperCollins Publishers: New York
- EUROCID. (2010). *O envelhecimento da população na Europa*. Accessed in 30th of november 2016 in: http://www.eurocid.pt/pls/wsd/wsdwcot0.detalhe?p_cot_id=3931.
- Fukuoka, M. (2001). *A Revolução de uma Palha. Introdução à Agricultura Biológica*. Via Óptima. Porto.
- Korkala, E., Hugg, T. and Jaakkola, J. (2014). *Awareness of Climate Change and the Dietary Choices of Young Adults in Finland: A Population-Based Cross-Sectional Study*. PLoS ONE. 9(5): e9748.
- Lopes, R. (2003). *Portugal Natural – da alimentação às terapias*. Lisboa.
- Moura, A.P. (2005). *Alimentos transgénicos: o porquê das atitudes do consumidor europeu*. Distribuição Hoje. Abril. pp. 28-30.
- Moura, A.P. (n.d.). *Consumo alimentar, Slides and lecture notes*. Universidade Aberta. Lisboa.
- Singer, P. (2000). *Libertação Animal*. Via Óptima. Porto.
- Smith, M. D. (2012). GMO reality check. *Better Nutrition*. 74(8): 36-39.
- UNESCO. (2010). The Green, Blue and Grey Water Footprint of Farm Animal and Animal Products. *Value of Water Research Report Series*. 48.
- Varatojo, F. (2010). *Mente Sã Corpo São*. Esfera dos Livros. Lisboa.
- Willett, W. (2005). *Eat, Drink, and Be Healthy: The Harvard Medical School Guide to Healthy Eating*. Simon&Schuster. New York.
- WCED (1987). *Our common future: report of the World Commission on Environment and Development*. Oxford University Press. Oxford.
- Zał, A., Bügel, S., Paoletti, F., Kahl, J., Bonanno, A., Dostalova, A. and Rahman, G. (2014). The influence of organic production on food quality – research findings, gaps and future challenges. *Journal of the Science of Food and Agriculture*. 94: 2600–2604.

CITRUS AS A COMPONENT OF THE MEDITERRANEAN DIET

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ABSTRACT

Citrus are native to southeastern Asia, but are present in the Mediterranean basin for centuries. This group of species has reached great importance in some of the Mediterranean countries and, in the case of orange, mandarin and lemon trees, they found here soil and climatic conditions which allows them to achieve a high level of fruit quality, even better than in the regions where they came from. Citrus fruits are present in the diet of the peoples living on the Mediterranean basin, at least since the time of the Roman Empire. In the 20th century they became the main crop in various agricultural areas of the Mediterranean, playing an important role in the landscape, in the diet of the overall population, and also in international trade. They are present in the gardens of palaces and monasteries, but also in the courtyards and orchards of the poorest families. Their fruits are not only a refreshing dessert, but also a condiment, or even a major component of many dishes. Citrus fruits have well-documented nutritional and health benefits. They can actually help prevent and cure some diseases and, above all, they are essential in a balanced and tasty diet.

Keywords: Orange, Mandarin, Clementine, Ascorbic Acid.

JEL Classification: Q10.

1. INTRODUCTION

Citrus are native to subtropical and tropical regions of Asia and the Malay Archipelago (Vavilov, 1926), but are present in the Mediterranean basin for centuries. This group of species has reached great importance in some of the Mediterranean countries and, in the case of orange, mandarin and lemon trees, they found in these regions, soil and climatic conditions which allows them to produce superior fruit quality. The hot summers and the mild winters, but with some alternation of low and high temperatures, make the fruits have a more attractive flavor and color than the fruits produced in the areas with warmer climates, where the citrus species had their origin.

Citrus fruits are present in the diet of the peoples living on the Mediterranean region for many centuries. The Roman agronomists already made many references to the cultivation of citrus fruits within the limits of their empire. Citrus fruits are not only consumed as a refreshing dessert, they are also used as a condiment, or even as a major component of many

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dishes, like roasted duck with orange or pork tenderloin with blood oranges. Citrus fruits have well-documented nutritional and health benefits, mainly attributed to high levels of bioactive compounds (Duarte *et al.*, 2016), such as phenols, including flavonoids, limonoids, essential oils and vitamins, particularly the vitamin C (Miguel *et al.*, 2009; Duarte *et al.*, 2010), and carotenoids. They can actually help to prevent some diseases and, above all, they are essential in a balanced and tasty diet.

Although citrus fruits were apparently unknown in the Mediterranean basin in ancient times, in Greek mythology it is possible to find multiple references to the mythical “golden apples”, which may well have been based upon oranges or citrons. With the introduction of good sweet orange cultivars, citrus started to play an important role in the landscape. In the 20th century, innovation in water pumping and irrigation methods, along with other factors, caused the citrus became the main crop in various agricultural areas of the Mediterranean, playing an important role in the landscape, and also in international trade. Citrus trees are present in the streets of many cities, in the gardens of palaces and monasteries (Figure 1), but also in the courtyards and orchards.

Figure 1 - Court of Oranges in the Great Mosque of Cordoba (Spain)



In this article, based on a literature review we intend to describe the importance of the citrus as a component of the Mediterranean diet. The origin of the species and its sprawling around the Mediterranean basin landscapes, along with its importance for healthy diets, are the main topics explored.

2. THE ORIGIN OF CITRUS AND ITS INTRODUCTION IN MEDITERRANEAN AREA

2.1 Citrus taxonomy

Edible citrus fruits exhibit huge diversity of shapes, colors and flavors and its classification is extremely difficult (Figure 2).

Oranges, mandarins, lemons, limes, grapefruits, pummelos, citrons and other citrus are classified in the botanical genus *Citrus* and can be distributed over more than one hundred species (Tanaka, 1954, 1961) or just on sixteen species of citrus (Swingle, 1943, 1967). Recently it was proposed a new classification of citrus, in which the genera *Poncirus*, *Fortunella* and *Eremocitrus* are included in the genus *Citrus* (Mabberley, 2008). This difficulty

in classifying the citrus fruit is due to the facility with which almost all of them may cross each other, giving rise to new interspecific or intergeneric hybrids and is also associated with the frequent occurrence of mutations which give rise to plants with minor or major changes in relation to the mother plant. In fact, there are three true species of edible citrus, which gave rise to numerous hybrids and mutants that are grown throughout the world. These true species are the citron (*Citrus medica*), the mandarin (*Citrus reticulata*) and the pummelo (*Citrus maxima*) (Mabberley, 1997; Scora, 1975, 1988).

Figure 2 - Diversity of citrus fruits produced in the Mediterranean basin. In the photograph we can see grapefruit (pigmented and non-pigmented), lemons, limes, blood oranges and mandarins



The orange, mandarin and lemon trees grown in the Mediterranean countries are hybrids among these ancient citrus species. Actually, mandarin is the name of a citrus group whose fruits are smaller, easier to peel and of flattened shape, when compared with oranges. The trees are usually smaller, and leaves are smaller and narrower than the orange ones. They can be grouped into a single (*C. reticulata*) species (Mabberley, 1997, 2008), or divided into multiple species (Tanaka, 1954). For this author the mandarins are divided in many species, some of them, cultivated in the Mediterranean (*C. clementina*, *C. unshiu*, *C. deliciosa*, etc.). Many of mandarin varieties are hybrids between some of these species and in some cases, are hybrids of mandarin with orange or grapefruit.

2.2 Origin of the most important citrus species

Native to southeastern Asia, citrus fruits are present in the Mediterranean basin for centuries. As far as we know, the first to arrive was the citron, then the sour orange and the lemon tree, followed by sweet orange, and finally, the mandarin.

Citron

The citron is native to India and has been cultivated in Asia since ancient times. The Greeks must have known it on the occasion of the invasions of Alexander the Great, and because they had found it in the Persia (Media), they knew it as “Median fruit” according to Theophrastus in *Historia Plantarum*. And it was the Greek name that caused Linus to give this species the name *Citrus medica*. Citron was the first citrus fruit to be introduced into the Mediterranean basin. A variety of citron is used by Jewish people in the feast of tabernacles (Figure 3).

Figure 3 - 'Etrog' citron (*Citrus medica* L.) used by Jewish people in the feast of tabernacles



Due to some similarity of the fruit and difficulties of translation between ancient and modern languages, sometimes what is known as lemon (*Citrus limon*) and what we know as citron (*Citrus medica*) is sometimes confused.

The lemon possibly came to the Mediterranean only under arabic influence at the 8th century but the citron was certainly present in antiquity (Pagnoux *et al.* 2013). At least the citron was known to the Greeks and Romans, which ate and attributed to the fruits and leaves pharmacological properties (Wilkins & Hill, 2015). Its presence is attested, for example, on the prices edict of Diocletian on 301 A.D. In this *Edictum De Pretiis* the citron is referred as “Citrium maximum” and costs 24 Denarii per each of the largest size, while 24 figs were 4 Denarii (Edict. Diocl. 6, 75). It was therefore an expensive product and not accessible to everyone. The discovery of some seeds of a citrus fruit of the *Citrus medica* in Pompeii in contexts of the 1st and 2nd century BC seems an evidence for the importing of this products from a long distance (Pagnoux *et al.*, 2013). The other members of citrus, such as lemon, or orange (bitter orange) were not known in the Mediterranean until the Post-Classical period (Wilkins and Hill, 2006).

Citron was grown for fruit production during several centuries and later as rootstock for other citrus fruits. In Portugal, this use of the citron as rootstock lasted at least until the end of the 18th century (Garrido, 1789).

Mandarins

The mandarin (*Citrus reticulata*) probably originated in the Southeast China or Indochina, and was cultivated in that area for many centuries (Verheij and Coronel, 1992).

Although known in the East from ancient times, it only arrived in Europe in 1805, on an import from China to England. In this country it was cultivated as ornamental, in greenhouses (orangeries). From England mandarin was taken to Malta and then to Sicily and to continental Italy. In Spain, mandarin was introduced in 1845 but its cultivation began in 1856, in the province of Castellón (Zaragoza, 1991).

It is not known for sure which one was the first mandarin that arrived in the Mediterranean, but probably it will have been that which was later called “Mediterranean mandarin” or “common mandarin”. The trees of the species produce those which are perhaps the tastiest

of all citrus fruits. That's why, its scientific name is *Citrus deliciosa*, which means, delicious citrus. The area of cultivation of this species has been decreasing because of the perishability of the fruits and the tendency for an alternating production with years of low production and years of excessive tree load. Even so, some varieties of this species ('Avana' group in Italy and 'Setubalense' in Portugal) still have a significant production. Besides the sweetness of the fruits, they are distinguished by the extraordinary aroma of the fruits and leaves.

One of mandarin species most cultivated in the Western Hemisphere originated in the Mediterranean. We refer to the clementine (*C. ×clementina*). This species came to exist as a result of accidental hybridization between a mandarin and a sweet orange (Barkley, 2006; Wu *et al.*, 2014). The first fruits were discovered by Brother Clément Rodier (after whom the fruit was named in 1902 in French and then in other languages) in the garden of his orphanage in Misserghin, near to Orán, Algeria. However, there are claims it is nearly identical to the Canton mandarin widely grown in the Guangxi and Guangdong provinces in China (Chapot, 1963). In any case, it was in the Mediterranean basin that the cultivation of clementines was perfected and it was here that new varieties of this group appeared. The seedless clementines are one of the most commercialized fruits in Europe.

Pummelo

According to Vavilov (1926), the pummelo (*C. maxima* Burm. Merrill) originates from the Indo-Malayan Center of origin of cultivated plants, which includes Indo-China and the Malay Archipelago. This species is little cultivated in the western hemisphere, but its importance is due to the fact that it is one of the progenitors of the orange and grapefruit species (Velasco and Licciardello, 2014). It produces the largest citrus fruits (Figure 4).

Figure 4 - Pummelo in a citrus collection in Algarve



Orange

Orange is a relatively heterogeneous group of citrus, including trees which produce medium-sized fruits, round to slightly oval in shape and whose rind separates with difficulty from the pulp. All oranges are hybrids of ancient cultivated origin, possibly between pummelo (*Citrus maxima*) and mandarin (*Citrus reticulata*). In this group we include sour orange (*Citrus aurantium*) and sweet orange (*Citrus sinensis*). The origin of sweet orange is not known with certainty. It is thought to be southern China, Cochinchina, Burma and regions of India, south of the Himalayas (Reuther *et al.*, 1967).

Sweet orange was widely cultivated in China, before being known in Europe. The culture had reached a fairly high degree of perfection at those times. The earliest known reference to sweet orange is found in the book “Yu Kung” dedicated to Emperor Ta Yu (2205-2197 BC). The oldest work dedicated to the cultivation of citrus fruits is the book entitled “Kiu lu” (or “Chü lu”), written by Han Yen-chih in Wenchou, in 1178. It is a complete work in which 27 varieties (of sweet and sour orange, mandarin, citron, kumquat, trifoliate, etc) are described. Among the varieties described, there are seedless sweet oranges. In this book, cultural techniques such as pruning, grafting, applying manure, treating pests, harvesting the fruits and their different uses are described.

What is the path followed by sweet orange to reach Europe, is an issue that has not yet been clarified. According to Gallesio (1811), between the X and XV centuries there is no reference to the presence of sweet orange in Europe. It seems that the species was not cultivated in Europe until the middle of the 15th century. From the early sixteenth century there are abundant references indicating that sweet orange is not only known, but is widely cultivated in southern Europe.

Some facts point to the possibility that, it was the Portuguese who imported the sweet orange tree from China, after discovering the sea route to India and having reached the shores of southern China. Valmont de Bomare in his “Dictionnaire raisonné universel d’histoire naturelle” (1764) says that the first imported sweet orange from which all the sweet orange trees of Europe descended, was grown in the garden of the Count of São Lourenço. The import of this orange tree is attributed to João de Castro and will have been realized, according to some, in 1520, according to others, in 1548. However, the fact that sweet oranges did not surprise the Portuguese navigators who arrived in the East seems to indicate that they already knew this species or at least some edible sour orange cultivars. When Vasco da Gama arrived in Mombasa in 1498, the chroniclers registered the presence of ‘very sweet oranges, much sweeter than those from Portugal’ (Herculano 1861). But this theory is not consensual and other authors report the importation of the first orange tree as occurring later, in 1624 or 1635, by order of Francisco Mascarenhas, governor of Macao (Ferrão, 1963). It may be that sweet orange already existed in Europe and the Portuguese only brought in sweeter varieties. What is indisputable is that the Portuguese played an important role in the expansion of orange culture in Europe, where in many countries the word orange is very similar to the word Portugal, as in the American continent, since it was the Portuguese who introduced the orange and other citrus fruits in Brazil (Ferrão, 1992).

The orange tree was introduced in the Algarve (south of Portugal) around the year 1635. In the middle of the 18th century, the Algarve already had an important orange production, even making some exports of this and other citrus fruits (sour orange and lemon) (Magalhães, 1988).

Lemon

The origin of the lemon tree is not well determined. It is thought to be South-East Asia, South China or Burma. No Chinese reference to this plant is known until the 12th century of our era. Only in 1175 did Fan Ch’eng-ta describe the fruit with the name “li-mung.” It seems strange, due to the proximity of the center of origin, that the Chinese did not know this tree. In the book about the orange Kiu lu, there is no mention of lemon. More recent data point to the possibility that lemon was already known in China 500 years before Christ (Mansfield, 2006). In India, it has been known in recent times and no wild lemon trees have been found. In the 10th century, the Arab geographers Istakhri and Ibn Haukal referred to an Indian fruit called “limunach”. Everything seems to indicate that lemon tree originated later than citron and sour orange, by mutation or hybridization among other citrus fruits

(one of which would be citron). Some studies seem to support this hypothesis (Malik *et al.*, 1974).

The mosaics of Pompeii, the reference to lemon in the *De Re Coquinaria*, the best-known cookbook of the Romans (Apicius, 1936) and other similar references could indicate that there were already lemon trees there in the times of the Roman Empire. However, it is more likely that there were intermediate forms between the citron and the lemon, or some kind of lemon different from the one we know today in Europe. The confusion is compounded by the fact that lemon has often been mistaken for citron and also because the term “lemon” groups other forms of citrus fruit (limes, and others) although some are quite distinct from our lemon.

In any case, it seems that it was the Arabs who spread the lemon tree along the shores of the Mediterranean along with the sour orange tree, or possibly a little later. It is assumed that the lemon tree arrived in Spain about the year 1150. Abu-Zaccaria’s book seems to indicate that lemon, sour orange and citron were already known and grown in the area of Seville.

Also the crusaders could have brought lemon trees to Europe. Jacques de Vitry, bishop of St. John of Acre (Palestine) in the 13th century, in his “History of Jerusalem” describes the abundant presence of cider, sour orange and lemon trees in Syria and Palestine. According to him, these fruits were not very common in Europe.

3. CITRUS IN THE MEDITERRANEAN LANDSCAPES

Mediterranean region have a great ecological diversity, as well as a great cultural diversity due to its long human history. Both, together, gave their contributions for the great richness of Mediterranean landscapes, but it is generally agreed that the Mediterranean region natural resources and landscapes had suffered one of the strongest pressures or depletions due to man’s misuse (Naveh & Dan, 1973).

Citrus trees could be very appealing landscape elements, from the observer perspective, due to their compact canopies with bright evergreen green leaves. During blossom their flowers imprint a sweet scented into the air around and during fruitification, the orange colored “balls” around the contrast with the green in such a harmonious way, that even a single tree could be seen as an ornamental element of the space (Figure 5). Although citrus trees were apparently unknown in the Mediterranean basin in ancient times, in Greek mythology we find multiple references to the golden apples, particularly in the garden of the Hesperides located somewhere between the Italian Peninsula and the Iberian Peninsula.

Figure 5 - Navel orange tree growing in the Algarve (Portugal) showing its “golden apples”



These mythical golden apples may well have been based upon oranges or citrons, which the Greeks may have been aware of because of their trade with the East. The citrus fruit, a modified berry with a thick rind and multiple seeds, was called *hesperidium*”, alluding to those mythical “golden apples” of the Greek goddesses Hesperides. After the discovery of the sea route to India and China, and the introduction of good sweet orange cultivars, citrus started to play an increasing role in the diet of the overall population, in international trade, and, of course, in the landscape.

For centuries, these lemon or orange trees, of an intense green with abundant golden fruits, have become part of the landscape of the Mediterranean basin. Citrus trees have been present in the gardens of palaces and monasteries, in the streets of Mediterranean cities, and in the courtyards and orchards of the poorest families. Because citrus trees are high water (and nutrients) consumption plants, until the mid-twentieth century the citrus trees were located in the most fertile plains and also in the valleys of the mountainous areas. In rare cases, they were planted in some sloppy areas where it was possible to bring water through ingenious irrigation canal systems. And, for this reasons, until the 1950’s, citrus trees had a discrete presence in the Mediterranean rural landscapes.

The development of technologies capable of drilling the ground up to hundreds of meters deep and placing submerged pumps there, has led to an increase in the availability of water for irrigation. In addition, the transport of irrigation water by pipes, instead of canals, allowed irrigation of land where previously only drought tolerant crops could grow. This allowed also the citrus trees to climb the slopes and settle in areas they could not dream of before (Figure 6). Along with human population increase, these technological innovations have made citrus fruit the most important crop in various agricultural areas of the Mediterranean and worldwide.

Figure 6 - Citrus orchard on a hillside where formerly almond, carob, fig and olive trees were grown. The installation of this orchard was only possible with strong water pumping and drip irrigation



From an economic point of view citrus production is estimated above 130 million tons per year (FAO, 2016), meaning that rank first in terms of world fruit production and international trade value. Citrus fruits are cultivated in many countries around the world. The main citrus fruit-producing countries are Brazil, China, the United States and the Mediterranean region; representing more than two thirds of the global citrus fruit production. According to CLAM⁵ data, the Mediterranean Basin accounts for about 20% of the world citrus production (and about 60% of the world fresh citrus trade). The production is mainly composed of sweet oranges and mandarins-like fruits. Citrus is a major segment in the Mediterranean agricultural industry with citriculture representing a major source of income to a significant number of people. It is a source of employment at various levels of the chain, mainly during production because most of the fruit is harvested by hand, and play a role as a driving force to the economy of the entire Mediterranean region.

In the Mediterranean basin, Spain is the leading producing country, whereas Italy and Egypt rank second and third, respectively. According to Eurostat Statistics Explained (data from 2007), the European countries (UE 28) with the largest area under citrus tree fruits orchards are Spain, followed by Italy, Greece, Portugal, France and Cyprus. In specific geographic areas, such as in the Algarve, Andalucía, Valencia region, Corsica, Sicily, citrus are the main or one of the main fruit crops.

In the Mediterranean countries, citrus farm size varies from less than one hectare to a few hundred hectares. Farms larger than 10 ha account for 80% of the production and are usually technologically advanced (Lacirignola & D'Onghia, 2009). Due to that, on those areas of the Mediterranean region, presently citrus orchards commonly dominate the rural landscapes, imprinting on them their very homogeneous regular pattern of equally distributed similar intense green and perfectly shaped canopy trees spread all over an entire huge patch or an entire landscape. In the opinion of Aranzabal, Schmitz, Aguilera and Pineda (2008), the cultural rural landscape of the Mediterranean basin has undergone notable changes in the last few decades. They considered that rural abandonment, on one hand, and on the other, agricultural intensification, are creating a new type of rural landscape which spatial configuration is apparently less appealing than the traditional one (Figure 7).

⁵ CLAM -Comité de Liaison de L'agrumiculture Méditerranéenne

Figure 7 - Small citrus orchards surrounded by abandoned traditional dryland orchards, in Algarve (Portugal)



Spatial heterogeneity, depending upon a balanced proportion of the agricultural croplands, pasture and woodland patches, seems to make part of an appraisal rural landscape, say the authors. And we add that those features certainly not correspond to a landscape extensively dominated by citrus orchards. The very pleasant feeling associated with the presence of a citrus tree or a few ones around, and the nice ever green imprint that a small-medium size orchard patch gives to a rural landscape, in the cases of citrus dominated landscapes is dissolved into the non-ending repetition of such beautiful trees, equally apart from each other, all over the space that one's eyes could reach.

The simplification on the structure and pattern of the landscape due to extensive citrus orchards, have other consequences below the reduction of landscape diversity and perceived beauty. The reduction of habitats diversity and consequent loss of biodiversity (reduction on species richness and abundance) has been associated with monoculture in rural landscapes. In the case of citrus based landscapes in the Mediterranean, for example Cerdá, Palacios and Retana (2009) analyzed the structure and composition of ant communities in citrus orchards in Catalonia (northeast Spain) and compares them with the ant fauna found in natural communities of the region. They found that the composition of ant communities present in the citrus orchards was extremely poor, with species richness and diversity lower compared with natural communities.

The intensive use of water and fertilizer required by citrus crops have another sidewalk effect – the pollution of aquifers and eutrophication of surface water bodies. Citrus fruits needs usually more natural resources than the crops they have come to replace. Demanding irrigation and fertilization have leads to an increasing importance of intensive agriculture as a source of non-point pollution. Due to its importance in terms of land use in some parts of the Mediterranean, citrus orchards and citrus production could be considered one of the main sources of resources depletion – water use in huge amounts and water contamination with fertilizers and pesticides. The importance of water contamination by intensive agriculture is regulated by EU environmental and agricultural regulations, in order to promote the mitigation of this negative aspect.

For perhaps more than two millennia, citrus trees have been present in many gardens around the Mediterranean, for their perfume, their fruit and their evergreen architectural effect (Handsombe, 2013). Its pleasant and discrete presence at Mediterranean landscapes changed to an almost omnipresence in some landscapes of countries such as Spain or Italy, where huge parts of the territory have a single use – citrus-based orchards - and seems to

be covered by a very long mantle made by a very simple repetitive pattern – regular square pattern with one similar tree in each node.

4. USES OF CITRUS IN MEDITERRANEAN COUNTRIES

Citrus beauty and utility are essential to the life of Mediterranean populations. About orange, it is said, in several Mediterranean countries, that it is “gold in the morning, silver at noon, and kills you at night”. The origin of this proverb is not well known, but it is possible that it was invented so that at night people would not steal oranges to eat. It may still be related to a certain difficulty in digestion when eaten after a meal. Either way, the orange is a good food at any time of the day. Oranges and mandarins are mostly used as fresh fruit, for dessert or snacks between meals (Figure 8). Orange juice is often the first morning food. But the orange is very used for seasoning of several dishes, although for that purpose, the most used is the lemon. And in the end of any Mediterranean meal, an orange roll cake or a lemon infusion is always good.

Figure 8 - Peeled fresh orange and orange roll cake



Citrus fruits are also widely used for the production of essential oils and for the manufacture of liqueurs. One of the best known liqueurs is Cointreau, made from a combination of sweet and bitter orange peels, macerated in neutral alcohol and distilled three times to concentrate the flavours. This drink invented by the brothers Adolphe and Edouard-Jean Cointreau has been manufactured since 1849 in the French city of Angers. In addition to this, many are the lesser known liqueurs, manufactured in the Mediterranean countries, from orange, lemon and mandarin fruits.

Among the essential oils produced from citrus, the neroli, made from bitter orange blossoms, is widely known. The name “neroli” was attributed to this essential oil because it was the princess of Nerola, Anne Marie Orsini who began to use it at the end of the 17 century, to perfume the gloves and the bath. Today, there are many perfumes, manufactured based on neroli or other essential oils from citrus.

5. CITRUS AND HEALTH

Citrus fruits have well-documented nutritional and health benefits. Since ancient times that citrus has been used not only as food but also in folk medicine to treat some complaints: bronchitis, tuberculosis, cough, cold, menstrual disorder, hypertension, anxiety, depression and stress (Favela-Hernández *et al.*, 2016). They can actually help preventing and curing some diseases and, above all, they are essential in a balanced and tasty diet. Citrus fruits do not possess sodium, fat and cholesterol, but are sources of several minerals (potassium,

calcium, phosphorus, magnesium, copper), vitamins (C, B1, B2, B3, B5, B6, B9), dietary fiber and secondary phytochemicals (carotenoids, phenols, including flavonoids, coumarins, limonoids, alkaloids and essential oils) which alone or in combination have been referred as being able to prevent inflammation, degenerative diseases, heart disease and even cancer (Ejaz *et al.*, 2006; Lv *et al.*, 2015).

Potassium not only helps to maintain the body's water, acid balance and normal pressure, but also is important in transmitting nerve impulses to muscles as well as in the muscle contraction (Economos & Clay, 1999). Vitamin C plays a key role in the absorption of inorganic iron; which can aid in the treatment of anaemia provided that adequate medicines are also administered. This vitamin is also important in the formation of collagen. A deficiency of this vitamin is responsible for the weakness of those tissues in which collagen is an essential element (ligaments, tendons, dentin, skin, blood vessels and bones). Vitamin B₁ or thiamine is important in the metabolism of carbohydrates and branched-chain amino acids and is only obtained through food, since humans are not able to produce it. Vitamin B₂ or riboflavin is involved in the oxidation-reduction reactions of metabolic pathways as well as in the respiratory chain for producing energy. Vitamin B₃ or niacin is involved in energy metabolism and detoxification reactions for xenobiotics. Vitamin B₅ or pantothenate is particularly involved in the fatty acid metabolism, whereas vitamin B₆ is involved in the amino acids metabolism. Finally, vitamin B₉ or folate is essential for new cell production and growth (Economos & Clay, 1999; Anonymous, 2001). Nowadays, deficiencies in the complex B-vitamins is uncommon, although sub-clinical deficiency can be found, particularly in distress conditions, as for example among refugees with a poor feeding (Anonymous, 2001).

Citrus fibre is mainly constituted by pectin (60-70%) along with cellulose and hemicellulose. This sort of fibre in association with lignin may contribute to the reduction of the rate of glucose uptake after carbohydrate consumption, and diminish the reabsorption of bile acids which gives rise to lowered plasma cholesterol levels.

Whereas minerals, vitamins and fibre are essential in a balanced diet for the human survival, carotenoids (pigments), phenols and essential oils may have a role in other biological processes, preventing or curing some diseases by anti-radical and anti-inflammatory processes. These secondary metabolites may be isolated from peel, pulp, seed, pressed oil, juice or entire fruit of diverse *Citrus* species. The amounts of such compounds depend not only of the *Citrus* species but also of the different fruit parts, which may affect the biological properties since they can be related (Lv *et al.*, 2015).

The antioxidant and anti-inflammatory activities have been attributed particularly to flavonoids (hesperitin), and phenolic acids (caffeic, chlorogenic, and ferulic acids). The anti-inflammatory activity was also reported for several *Citrus* species, and the compounds involved in this property included flavonoids (naringin, naringenin, hesperidin, nobiletin, quercetin), essential oils (limonene), and coumarins (auraptene, imperatorin). Such activities were determined using several *in vitro* (both free-system cells and cell cultures) and *in vivo* methodologies (Lv *et al.*, 2015 and references therein).

In addition, essential oils of Citrus may also present anti-microbial activity. In a recent review made by Favela-Hernández *et al.* (2016), they reported the antibacterial activity of *C. sinensis* essential oils, with different concentrations, against several bacteria (*Escherichia coli*, *Pseudomonas aeruginosa*, *Staphylococcus aureus* including those that are methicillin resistant (MRSA), *Bacillus subtilis*, *Shigella*, *Listeria monocytogenes*, and *Salmonella typhimurium*).

Citrus limonoids, which are triterpenic compounds, have anticancer activity in the presence of a variety of different animal models (stomach, lung, skin cancer, human colon adenocarcinoma cells, and human breast cancer cells, among others) (Ejaz *et al.*, 2006; Lv *et al.*, 2015). However, flavonoids, coumarins and carotenoids have also demonstrated to be inhibitors of some cancer types (Lv *et al.*, 2015). In addition, citrus derived-flavonoids also

are able to decrease blood cholesterol and triglycerides, and blood glucose (Lv *et al.*, 2015). Such properties are particularly attributed to polymethoxylated flavonoids (nobiletin, tangeretin) as well as to the flavanones hesperetin, naringenin, naringin and neohesperidin (Lv *et al.*, 2015).

Other attributes have been reported for several species of *Citrus* genus such as relaxant, sedative and anxiolytic activities. Such properties are due particularly to the essential oils whereby they have been used in aromatherapy (Favela-Hernández *et al.*, 2016).

Overall, considering the presence of all those bioactive compounds in citrus fruits and juices, they should be part of a balanced diet in order to prevent some diseases and consequently promote human health. If the type and content of such compounds are dependent on diverse factors (species, varieties, plant part, stages of maturity, environmental conditions during growth, storage conditions and postharvest treatments) (Duarte *et al.*, 2016), the beneficial attributes may also change, therefore great efforts must be done in order to guarantee always a high quality final product.

6. CONCLUSIONS

Citrus fruits are a heterogeneous group of fruit trees with canopies of different types, spherical or weeping, with heights ranging from a few tens of centimeters to several meters. They are used as ornamental and for fruit production. The fruits can be of different shapes, sizes and colors. This group includes elongated lemons, spherical oranges and flattened mandarins. The fruit size ranges from small kumquats and calamondins to large grapefruits and pummelos, reaching one or more kilograms. Regarding the color, the oranges have the color that was named after their own name. But we can find citrus of other colors, from yellow lemons and green limes, to deep red blood oranges, passing through a wide range of shades of orange.

Citrus fruits, although they come from Asia, are part of the history and culture of the Mediterranean; they were adopted in the region, having become part of it. The citrus orchards interspersed with other species, decorate the Mediterranean landscape, forming multicolored mosaics of rare beauty and give it the golden touch characteristic of the most beautiful jewels. They decorate fields and cities, are in backyards and in the interior of houses.

Lemons, oranges and mandarins enter the recipes of many dishes and sweets from the Mediterranean diet, enhancing the flavor and enriching their nutritional value. They are essential for a rich and balanced diet containing many bioactive compounds with important role in preventing and even curing diseases.

Citrus fruits are thus one of the characteristic elements of the Mediterranean diet, giving it greater richness and diversity and contributing to its beneficial effects on human health.

REFERENCES

- Anonymous (2001). Thiamin, riboflavin, niacin, vitamin B6, pantothenic acid and biotin. In: *Human vitamin and mineral requirements. Report of a joint FAO/WHO expert consultation*. Bangkok, Thailand. Food and Agriculture Organization of the United Nations. World Health Organization. Food and Nutrition Division. FAO, Rome.
- Apicius (1936). "*De re coquinaria*" - *Cookery and Dining in Imperial Rome*. Trans. Joseph Dommers Vehling. Walter M. Hill Ed. Accessed in 12th of december 2016, on the web site of the University of Chicago: <http://penelope.uchicago.edu/Thayer/E/Roman/Texts/Apicius/home.html>

- Barkley, N.A., Roose, M.L., Krueger, R.R. and Federici, C.T. (2006). Assessing genetic diversity and population structure in a citrus germplasm collection utilizing simple sequence repeat markers (SSRs). *Theor Appl Genet.* 112: 1519-1531. doi:10.1007/s00122-006-0255-9.
- Cerdá, X., Palacios, R. and Retana, J. (2009). Ant community structure in citrus orchards in the Mediterranean Basin: impoverishment as a consequence of habitat homogeneity. *Environmental Entomology.* 38(2): 317-324.
- Chapot, H. (1963). La Clémentine. *Al Awamia.* 7: 1-34.
- Duarte, A., Caixeirinho, D., Miguel, M.G., *et al.* (2010). Vitamin C content of citrus from conventional versus organic farming systems. *Acta Horticulturae 2010.* 868: 389-394.
- Duarte, A., Carvalho, C. and Miguel, M.G. (2016). Bioactive compounds of citrus as health promoters. In: Silva, L. & Silva, B. (Ed.), *Natural Bioactive Compounds from Fruits and Vegetables as Health Promoters.* Bentham Science Publishers. 1: 29-97. DOI: 10.2174/97816810823941160101.
- Ecónomos C. and Clay, W.D. (1999). Nutritional and health benefits of Citrus fruits. *FNA/ANA.* 24: 11-18.
- Ejaz, S., Ejaz A, Matsuda, K. and Lim, C.W. (2006). Limonoids as cancer chemopreventive agents. *Journal of the Science of Food and Agriculture.* 86: 339-345.
- Eurostat. (2016). *Agricultural production - orchards.* Accessed in 2nd of november 2016, on the web site of: European Union: http://ec.europa.eu/eurostat/statistics-explained/index.php/Agricultural_production_-_orchards#Other_fruit_trees
- FAO (2016). *Food and agriculture data.* Accessed in 4th of november 2016, on the Web site of: Food and Agricultural Organization: <http://www.fao.org/faostat/en/#home>
- Favela-Hernández, J.M.J., González-Santiago, O., Ramírez-Cabrera, M.A., Esquível-Ferriño, P.C. and Camacho-Corona, M.R. (2016). Chemistry and pharmacology of Citrus sinensis. *Molecules.* 21: 247. DOI:10.3390/molecules21020247.
- Ferrão, J.E.M. (1979). Acerca da Introdução da Laranjeira Doce em Portugal. *Anais do Instituto Superior de Agronomia.* 38.
- Ferrão, J.E.M. (1992). *A Aventura das Plantas e os Descobrimentos Portugueses.* IICT, Lisboa.
- Gallesio, G. (1811). *Traité du Citrus.* L. Fantin libraire, Paris.
- Handscombe, D. (2013). Lemons in Mediterranean-Climate Gardens. *The Mediterranean Garden.* 74.
- Herculano, A. (1861). *Roteiro da viagem de Vasco da Gama em MCCCCXCVII.* Imprensa Nacional. Lisboa.
- Garrido, J.A. (1789). *Livro da Agricultura.* Jozé de Aquino Bulhoens. Lisbon.
- Khan, I. (2007). *Citrus Genetics, Breeding and Biotechnology.* CAB International.
- Lacirignola, C. and D'Onghia A.M. (2009). The Mediterranean citriculture: productions and perspectives. In: D'Onghia, A.M., Djelouah, K., Roistacher, C.N. (eds.). *Citrus tristeza virus and Toxoptera citricidus: a serious threat to the Mediterranean citrus industry.* Bari: CIHEAM. Options Méditerranéennes: Série B. Etudes et Recherches. 65: 13-17.
- Lembke, J. (1996). *Virgil's Georgics.* Yale University Press. USA.
- Lv, X., Zhao, S., Ning, Z., Zeng, H., Shu., Y, Tao, O., Xiao, C., Lu, C. and Liu, Y. (2015). Citrus fruits as a treasure trove of active natural metabolites that potentially provide benefits for human health. *Chemistry Central Journal.* 9: 68. DOI: 10.1186/s13065-015-0145-9.

- Mabberley, D. J. (1997). A classification for edible Citrus (Rutaceae). *Telopea*. 7(2): 167-172.
- Mabberley, D. J. (2008). *Mabberley's plant book: a portable dictionary of plants, their classification and uses*. 3rd edition. Cambridge University Press. New York.
- Magalhães, J.R. (1988). *O Algarve Económico 1600-1773*. Editorial Estampa. Lisbon.
- Malik, M.N., Scora, W.W. and Soost, R.K. (1974). Studies on the origin of the lemon. *Hilgardia*. 42: 361-382.
- Mansfield, J. (2006). *Lemon*. Northern Territory Government. Australia.
- Miguel, M.G., Duarte, A., Nunes, S., Sustelo, V., Martins, D. and Dandlen, S.A. (2009). Ascorbic acid and flavanone glycosides in citrus: Relationship with antioxidant activity. *Journal Food Agric Environ*. 7(2): 222-227.
- Naveh, Z. and Dan, J. (1973). The human degradation of Mediterranean landscapes in Israel. In: *Mediterranean type ecosystems*. pp. 373-390. Springer Berlin Heidelberg.
- Pagnoux, C., Celant, A., Coubray, S., Fiorentino, G. and Zech-Matterne, V. (2013). The introduction of Citrus in Italy with reference to the identification problem of seed remains. *Veget Hist Archaeobot*. 12: 421-438 .
- Reuther, W., Webber, H.J. and Batchelor, L.D. (1967). *The Citrus Industry 1. History, distribution, botany, and varieties*. University of California, Berkeley.
- Scora, R.W. (1975). On the history and origin of citrus. *Bulletin of the Torrey Botanical Club*. 102(6): 369-375.
- Scora, R.W. (1988). Biochemistry, taxonomy and evolution of modern cultivated citrus. *Proceedings of the International Society of Citriculture*. 1: 277-289.
- Swingle, W.T. (1943). The botany of citrus and its wild relatives of the orange subfamily. In: Webber, H.J. and Batchelor, L.D. (eds). *The Citrus Industry*. University of California Press. California. pp. 129-474.
- Swingle, W.T. (1967). The botany of citrus and its wild relatives. In: Reuther, W., Batchelor, L.D. and Webber, H.J. (eds). *The Citrus Industry*. University of California Press. California. pp. 190-430.
- Tanaka, T. (1954)- Species problem in Citrus (Revisio aurantiacearum, IX). *Japan Society Prom. Sci. Veno*. Tokyo.
- Tanaka, T. (1961). Contribution to the knowledge of Citrus classification. *Reports Citrologia*. 107-114.
- Vavilov, N. I. (1926). Центры происхождения культурных растений (*Tsentry proiskhozhdeniya kulturnykh rastenii*). Leningrad. USSR. (In Russian).
- Velasco, R. and Licciardello, C. (2014). A genealogy of the citrus family. *Nature Biotechnology*. 32: 640-642.
- Verheij, E.W.M. and Coronel R.E. (1992). Plant Resources of South-East Asia 2. *Edible fruits and nuts*. PROSEA. Bogor.
- Wilkins, J.M. and Hill, S. (2006). *Food in the Ancient World*. Blackwell Publishing.
- Wu *et al.* (2014). Sequencing of diverse mandarin, pummelo and orange genomes reveals complex history of admixture during citrus domestication. *Nature Biotechnology*. 32: 656-662.
- Zaragoza, S. (1991). Antecedentes históricos. In: Abad, V. (ed.). *Historia de la Naranja*. Levante/Generalitat Valenciana. Valencia, Spain.

NEW RESOURCES FOR SMART FOOD RETAIL MAPPING A GIS AND THE OPEN SOURCE PERSPECTIVE

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ABSTRACT

In this paper it is demonstrated that open-source GIS software may contribute to allow non-profit organizations and local food retailers to strategically locate food shops. This impacts realtors and other businesses as well. Areas are covered and clients served avoiding food deserts and increasing security in the health sector (Barnes *et al.*, 2016).

The methodology demonstrates how mapping may be processed, allowing people to get a good understanding of the food distribution. Also, decision making at corporate level improves due to better connecting to local production and organic retailers and to better reach out to local consumption. A major consequence of this exercise is likewise to educate users on the negative impacts of food deserts on health and improve awareness supporting the design and integration of sustainable and healthy lifestyles (Vaz and Zhao, 2016).

This novel proposal that combines spatial and locational data visualization (McIver, 2003), as well as sharing of information of healthy food retailers within the urban nexus (Morgan and Sonnino, 2010) engage communities actively to participate in the integration of new consumer behaviours and make them clearly expressed.

Keywords: GIS Open Source, Food Retail, Smart Food.

JEL Classification: R11, R32, R58.

1. INTRODUCTION

The importance of open-source geographic information systems is that it aids in the research process that applies to many disciplines, such as food security (Ruiz-Garcia, 2010). Open-source software can display a map in a variety of different forms for decision support (MacEachren *et al.*, 2004) highlighting and emphasizing different relationships between socio-economic variables, land use at urban level (Vaz and Arsanjani, 2016). In this sense, understanding the spatially-explicit interactions of different variables in regards to food security and quality at urban level is utmost importance to create securer and healthier cities (Twiss *et al.*, 2011). Concentration of the spatial relation with food retailers and the socio-economic habits, and the linkage of healthy, affordable grocery stores, good food markets, and farmer's markets should be a crucial part of the smart cities paradigm (Caragliu *et al.*, 2011). By integrating geovisualization techniques (McEachren *et al.*, 2004; Chen and Clark, 2016), the ability to define opportunities for food retailers to locate into food deserts in Toronto neighbourhoods is investigated. This is of particular importance given Toronto's significant urban growth in the last decades (Vaz and Arsanjani, 2015). Additionally, the chance for food retail businesses to profit from the rise and awareness of the food security moment is integrated. Many government agencies, not-for-profit organizations, and research

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institutions are the main stakeholders in trying to advocate and solve the problem of the large amounts of food insecure households and individuals in a food-rich nation like Canada. The research institutions and government agencies such as Toronto Public Health or Food Secure Canada have already developed resources for food retail mapping (Larsen and Gilliland, 2008). Nevertheless, it is the not-profit-organizations who run good food markets and function based on grants and donations in Toronto that particularly need to gain an interest in GIS and open-source mapping software (Brudney *et al.*, 2016). With the knowledge of open-source GIS software non-profit organizations and local food retailers can research or coordinate where to locate and expand organizations, or urban agriculture to a neighbourhood. The execution of strategically placing healthy and affordable food retailers not only involves a municipal or environmental planner, but impacts realtors and other businesses in the surrounding area by means of avoiding food deserts, which comprise a serious burden to the health sector (Barnes *et al.*, 2016).

The importance of mapping allows one to communicate and visualize data that may be difficult to understand when displayed in statistics or raw data (Fraser Taylor and Caquard, 2006). The versatility and practicality that comes from mapping enables people to distinguish the relationship between land and data as well as to acquire a clearer understanding of the topological distribution which interacts with decision making. In this sense, community mapping may support several relevant socio-economic instances such as: (i) supporting local production and organic retailers with selling points, (ii) reach out to the consumers on the importance of local consumption for sustainable development, (iii) educate users on the negative impacts of food deserts on health, (iv) create consumer aware communities supporting the design and integration of sustainable and healthy lifestyles (Vaz and Zhao, 2016). The ubiquitous nature of these tasks is achieved by means of the technocentric combination of spatial and locational data visualization (McIver, 2003), as well as sharing of information of healthy food retailers within the urban nexus (Morgan and Sonnino, 2010). The necessary integration of volunteered geographic information (VGI) within information dissemination is paramount (Gouveia and Fonseca, 2008), as communities can thus become actively engaged and participate in the integration of new consumer behaviours.

2. THE ROLE OF OPEN-SOURCE GEOGRAPHIC INFORMATION SYSTEMS

The influence of open-source Geographic Information Systems on food justice has proven its success over the past and future to enhance many aspects of a business such as the decision-making process, consulting and in marketing (Pettygrove and Ghose, 2016). Open-source software is widely applicable and can enhance performance and profit for businesses in real-estate, insurance, and banking or financial services (Perens, 1999). However, an open-source geographic information system can offer more for businesses and organizations connected to alleviating food insecurity in Canada (Chen and Che, 2001). Open-source GIS is referred to as a software that is accessible because it is free in the sense that the source code is available for anyone to modify, redistribute and view. Open-source software is very accessible, as in it can be viewed on internet browsers, or downloaded to desktops. A common misunderstanding is the competence of how the program or software; the sequence of commands, tools, and process that influence the outcome of the computer. Open-source GIS can translate the source code, resulting in the program running efficiently and fostering continuous improvement (Neteler and Mitasova, 2013). It especially benefits the public, but some open-source software may not be readily available in terms of data, but as long as the trend of open-source GIS continues to grow, so will the advocacy for spatial data to be more accessible for the public (Roberts *et al.*, 2006).

The difference between open-source GIS and closed source software such as ArcGIS is that a community approach is what allows the operation and development of open-source software to grow. Open-source software is a unique platform when compared to commercial proprietary software because the opportunity to modify the source code and create other works and research projects is possible. The advantage of choosing open-source over closed source software is that a closed source software offers a design that cannot be changed. If needs are not being met, the better option would be an open-source approach. To identify as open source software, a program needs to not have the source code and copyright information hidden (Camara & Onsrud, 2004). Also, under the licensing requirements the program cannot be copyrighted, giving the opportunity for anyone to run the software in any way they please which is unique because of the rules and regulations behind licensing and the source code (Camara & Onsrud, 2004). As previously mentioned, the open-source approach has a large community influence that is responsible for contributing to the original creators work by improvements that are made and errors being fixed. The support from a community of programmers is beneficial because it allows for people from different backgrounds to develop the software together relatively quickly. Some individuals are involved in open-source software to gain experience in technical skills, or continuing strengthening the open-source movement. The opportunity to engage and attract individuals who are from different backgrounds, and work of a variety of organizations such as food security works towards developing open-source software. With people who may not have the education in mapping or even technical skills can still bring new information and ideas to the scene of open-source.

3. COMMERCIAL VERSUS OPEN SOURCE GIS SOLUTIONS FOR FOOD RETAIL

Many present examples that Toronto Public Health uses to depict food retail environments in Toronto are produced with commercial GIS software. The usability and easy integration of commercial GIS software, despite the difference in cost, promote the preference of these solutions. Nevertheless, cost-efficiency for small and non-profit organisation is an important benchmark for preferring open source GIS, where licensing of commercial software is not always feasible and has significant budgetary constraints. In this sense, open-source GIS not only refers to the software that can visualize maps on different applications, but pertains to open-source geospatial libraries that can offer integrated solutions for data visualization as well as data analysis. The Geospatial Data Abstraction Library (GDAL/OGR) is popular since its functions includes converting and translating raster and vector data formats. Open layers for instance, is an interesting open source solution for spatial food analytics, given it simplicity of implementation and rapid result driven environment, which allow for visualization and interactive integration of spatial data components. OpenLayers corresponds to a JavaScript-based web mapping application framework that allows access to various data sources such as OGC services, commercial providers (e.g. Google, Microsoft, and Yahoo), and various data formats and protocols, making it possible to integrate a plethora of different geographical components and merging a significant number of different scales of analytics. For example, FoodShare (<http://foodshare.net/>) is a not-for-profit organization that strives to enhance healthy food through education in schools and communities In 2015, it served 6,370 lbs of produce grown in schools, supported 775 nutrition programs, and distributed 2,215,879 lbs of fresh vegetables and fruit. Additionally, Good Food Markets are examples of food retailers who can benefit from mapping through open-source software because many of the owners who run these mobile markets may not have received or even heard of Geographic Information Systems before. Furthermore, members who are new to the community and are using services such as sharing a plot garden or going to a food market; maps can be very

useful to a new migrant where English is not their mother tongue. FoodShare currently maps on good food markets within Toronto using an OpenLayers JavaScript application for instance (Figure 1).

Figure 1. Mapping of Good Food Markets



Source: <http://foodshare.net/program/markets/>

Common open-source software refers to programs such as GRASS GIS, MapWindow GIS, QGIS, and SAGA GIS. MapServer is an example of an open-source software that functions with a client (client-centric server) and server dynamic (server-centric server). Additionally, MapServer's architecture is what makes it stand out due to a three-tier approach, consisting of a hybrid structure of a balanced client-server. GRASS GIS is an innovative open-source software because until recently, public access to exposure of map visualizations and browsing was not common. Open-source is appealing and multifaceted because different types of open-source GIS can even be accessed through web browsers due to Java and HTML. This brings a significant potential for open-source software for serving to alleviate food security in metropolitan areas, particularly in the City of Toronto is a unique strategy that can be widely applied to different individuals and organizations. As the availability of smart phone devices with increased location precision grows, such initiatives are bound to bring significant innovation to identifying food security within urban areas. Together with issues reported by environmental injustice, a different scope of injustices preceding food security that is a growing concern within Toronto's urban landscape (Vaz *et al.*, 2017). The issue addresses a variety of different constituents that come from different backgrounds; ranging from income, ethnicities, gender and more. Toronto's goals primarily focus on increasing access to food, and solving the problems of health-related issues (chronic, disease, obesity), food safety and environmental pollution.

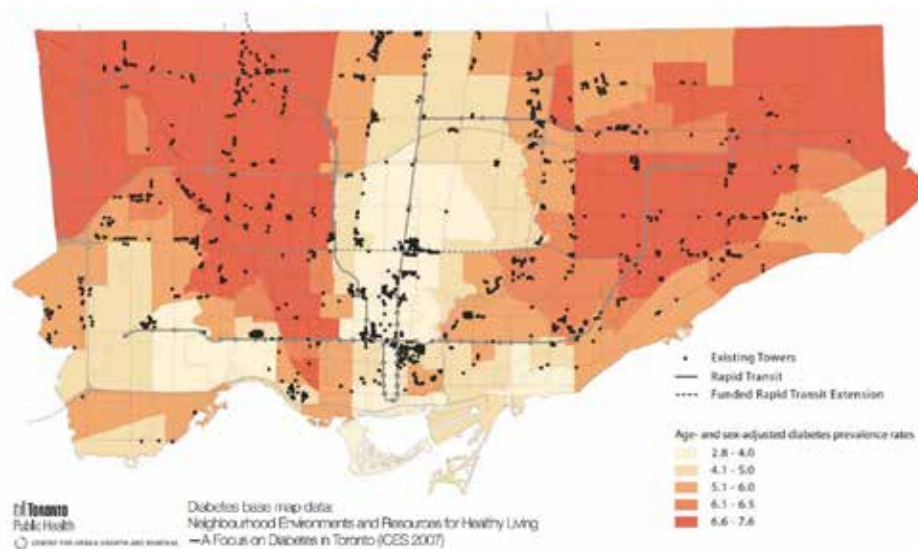
Since the principles of food security are interdisciplinary, the need for open-source software is accrued by the importance of incorporating the amount of efforts that certain organizations and food retailers are working on to solve the prevailing issue of food security (Pinstrup-Andersen, 2009). The use of open-source software aids in the research process in understanding relationships between social, economic, and environmental factors relating to geographic distribution that presents food insecure neighbourhoods, areas, and wards within the city. Open-source GIS depicts the spatial relationships related to identifying food deserts, which are referred to as areas that do not have accessible healthy or affordable food retailers, resulting in residents shopping at nearby convenience stores that offer expensive and low quality food.

Additionally, the rise of food retailers such as farmers' markets and good food markets are trending and can be found throughout the city. The occasion to integrate open-source software with the abundance of potential food retailers to visually display where the markets are located can inform the public, policy makers, and other organizations about the food options within their neighbours. Specifically, food deserts are of areas of concerns in neighbourhoods such as Flemingdon Park, South Riverdale, and throughout East York Toronto. Using open-source software to explore the correlations between food deserts, and where to find healthy food retailers in a neighbourhood are identified. But, another opportunity arises for business involved in food because once considerations are made on where the lack or abundance of healthy food retailers are located, the chance to determine where a food retailer show locate are supported.

4. TORONTO'S FOOD STRATEGY

Current food projects in Toronto are underway as Toronto is being recognized as a leader in urban agriculture and food security. Recently, Toronto along with other global cities signed the Milan Urban Food Policy Pact and plan to continue the awareness and improvement of Toronto's food security. The occasion for expanding the skills, practice and knowledge of open-source GIS is crucial for the future. The Toronto Food Strategy is a unique approach to food that understands the problems in relation to the current food system- high environmental costs, poverty in a food rich nation, obesity, accessibility and other related growing diseases. The strategy for improving the current food system considers and understands the importance of partnerships with a variety of stakeholders such as private industries, government and community agencies, and institutions. The Food Retail Environment Mapping is a unique project that is underway to analyze the research that maps provide on food deserts and other factors such as landscape, income, and neighbourhood (Toronto Public Health, 2015).

Figure 2. Post-War Apartment Towers and Areas of Incidence of Diabetes Across Toronto



Source: Toronto Public Health, 2012

Notably, what stands out once relationships have been discovered from maps about Toronto's landscape and its impact on food accessibility is that the next step is the planning process. Landscape and urban planning factors such as ravines, lakes, corridors, proximity

of major highways impact food accessibility; preventing people from available healthy, fresh food. The opportunity for food retailers to locate themselves in identified food deserts would be beneficial to alleviating food insecurity among low income households or individuals who are subjected to shopping at expensive convenience stores. This leads to concerns on the inequalities within neighbourhoods in Toronto, of interest to be monitored (Figure 2).

5. FUTURE IMPACT OF OPEN-SOURCE GIS FOR ALLEVIATING FOOD SECURITY

The City of Toronto demographics department has identified Neighbourhood Improve Area Profiles that represent many food deserts based on most low-income households, recent migrants, and community housing. Some food deserts that are also listed as neighbourhood improvement areas include South Parkdale, Black Creek, Regent Park and Victoria Park Village. To our knowledge, no organizations including government agencies have mapped out the relationship between the identified Neighbourhood Improvement Areas in relation to food insecure households and individuals. The process in improving a neighbourhood and how mapping is influential is when a food retailer has the knowledge to integrate technical skills through open-source GIS, and can then gain new knowledge about where a business such as a good food market would be most popular and attract as many consumers as possible. The mapping process may be intimidating to a local farmer, or stakeholder involved in a CSA program, which is a community supported agriculture program. It can also be frustrating when someone may want to expand their food business, but are incapable of knowing where to begin in the mapping process. Open-source software comes handy at that point; it is a great tool for starting out with GIS rather than a commercial, proprietary software that more government agencies use.

The opportunity for open-source GIS does not only apply to food retailers, but is interdependently related to urban agriculture, particularly green rooftops or community gardens. Private sector grocery stores such as Longo's, Loblaws, No-frills as well as other food retailers are a part of the food retailing business. Larger corporations such as the ones listed have the network and already significant profits to invest in companies that specialize in GIS, or agencies that primarily use commercial software where they do the mapping on behalf of the company. On the other hand, good food markets such as Parkdale's Good Food Market, not-for-profit organization such as Cultivate Toronto and local, family food markets may not have the available funds to invest in food mapping for their business.

The option and availability of open-source GIS mapping gives people an opportunity through manuals, YouTube tutorials and forums of a shared community to gain skills in digital mapping for the benefit of spreading healthy, high-quality, nutritious food.

The options are endless for food retailers to expand their market through open-source software. Offering customers and consumers healthy, local food not only improves overall health of a population, but has a positive impact on reducing environmental pollution from creating a local, sustainable food system. The occasion to visually represent and communicate where the closest food retailer is located, nearest community garden, and competition of food related businesses can be produced through maps since different organizations offer community support agriculture programs, available free plots to grow food, food banks or co-ops, and food delivery of local, organic produce. In addition, food retailers who are more versatile in their business and not only provide the service of offering local, high-quality inexpensive food, but also is an organization that promotes educational advocacy can have the strongest benefit from mapping. For instance, "Mapping can be applied in specific

situations or projects, such as understanding the needs of a client group (i.e. Consumers or local farmers), or teaching school children about food issues.

Furthermore, the annual reports that businesses and organizations publish are missing a key aspect- a mapping element. Annual reports include information on grants, messages from the CEO and board members, employment, and projects or initiatives that the particular organization has been working towards. Evergreen Brickworks, Cultivate Toronto and Greenest City are examples of organizations that submit and distribute annual reports each year who work towards creating a stronger, local food system in Toronto. Based on my findings from exploring a variety of different annual reports, many of them are formatted similarly with figures, and statistics but nothing is measured in terms of visual maps.

6. CONCLUSION

Not only is there potential for food retailers, but the options are endless for visualizing food security opportunities. For instance, mapping green roofs, CSA programs, not-for-profit organizations and more can be visually depicted. Geographical food justice is singled out throughout the report, an emphasis on not-for-profit organizations that function based on grants and donations can benefit extremely from open-source software. Also, geographical food justice is a unique movement that can contribute to the improvement of food security. By incorporating and spreading the knowledge of open-source geographical information systems to people who work for a good food market, farmers' markets, community gardens, rooftop gardens, urban agriculture (Vaz *et al.*, 2014), and advocacy groups in food security, accessibility for food can be improved. Food security also operates within a community context, similarly to open-source software. The chance to grow the open-source software field by integrating it with food security and urban agriculture needs to occur. Particularly within the incremental risk of brown fields and the amassing of urban land use change (Loures and Vaz, 2016). Many individuals in the food security field come from diverse backgrounds, the results are worth noting and the future of open-source software can ultimately develop completely different new abilities if a new and diverse group of people join in on the ubiquitous nature of collective technological enhancement through smarter cities and regional intelligence (Vaz, 2016).

REFERENCES

- Barnes, T. L., Colabianchi, N., Hibbert, J. D., Porter, D. E., Lawson, A. B. and Liese, A. D. (2016). Scale effects in food environment research: Implications from assessing socioeconomic dimensions of supermarket accessibility in an eight-county region of South Carolina. *Applied Geography*. 68: 20-27.
- Brudney, J. L., Russell, A. and Fischer, R. L. (2016). Using data to build community: exploring one model of geographically specific data use in the non-profit sector. *Community Development Journal*. DOI: 10.1093/cdj/bsw008.
- Caragliu, A., Del Bo, C. and Nijkamp, P. (2011). Smart cities in Europe. *Journal of Urban Technology*. 18(2): 65-82.
- Chen, J. and Che, J. (2001). Food insecurity in Canadian households [1998/99 data]. *Health Reports*. 12(4): 11.
- Chen, X. and Clark, J. (2016). Measuring space-time access to food retailers: a case of temporal access disparity in Franklin County, Ohio. *The Professional Geographer*. 68(2): 175-188.

- Fraser Taylor, D. R. and Caquard, S. (2006). Cybercartography: maps and mapping in the information era. *Cartographica: The International Journal for Geographic Information and Geovisualization*. 41(1): 1-6.
- Gouveia, C. and Fonseca, A. (2008). New approaches to environmental monitoring: the use of ICT to explore volunteered geographic information. *GeoJournal*. 72(3-4): 185-197.
- Larsen, K. and Gilliland, J. (2008). Mapping the evolution of 'food deserts' in a Canadian city: Supermarket accessibility in London, Ontario, 1961–2005. *International Journal of Health Geographics*. 7(1): 1.
- Loures, L. and Vaz, E. (2016). Exploring expert perception towards brownfield redevelopment benefits according to their typology. *Habitat International*. <http://dx.doi.org/10.1016/j.habitatint.2016.11.003>.
- MacEachren, A. M. *et al.* (2004) Geovisualization for knowledge construction and decision support. *IEEE Computer Graphics and Applications*. 24(1): 13-17.
- McIver Jr, W. (2003). A community informatics for the information society. *Communicating in the Information Society*. 33-64.
- Morgan, K. and Sonnino, R. (2010). The urban foodscape: world cities and the new food equation. *Cambridge Journal of Regions, Economy and Society*. 3(2): 209-224.
- Neteler, M. and Mitasova, H. (2013). *Open source GIS: a GRASS GIS approach*. Vol. 689. Springer Science & Business Media.
- Perens, B. (1999). The open source definition. In: C. DiBona, S. Ockman, & M. Stone (Eds.), *Open Sources: Voices from the Open Source Revolution*. O'Reilly & Associates. Sebastopol, CA. pp.171-188.
- Pettygrove, M. W. and Ghose, R. (2016). Community-engaged GIS for urban food justice research. *International Journal of Applied Geospatial Research (IJAGR)*. 7(1): 16-29.
- Pinstrup-Andersen, P. (2009). Food security: definition and measurement. *Food Security*. 1(1): 5-7.
- Roberts, J. A., Hann, I. H. and Slaughter, S. A. (2006). Understanding the motivations, participation, and performance of open source software developers: A longitudinal study of the Apache projects. *Management Science*. 52(7): 984-999.
- Ruiz-Garcia, L., Steinberger, G. and Rothmund, M. (2010). A model and prototype implementation for tracking and tracing agricultural batch products along the food chain. *Food Control*. 21(2): 112-121.
- Toronto Public Health and the Centre for Urban Growth and Renewal. *Toward Healthier Apartment Neighbourhoods: A Healthy Toronto by Design Report*. September 2012. City of Toronto.
- Toronto Public Health. *Toronto Food Strategy*. 2015 Update. June 2015.
- Twiss, J., Dickinson, J., Duma, S., Kleinman, T., Paulsen, H. and Rilveria, L. (2003). Community gardens: lessons learned from California healthy cities and communities. *American Journal of Public Health*. 93(9): 1435-1438.
- Vaz, E. (2016). The future of landscapes and habitats: The regional science contribution to the understanding of geographical space. *Habitat International*. 51: 70-78.
- Vaz, E. and Jokar Arsanjani, J. (2015). Crowdsourced mapping of land use in urban dense environments: An assessment of Toronto. *The Canadian Geographer/Le Géographe Canadien*. 59(2): 246-255.

- Vaz, E. and Jokar Arsanjani, J. (2015). Crowdsourced mapping of land use in urban dense environments: An assessment of Toronto. *The Canadian Geographer/Le Géographe Canadien*. 59(2): 246-255.
- Vaz, E., Anthony, A. and McHenry, M., (2017). The geography of environmental injustice. *Habitat International*. 59: 118-125.
- Vaz, E., De Noronha, T. and Nijkamp, P. (2014). Exploratory landscape metrics for agricultural sustainability. *Agroecology and Sustainable Food Systems*. 38(1): 92-108.
- Vaz, E., Zhao, Y. and Cusimano, M. (2016). Urban habitats and the injury landscape. *Habitat International*. 56: 52-62.

LOW - TECHNOLOGY INDUSTRIES AND REGIONAL INNOVATION SYSTEMS: THE SALMON INDUSTRY IN CHILE

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ABSTRACT

Results show that the worldwide competitiveness of the low-tech Salmon Industry in the Los Lagos region has not developed the principal factors permitting the consolidation of a Regional Innovation System (RIS). On the contrary we identify important gaps in terms of the regional conditions such as “networking”, “knowledge creation and diffusion”, among others, capable to stimulate the innovation behavior of salmon firms.

Keywords: Salmon Industry, Innovation, Los Lagos Region, Regional Innovation System.

JEL Classification: Q22, O31, R11, R58.

1. INTRODUCTION

Despite the important recent efforts and policies to increase Chilean productive advantages in order to capture new opportunities in a knowledge based economy (Eyzaguirre, *et al.*, 2005; Benavente & Price, 2014), most of the Gross Domestic Product (GDP) incomes are still provided by resource based industries. Specifically, salmon industry has become an important source of regional incomes and the engine of regional economic growth, contributing in 2014 to almost 30% of total regional GDP of the “Los Lagos” region and 3.5% of national GDP.

In 2015, despite of important industrial crises mainly related to environmental problems (such as Infectious Salmon Anemia (ISA)) that have diminished the production and competitiveness of salmon firms, Chile still maintain its position as the world’s second largest producer with around 30% of global output after Norway that accounted for 50% of total production.

In order to analyze if the development of a competitive low technology activity such as salmon industry has been capable to generate a Regional Innovation System (RIS), it is important to understand, from the vision of regional key actors, to what extent the evolution of the salmon industry has generated and also used structural regional conditions to foster innovation activities based on regional norms and culture that arise from an specific economic regional specialization. In that context, it is analyzed if innovation behavior of salmon industry has systematically take advantages of regional externalities, knowledge creation and diffusion, networking activities and support and interaction with regional institutions.

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2. THEORETICAL FRAMEWORK

The evolutionary approach has changed the neoclassic geography perspective to a more social, institutional and cultural economic geography approach (Boschma and Frenken, 2006). The theoretical and empirical debate about concepts of competitiveness and innovation such as “Innovation Systems” (Lundvall, 2007) and “Regional Science” allowed the apparition of the concept “Regional Innovation Systems” (RIS), that it is understood as the institutional infrastructure that support the innovation of the productive structure in a region (Asheim & Gertler, 2005). It is configured in a region, a social system where innovations occurred as the result of interactions between economic actors within an open system (Asheim & Isaksen, 2000; Isaksen, 2001; Evangelista, *et al.*, 2002; Cooke, 2003; Andersson & Karlsson, 2004; Asheim & Coenen, 2004; Bracayk, *et al.*, 2004; Doloreux & Parto, 2005).

Those regional complex systems can be fed back through a mechanism of new knowledge production, based on accumulated local knowledge and learning process (Hudson, 1999). The dimension of this system arises from the members of the regional networks that make it up: large and small firms, industry, entrepreneurs, educational institutions, R&D laboratories, members of trade and a government structure (Storper, 1995). In this context, the necessity to understand regional features taking into account the location of firms, networking, informal business systems, lower transaction costs, generation and dissemination of information as an input for innovation (Paci & Usai, 2000; Breschi & Malerba, 2005; Fischer, 2006) is stressed. The analysis and interpretations of the new economic geography and the various inputs that have expanded their state of theoretical development (Noronha Vaz & Nijkamp, 2009) have been very important to demonstrate also the importance of territorial external sources of knowledge to innovative firms (Simmie, 2002; Audretsch & Feldman, 2004; Hirose & Yamamoto, 2007; Christ, 2009).

Despite that most of the “emerging” RIS in developing countries are highly featured by important weaknesses in terms of fragmented institutional interactions and learning, the positive role played by RIS policy approach supporting the industry transition from competitiveness based on low cost activities to competitiveness based on innovations is underpinned. RIS may become a specialized hub in a global value chain occupying a specific segment in the global market (Chaminade & Vang, 2006).

3. METHODOLOGY

This research tries to answer the following question: Is it possible that the business development and innovative behavior of a competitive rural industry generates conditions to the promotion of a RIS? In order to answer the question, research has been developed considering analyses and instruments of qualitative methodology (Clark & Fast, 2008). The development of a case study (Yin, 2003) based on the “Los Lagos” region in Chile has also been considered in order to analyse the performance of the salmon industry as the main regional economic activity.

Primary information was collected from 24 key regional institutions related to salmon industry using a semi-structured interview. A flexible interview guide with open questions was used in order to not limit interviewees in order to reach the best degree of depth in their responses. In this context, an important body of informal and specialized discourse was collected, obtaining deeper information from stakeholders and high leaders of regional institutions linked to the development of salmon industry. This primary information obtained through the use of extensive interviews was studied by content analysis using ATLAS.TI software tool (Strauss y Corbin, 2002).

Figure 1. Regional Interviewed Institutions

Research Institutions ○ Instituto Tecnológico del Salmón ○ Asociación de Productores de Salmón ○ Universidad de Los Lagos ○ Universidad Austral ○ Universidad de Chile ○ Consejo Nacional de Ciencia y Tecnología ○ Servicio Nacional de Empleo y Capacitación	Support Institutions ○ Fundación Chile ○ Corporación de Fomento a la Producción ○ Instituto de Fomento Pesquero ○ Ministerio Desarrollo Social ○ Agencia de Promoción
Governance Institutions ○ Subsecretaría de Pesca ○ Servicio Nacional de Pesca ○ Ministerio del Trabajo y Previsión Social ○ Ministerio de Medio Ambiente ○ Ministerio de Economía ○ Comité Regional de uso de Borde Costero ○ Gobierno Regional de Los Lagos ○ Ministerio de Salud ○ Directemar	Regional Municipalities ○ Municipalidad de Quemchi ○ Municipalidad de Puerto Montt ○ Municipalidad de Ancud

Main discourses were analyzed through the classification and categorization of specific topics and sub-topics allowing for the finding of correlations among variables considered in the function of research objectives, common speech and key differences about certain points. The analysis of the information collected from interviews was completed with secondary information.

In order to attain a more complete characterization of the salmon industry conditions for the development of a RIS, information was categorized according to the type of institution that was attained. Thus, we arrived at 4 main groups of text: Research, Support, Governance Institutions and Municipalities. Taking this into account it was determined that a set of general codes would be defined for all interviews, but each group would also have their own specific codes to retrieve this differences for further analysis.

4. BRIEF CHARACTERISTICS OF THE SALMON INDUSTRY IN CHILE

Over the last 20 years, the salmon industry, through its dynamism and successful partnerships, has been a consistent driver of national export growth. In 2014, salmon industry exportations reached \$4 billion US generating in the same year 800,000 tons of salmon mainly exported to USA and Japan that make up around 55% of the total market, followed by Brazil and other countries. The salmon industry has provided in the last decade around 40,000 jobs approximately every year.

After many failed attempts to find the right place for its production, has been mainly developed in the Los Lagos Region of the south of Chile, based on the important natural comparative advantages. These advantages are related to ecological and environmental conditions, mainly sea- water conditions and low-cost labor in these regions. An important fishing industry in other regions of the country also provides food for salmon at low

cost. Besides this, macro-economic conditions and trade liberalization in the country has facilitated the arrival of foreign direct investment. This is compounded by a weak legislation regarding safeguards and inspections related mainly to environment protection.

The explosive growth of the Chilean salmon industry has been linked to the capacity to generate scale economies in salmon and feed production, as well as the processing and distribution phases saving costs with the progressive incorporation of new technologies (Asche, 1997 in Olson and Criddle, 2008; SERNAPESCA, 2014). In that context, studying the salmon industry in Chile, Lisuka (2006) stresses that salmon industry has been featured by important innovation initiatives and catching-up efforts to reach global high standards that have allowed it to increase their productivity and competitiveness.

The Salmon industry is featured by an increasing concentration of Chilean and international salmon firm producers by merger/acquisition processes that have reconfigured the map of regional and global actors, regional linkages and the salmon value chain. In 1992 there were 63 salmon firm producers that were reduced to 40 in 1999 (Lisuka, 2006). In the same context, based on IFOP (Instituto de Fomento Pesquero) information, Bjørndal and Aarland (1999) have also noted that the evolution of the Chilean salmon industry will continue towards a significant industry concentration of large companies. In fact, according to other results from Vera (2009), the concentration of salmon processing companies decreased in the period 1994-2008, from 100 to 49 firms. According to SOFOFA, Sociedad de Fomento Fabril de Chile (2010), only eleven large firms in 2010 made up 60% of the total salmon exportations. According to SERNAPESCA (2014), only four firms: Marine Harvest, AquaChile, Mitsubishi, Los Fiordos and Multiexport Foods made up around 50% of the total market in 2014.

In this context, despite the important trend of concentration and the vertical integration of Salmon TNCs producers, the salmon industry is still featured by the intense utilization of forward or backward linkages. According to Olson and Criddle (2008) over half of all firms of the salmon industry have market interactions toward market or supply direction in all phases of the productive process, especially small and medium firms that provide different products and services such as feed, equipment for the hatching and processing phases, pharmaceutical inputs, logistics and transport, and packaging, etc. (Maggi, 2002).

It is important to stress that salmon industry conformation, currently featured by vertically and horizontally integrated TNCs, has been an evolved process that was initially featured by the apparition of isolated and independent firms in all phases of the salmon productive process (Olson and Criddle, 2008). In this context, the salmon industry has been conformed following a bottom-up evolution lead by regional firms (Felzensztein, *et al.* 2010). It is also recognized that public and private efforts and coordination initiatives have allowed the generation of a well know Chilean brand in international markets of salmon production (Perez-Aleman, 2005).

5. RESULTS: REGIONAL CONDITIONS TO PROMOTE INNOVATION

In order to respond empirically if the salmon industry has been able to generate and developed the main factors for the emergence a RIS, the following information provide important inputs and evidence related to four specific variables; interaction behaviour of salmon industry with regional institutions, networking and associativity, innovation initiatives of salmon firms and knowledge creation and diffusion. It is important to note that the following analysis has been developed considering the differences, particularities and similarities of each of the institution groups.

5.1 Interaction among Regional Institutions and Salmon Industry

- “Firms interact with institutions based on necessity of legal or technical approval” -

Institutions of Governance, Support, Research and Municipalities declared that the relation that they personally, their department and the institution had with the firms and with the salmon industry, was in general none or indirect. Governance institutions claimed to have a narrow lane by which they communicate with the firms and the salmon industry as a whole, and that it is basically in one respect only: the delivery of control regulation information towards the industry and the receiving of approval solicitations from the firms. In some cases, it was declared that even when the firms do not meet the minimum standards for justifying their practices, it is the Governance Institution that provides the backup information or arguments for the approval of their need.

There is no active participation of the firms in the planning of control programs and regulations, nor are there proposals, but in some cases only a negotiation table, where the governance institution tries to come to an agreement on some regulations from the firms that are consistently pulling to reduce regulations on production, extraction and waste management.

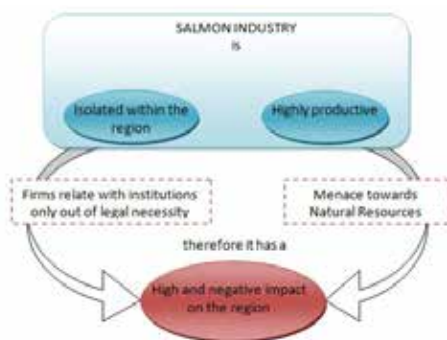
According to the statements, Research Institutions have two ways of relating to the salmon industry: by generation of knowledge and by generation of human capital, and in both cases the industry does not participate directly or actively. In turn the research institutions themselves try to establish some relation with the development of the industry by focusing on the production of useful knowledge or appropriate human capital formation.

From the Support Institutions, it was declared that the salmon industry firms do not participate frequently in the foment programs. Mostly because it is a resourceful industry that does not see the use of public funding, and also because the resources delivered from these institutions aim largely to the small and medium sized local firms of different emerging industry, such as the service providers for the salmon industry and others.

The municipalities’ view is not only critical towards the lack of involvement of the firms with the region and its institutions, but also in regards to the negative impact that the industry has socially, economically and environmentally on the region. They stated that the salmon industry firms only communicate with municipalities when they need political support from the local counsel or when they need low skill workers. In addition, they considered it to have a huge negative impact on the region, in different aspects.

Governance’s and Support’s view of the salmon industry could be represented as follows:

Figure 2. Governance view of Salmon Industry



Source: Own Elaboration

Figure 3. Governance view of Salmon Industry



Source: Own Elaboration

Across the interviews, the salmon industry was strongly associated with the words “arrogant”, “isolated” “high and negative impact”, all of these accounting for an image that can only be an obstacle for the trust and collaboration needed for a RIS conformation based on the high competitive of the salmon industry.

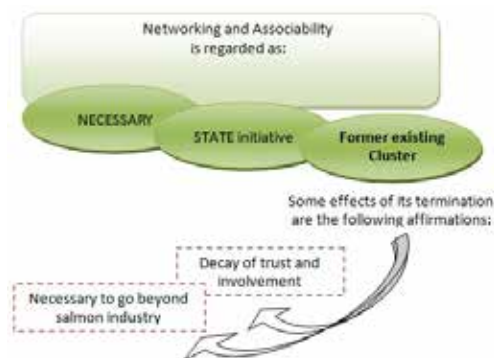
On the other hand, a conflicting view was found in some institutions. The Regional Bureau of the Ministry of Economy (SEREMI Economía), the National Fishing Service (SERNAPESCA), and the Sub-secretary of Fishing (Subsecretaría de Pesca), had a slightly more positive image of the salmon industry.

5.2 Networking, Coordination and Cooperation

It was stated from the institution’s perspective that Salmon industry performed isolated within the region. In that context, considering not only the current display for networking encouraged by the salmon industry, but also any disposition that could potentially become or contribute to the generation of networks to develop a RIS, we found both opportunities and challenges within the discourses attained from the institutions interviewed.

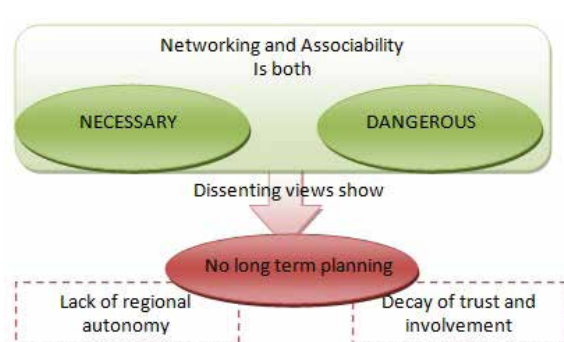
Governance and Support’s view of Networking could be synthesized as follows:

Figure 4. Governance view of Networking



Source: Own Elaboration

Figure 5. Support view of Networking



Source: Own Elaboration

- “Decay of trust and involvement”, “Lost of..”, “Lack of...” -

Firstly, it can be noted that there is a strong association between networking and the past. When asked about collaboration between firms, or any type of coordination between firms and institutions of any kind, more than often past initiatives and former institutions are brought to the table. There is also a recurring reference to the former closeness that different institutions had with local development, especially economically, that now is perceived as being lost.

As examples of networking with the industry, 3 events were brought to the table:

a) Governmental intervention previous to the origin of the industry:

It was noted that in the early 1970’s the central government promoted the opening of university programs to explore the salmon industry in the region. That was interrupted in later governments. This is regarded as a visionary effort to bring regional and national development amid a strong institutional surrounding, a manner of dealing with the local industry that is now considered to be lost.

b) Clean Production Plan:

This was a governmental program led by CORFO (Corporación de Fomento de la Producción) that managed to establish a close relation with firms around waste manage and clean production. This program is referred as one of the few well accomplished instances of

close collaboration in which many firms participated, but it is also considered as an effort that lost its continuity.

c) Former existing salmon cluster:

It was a governmental instance that is remembered as unique in the sense that it involved all of the firms and critical actors in the salmon industry. In some cases, even though it no longer exists, people name it as one of the current spaces for general coordination of institutions with the firms.

A common expression across the interviews is that “the national policy changed”, but there is no clarity towards what, just the shared sense of a loss. This actually means that public policies related to industrial development are not considered as long term policies and they have changed depending on the government administration. During the government administrations of Presidents Eduardo Frei Ruiz-Tagle, Ricardo Lagos and the first administration of Michelle Bachelet (1994 - 2010), an industrial policy was initiated that focused on the promotion of the Regional Clusters based on well-developed and potential economic sectors in a few regions of Chile, such as the fruit industry, mining and the salmon industry. However, this policy changed during the last government administration of President Sebastian Piñera (2010 - 2014) who emphasized the role of market to promote specific sectors of the economy.

In this sense, beyond the absence of a cluster policy in recent years, what could be more critical for the development of a RIS around the salmon industry in the south region of Chile might be the real dispositions of regional actors towards cooperation and organization among firms and institutions.

- “No general orientation”, “Individualistic industry” -

There are dissenting discourses regarding the importance of coordination and association in the development of the region. These conflicting views may be at the root of the sense of disorientation at regional level considering the future of the salmon industry.

In most of the interviews it was stated that firms don't display a strong intention to collaborate or to generate networks within the region, nor between the firms themselves. Accordingly, the existing coordination is assessed as insufficient and inoperative for the most part. In the Support Institutions view, the firms refuse to associate or collaborate, and only after a crisis where they required to relate more with Government Institutions, respecting the “neighbourhoods” program which, according to this perspective, was promoted by a governmental initiative.

From the Research Institutions, it is stated that salmon firms do not even work with each other; they do not plan interventions or studies together in order to prevent risks. Each one responds to the particular and current need that they themselves identify. In agreement with this, support institutions see the salmon as an individualistic industry, oblivious of the importance of guarding the industry as a whole. They also declared that for the most part cooperation initiatives are led by governmental institutions and programs rather than by the industry.

All of these features associated with the salmon industry are regarded as highly problematic for the development of the region and the industry itself; more networking and associate collaboration is viewed as necessary to increase the competitiveness of the industry (diminishing the gap between bigger and smaller firms), and to increase innovation.

On the other hand, Government Institutions that we have identified as a separated set of interviews based on its divergent content (regional bureau of the Ministry of Economy SEREMI Economía, National Fishing Service SERNAPESCA, and Sub-secretary of Fishing Subsecretaría de Pesca) continue to depict a contrasting view.

From their perspective, there is enough dialog and collaboration between the different actors in the region and there has been a significant improvement in respect to previous states of the industry. Accordingly, this evaluation of networking in the industry relates to their manifested notion that networking and associate collaboration is a “complicated matter”, not necessarily desirable, because it has the effect of diminishing competitiveness and productivity. This is the view exerted by the Ministry of Economy and thus it may be at the basis of the conflicting discourses and efforts for networking in the region.

In the theoretical framework, we considered that networking can be also viewed as an obstacle for innovation, in particular when strong path dependencies are at hand; strict rules, institutional memory or collaborative expressions could convert the region into an inflexible system, and work as an obstacle to the creativity and innovation processes and not permit commercialization of new knowledge to solve problems (Cooke, *et al.*, 2007).

In terms of the cluster policy, it can even be argued that with the evolution of the salmon cluster, governance structures have tended to generate quasi-hierarchical market relationships (Maggi, 2002), and thus its dissolution would be a necessary measure for the future development of a RIS in the region.

We thus face a conflict of perspectives where the role of networking is a critical issue. In one, networking and collaboration are pre-requisites for an integrated innovation system and, in the other, they are major obstacles for the necessary flexibility of firms.

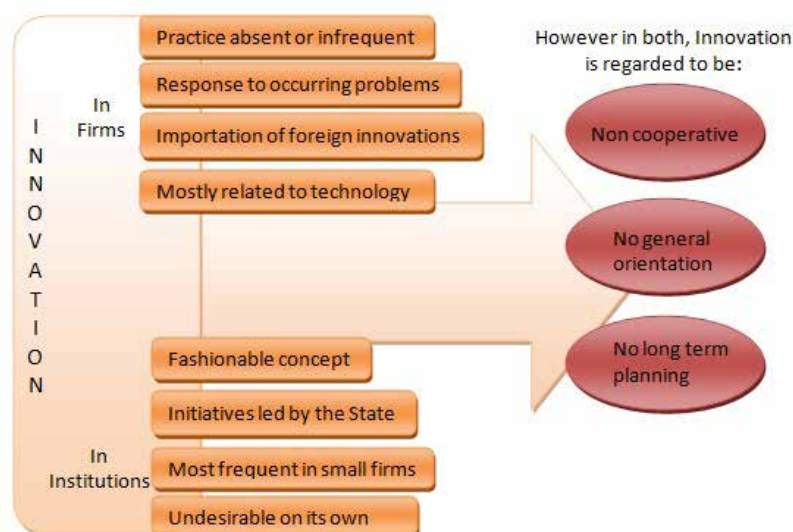
Nonetheless, the existence of a competitive salmon industry can be an opportunity to generate socioeconomic development in terms of the improvements in products, production processes, infrastructure and human resources. And in this sense the absence of a clear alternative indicates a deliberate and conscious decision to abandon such efforts.

5.3 Innovation Behaviour of Salmon Industry

- “Practice absent or infrequent”, “Related to technology”, “Salmon industry is non-innovative” - Across most of the interviews the description of innovation and the reference to innovations in particular was rather scant. Innovation as a concept is mostly associated to technology and therefore capital. From that line of thought, as the salmon industry is perceived as a highly productive industry, some sectors declared that it has a lot of innovative capacity and initiative.

The most frequent associations around innovation can be diagrammed as follows:

Figure 6. Frequent Associations around Innovation



Source: Own Elaboration

Innovation is mainly associated with access to technology and in that regard both the Regional bureau of the Ministry of Economy (SEREMI Economía) and the National Fishing Service (SERNAPESCA) have a positive vision of the salmon industry. However, the most extended view across all institutions considered is that the salmon industry is far from innovative and lacks the real intention to ever become one.

Support institutions are blunt in declaring that the Chilean salmon industry is not innovative. It does not participate in the governmental programs, and it has neither long term nor a profound vision of innovation. It just innovates by force of the market or natural crisis demands.

From universities innovation is seen as a foreign and far concept for the firms, mainly because it is thought that their prime concern is to generate incomes. In this regard the relation to knowledge is also submitted to this immediate need and thus relegated in importance. It is stated that firms are comfortable with being an extracting industry as long as it reports economic revenues in the short term.

- *"Smaller and medium size firms"* -

However, it is recognized that smaller firms which are not salmon producing but mostly provide services to the industry, tend to be more innovative because they are more flexible and also are more compelled to be.

Research institutions note that within firms, the smaller and medium sizes are regarded as the most interested on innovation, as well as the ones that have more relation with universities, backing up research and soliciting information.

- *"Undesirable on its own", "Fashionable concept" and "No general orientation"* -

In terms of the place of innovation within the interviewed institutions, we can observe that it is also a foreign and limited notion. As it is associated mostly with technology, Governance Institutions and Municipalities assign innovation to firms and the industry as their responsibility and concern, having almost no relevance for their own fields of work (such as community, health, employment, and even environment). In fact, when asked for their own institution's awareness of innovation in the region, most of them stated that they do not care for innovation.

Some Governance Institutions showed concern about the innovations of the industry in terms of checking if it has an impact on the environment, but no further involvement was declared.

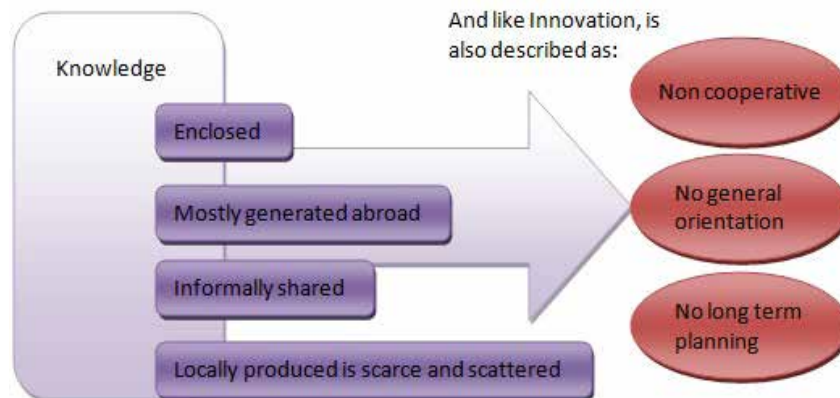
From Research and Support Institutions it was recognized that innovation in the region is very rudimentary and that it is mainly a fashionable concept. It is known to be a promoted concept from different institutions, even though public funding, but it has not had a previously determined a regional and coordinate course of action, nor is it overseen in its execution, and ultimately every firm and institution defines what constitutes innovation or not.

5.4 Knowledge Creation and Diffusion

As it was developed earlier, knowledge is a crucial factor in the formation of a RIS. Whether it is derived from practice or theoretical exploration, the exercise of reflexivity applied to local endeavours is a permanent injection of movement on the dynamics of a RIS. The openness of firms and institutions -involved in the development of a region- to receive and share knowledge is commonly regarded as a core condition for innovation dynamics.

Most associated terms for Knowledge:

Figure 7. Associated Terms for Knowledge



Source: Own Elaboration

- “Enclosed” and “Generated abroad” -

In the interviews conducted in the Los Lagos region, knowledge was not frequently associated with innovation nor with the development of the industry. In coherence with the relegated place that innovation showed, knowledge was perceived mostly as enclosed, whether in firms or in universities, and primarily attained from abroad.

From governance and support institutions it was stated that bigger firms generate their own knowledge or get it from abroad, and that it always remains enclosed; they do not share it with their peers from the local industry. This relates to what was mentioned earlier in the theoretical framework about the effect of the multinational character of the locally based firms of the industry. It's been noted that they may reduce institutional and collaborative R&D networks because they tend to generate internal R&D (UN, 2006).

It was retrieved that the few instances of spreading knowledge were the bi-annual fairs, and mostly informal and personal relationships between people from different firms. There is however an interesting case where former firms employees are now working in municipal departments, and were mainly hired for their experience in the salmon industry.

It is admitted as well that the firms do not absorb knowledge generated by the institutions. Only in the previously detailed event in which the firms lack the necessary backup evidence to support certain measures taken, some firms rely on the institution's work.

Now, considering that the salmon industry is a low-tech and therefore a synthetic knowledge based industry, the sharing of locally produced knowledge is of the utmost significance. As was previously exposed, in the case of engineering based knowledge industries, spin-offs, R&D initiatives and university-industry, collaboration is reduced and innovations are mainly the result of experimentation (learning by doing) and the use of specific know-how (Asheim and Coenen, 2004).

This scenario was confirmed also by the perspective recovered from the Research Institutions interviewed. They noted that firms do not go to them to plan any research, but only to ask for specific accomplishments of predefined research objectives. In this sense, they declared to be treated as a private agency that merely sells legally respected approval, which is from time to time needed by the firms. This kind of relationship was also, as it's been described before, common to depict the relation that the industry in general has with all institutions in the region.

- “No general orientation” and “Smaller and medium size firms” -

On the other hand, universities agree that there is not enough access to funding (public and private) for the development of more intensive research in the region, and that the efforts from within the institution are constant. Universities claimed that most of the time knowledge remains enclosed also because there is no follow up on the researches, and this indicates for them that the main concern for different reasons, is not about knowledge and its potential use for the development of the region, but merely about knowledge being produced for the sake of producing it.

It is admitted, though, that collaboration and interest in developing research comes more often from the small and medium size firms that provide services to the salmon industry (and others) than from the salmon firms themselves. They may be the closest ones to collaborate with the development of a knowledge market.

- “Salmon industry does not learn” -

This “enclosure of knowledge” and “lack of oriented knowledge being produced” sensation is also manifested in the view that almost all of the institutions interviewed shared about the salmon industry: being incapable of learning and developing. The salmon industry was often described as a blind one; it keeps repeating the same mistakes, over and over, and deliberately shows no intention to reconsider its path. Therefore, it only changes course when forced to do so, by national regulation or natural crisis.

For the majority of the institutions interviewed, this is not a simple feature of incompetence on the industry’s behalf but a rather essential aspect of the nature of its concerns. They claimed that the salmon industry does not care about its negative impact or the common wellbeing for that matter, and hence, the state should be in charge of that.

There is a strong association between the notion of “enclosed” and the “lack of involvement of a national policy and funding” that could coordinate and orient the generation of knowledge in the region.

6. FINAL REMARKS

From the analysis carried out by this research, results show that the consolidation of the low-tech Salmon Industry in the Los Lagos region has not developed the principal factors that permit the apparition of a RIS (Knowledge generation and diffusion, networking, innovation); on the contrary, regarding a RIS approach to analyse the national and regional innovation policies, the functional organization and the history of the salmon industry in Los Lagos and also the view of the main regional actors, public and private institutions, there are important gaps in terms of the regional conditions to foster innovation in salmon firms. In this case, the business development and innovative behaviour of a competitive rural industry such as the salmon industry has not generated the minimum conditions for the promotion of a RIS (Norhona Vaz, 2011).

In that context, main findings are in the line of research provided by Intarakumnerd and Chaminade (2011) that identify systemic problems that should be surpassed in developing countries to the generation of RIS; infrastructure problems (physic, scientific and network), technological transition problems, lock-in problems, soft (routines, values, etc.) and hard (firms, organizations, etc.) institutions problems, networks problems (linkages), capabilities and learning problems.

Particularly, innovation is considered by regional actors as poorly depicted; centred on the acquiring of technology mainly, but mostly was a void concept, removed from any concrete experience or profound knowledge of its systemic approach. There is however a

shared view among research and support institutions that innovation is needed to reduce the negative impacts of the industry in the region. Although in order to undertake this task, the efforts needed are attributed as a responsibility beyond firms, in the form of public funded knowledge, more regulation, and so on.

It is important to mention that in many cases the comparative advantages of Chile; as the low price of labor and the low level of expenditure relating to the care of the environment, have not pushed firms to innovate systematically in order to increase their low levels of productivity that presents the industry with respect to Norway, its main competition. Thus, there has not been a critical need to generate new marketable knowledge to improve or replace internal factors of production in order to meet production demand

On the other hand, there is a conflicting view on the necessity of networking in the region. As it was exposed throughout the document, contrary to the most commonly shared view across the regional actors, there is an idea that close linkage between firms and other regional institutions is not desirable for the development of the industry.

Therefore, the widespread feeling of abandonment that most institutions expressed in regards of promoting networking seems to be a natural reaction to the actual change in a formally cluster based policy of development for the region. In the region, the need for association and collaboration remains highly regarded and thus, the lack of governmental initiatives to attend to that need is also enormously felt. The memories of former instances of collaboration are proudly and emotionally missed, while the current “freedom of action” is regarded as mere voluntary absence on the state’s behalf.

As it has been exposed and confirmed by the image retrieved from regional actors, the salmon industry, despite its high world competitive, seems to prefer:

- a) To remain as a segregated industry, enclosing a small group of the bigger firms and excluding the rest of the industry (leading to ultimately terminating it),
- b) To remain as an extracting and short term industry, and
- c) To remain isolated from the regions’ institutions and community.

Considering this industry disposition, the perceptions of almost all regional actors, and the support of the national policy (expressed in its current non-interference), one could argue that the salmon industry has disseminated and reinforced the notion that low-tech industries are harmful for the region’s development and thus, deepened the distrust towards big “successful” firms.

However, some conditions or rather pre-dispositions were found favourable for the development of a RIS in the region allocated in smaller entrepreneurship that could be further explored. Smaller and medium size firms in the region were depicted by many institutions as innovative, supportive of knowledge generation in the region and more integrated with the regional institutions. They were identified as mostly service providers, related to the salmon industry but not exclusively.

The effect of the salmon industry may produce market connections, access to new technologies and specialized goods and services. The opportunity for the salmon industry as a strategic economic axe of action is mandatory to guide and promote innovation, business aspects, management and administration of new ventures. There is not another regional economic activity in a better position to lead the installation of a renewed RIS based on a regional cultural mentality focused on innovation and creativity as the motors of the regional development. However, this process will require deep public support, public and also private institutions, industry associations and institutions that provide economic and financial services must be mobilized around this opportunity.

The discussion around the possibility of having a special focus in regional investments cantered in a specialized economic activity or by the contrary supporting a diversified economy is still open. Currently regional policies in Chile are inclined to generate structural

conditions to the development of economic alternatives for mono-productive regions that have been not capable of getting a diversified economy, being exposed to a total crisis in the case that production and exportations could be affected by the reduction of the global lack of market demand.

Therefore, it is necessary to create new forms of development associated with RIS, where entrepreneurial vision and innovation is the critical factor in the territory aimed to generate a business network able to sustain, consolidate and enter into the market under various forms of production.

Undoubtedly, the existence of the salmon industry can promote an early stage of learning and development activities based on this key industry and its requirements consolidating then an economic, social and an institutional platform able to complement and build new economic axes diversifying the regional products and services in a second stage to the consolidation of a RIS.

7. FUTURE RESEARCH

In the present study, we have provided empirical knowledge about the possibility of creating a RIS from regional conditions that have resulted in the development process and consolidation of the cluster of salmon in the region characterized as an activity that requires a low knowledge creation, technology and innovation since its development is based on the efficiency to carry out the production process and the existence of specific natural advantages. Indeed, it is interesting to note that the results of this research suggest the difficulty that this cluster has to create conditions that promote innovation in the region, but nevertheless can be promoted through an efficient RIS policy that emphasizes regional characteristics and specific solutions to overcome major gaps identified.

The salmon industry in this regard should take a new step of development based on sustainability and harmonious development in conjunction with other regional actors and certainly be able to transfer the positive externalities of the industry to the rest of the region and its inhabitants.

In this context, future research should be linked to the generation of public policies capable to improve the main identified gaps and enhance those that are positive for the region and for the promotion of a RIS. Although the present study attempts to shed light on the possibility of generating a RIS considering the advantages that could be the result of the development of a cluster based on the use of natural resources and low creation of new knowledge and innovation, it is necessary to develop new research that allow to main regional stakeholders take advantages of those potential conditions through focused public policies that foster the creation of an environment of regional innovation used by other economic activities in order to boost regional economy, economic growth and social development.

REFERENCES

- Andersson, M. and Karlsson, C. (2004). Regional Innovation Systems in Small & Medium-Sized Regions. A Critical Review & Assessment. *Paper N° 10, Electronic Working Paper Series (JIBS, CESIS)*. The Royal Institute of Technology, Centre of Excellence for Studies in Science and Innovation.
- Asheim, B. and Isaksen, A. (2000). *Regional innovation policy towards SMEs: Learning good practice from European instruments*. Paper presented at Workshop on the regional level of implementation of innovation and education and training policies, Brussels.

- Asheim, B. and Coenen, L. (2004). *The Role of Regional Innovation Systems in a Globalising Economy: Comparing knowledge bases and Institutional Frameworks of Nordic Clusters*, Paper to be presented at the DRUID Summer Conference 2004 on Industrial Dynamics, Innovation and Development, Elsinore, Denmark, June 14-16, 2004.
- Asheim, B. and Gertler, M. (2005). The Geography of Innovation. Regional Innovation Systems. In: J. Fagerberg *et al.* (eds.), *The Oxford Handbook of Innovation*. Oxford University Press. pp. 291-317.
- Audretsch, D.B. and Feldman, M.P. (2004). Knowledge Spillovers and the Geography of Innovation. In: J. V. Henderson and J.F. Thisse (eds.), *Handbook of Regional and Urban Economics*. Volume 4, Cities and Geography. Elsevier. North Holland, pp. 2063-3073.
- Benavente, J. and Price, J. (2014). Evolution of the Public Institutions of Science, Technology, and Innovation in Chile: 1990–2012. In: G. Crespi & G. Dutrénit (eds), *Science, Technology and Innovation*. Springer International Publishing, Switzerland.
- Bjørndal, T. and Aarland, K. (1999). Salmon aquaculture in Chile. *Aquaculture Economics and Management*. 3(3): 238-253.
- Boschma R.A. and Frenken, K. (2006). Why is economic geography not an evolutionary science? Towards an evolutionary economic geography. *Journal of Economic Geography*. 6: 273–302.
- Bracayk, H., Cooke, P. and Heidenreich, M. (eds.) (2004). *Regional Innovation Systems. The role of governance in a globalized world*. 2nd edition, Routledge.
- Breschi, S. and Malerba, F. (2005). Clusters, Networks, and Innovation: Research results and new directions. In: S. Breschi and F. Malerba (eds.), *Clusters, networks, and innovation*. Oxford University Press, pp. 1-28.
- Christ, J.P. (2009). New Economic Geography Reloaded: Localized Knowledge Spillovers and the Geography of Innovation. *FZID Discussion Papers*. 01(2009): 1-46.
- Clark, II. and Fast, M. (2008). *Qualitative Economics: Toward a Science of Economics*. Coxmoor Press, London, UK.
- Cooke, P. (2003). Strategies for Regional Innovation Systems. Learning Transfer and Applications. *UNIDO, policy papers*. Centre for Advanced Studies, Cardiff University in cooperation with Olga Memedovic.
- Cooke, P., de Laurentis, C., Tödtling, F. and Trippel, M. (2007). *Regional Knowledge Economies: Markets, Clusters and Innovation*. Edward Elgar Publishing, USA.
- Doloreux, D. and Parto, S. (2005). Regional Innovation Systems: Current discourse and unresolved issues. *Technology in Society*. 27: 133-153.
- Evangelista, R., Iammarino, S., Mastrostefano, V. and Silvani, A. (2002). Looking for regional Systems of innovation: Evidence from the Italian Innovation Survey. *Regional Studies*. 36(2): 173-186.
- Eyzaguirre, N., Marcel, M., Rodriguez, J. and Tokman, M. (2005). *The Way to the Economy of Knowledge: The Road to Growing Equitably in the Long Term*. 97, Centro de Estudios Públicos, Santiago, pp. 5-57.
- Felzensztein, C., Gimmon, E. and Carter, S. (2010). Geographical Co-Location, Social Networks and Inter-Firm Marketing Co-operation: the Case of the Salmon industry. *Long Range Planning*. 43: 675-690.
- Fischer, M.M. (2006). *Innovation, networks, and knowledge spillovers*. Selected Essays Springer, Berlin-Heidelberg.

- Hirose, K. and Yamamoto, K. (2007). Knowledge Spillovers, location of industry, and endogenous growth. *Annals of Regional Science*. 41: 17-30.
- Hudson, R. (1999). The learning economy, the learning firm and the learning region, A sympathetic critique of the limits to learning. *European Urban and Regional Studies*. 6(1): 59-72.
- Intarakumnerd, P. and Chaminade, C. (2011). Innovation policies in Thailand: towards a system of innovation approach? *Asia Pacific Business Review*. 17(2): 241-256.
- Isaksen, A. (2001). Building Regional Innovation Systems: Is Endogenous Industrial development Possible in the Global Economy? *Canadian Journal of Regional Science*. XXIV(1):101-120.
- Lizuka, M. (2006). 'Low tech' industry: a new path for development? *The case of the salmon farming industry in Chile*. Paper submitted for 4th Globelics Conference in India 2006. Oct 4-6, 2006. SPRU, University of Sussex.
- Lundvall, B. Å. (2007). National Innovation Systems - Analytical Concept and Development Tool. *Industry and Innovation*. 14(1): 95-119.
- Maggi, C. (2002). El cluster del cultivo y procesamiento del salmón en la región sur-austral de Chile. *Cooperación Técnica*. BID-FOMIN Trust Fund Italiano. Cadenas Productivas: Lecciones de la experiencia internacional y regional.
- Noronha Vaz, T. and Nijkamp, P. (2009). Knowledge and innovation: the strings between global and local dimensions of sustainable growth. *Entrepreneurship and Regional Development*. 21(4): 441-455.
- Noronha Vaz, T. (2011). *The Design of Industrial Models*. In: S. Desai, P. Nijkamp and R. Stough (Ed.), *New Directions in Regional Economic Development: The Role of Entrepreneurship Theory and Methods, Practice and Policy*. Edward Elgar Publishing, Cheltenham, United Kingdom, pp. 60-76.
- Olson, T.K. and Criddle, K.R. (2008). Industrial Evolution: A Case Study of Chilean Salmon Aquaculture. *Aquaculture Economics & Management*. 12(2): 89-106.
- Paci, R. and Usai, S. (2000). Externalities, Knowledge Spillovers and the spatial distribution of innovation. *Geo Journal*. 49: 381-390.
- Perez-Aleman, P. (2005). Cluster formation, institutions and learning: the emergence of clusters and development in Chile. *Industrial and Corporate Change*. 14(4): 651-677.
- Salmón Chile (2014). <http://www.salmonchile.cl/en/info-center.php>
- Servicio Nacional de Pesca (SERNAPESCA) (2014). *Informe Sectorial de Pesca y Acuicultura*. http://www.subpesca.cl/publicaciones/606/articles-86801_documento.pdf
- Simmie, J. (2002). Knowledge Spillovers and Reasons for the Concentration of Innovative SMEs. *Urban Studies*. 39(5-6): 885-902.
- SOFOFA (Sociedad de Fomento Fabri) (2015). <http://web.sofofa.cl/informacion-economica/indicadores-industriales/informe-comercio-exterior/ranking-de-empresas-exportadoras-por-productos>
- Storper, M. (1995). The Resurgence of Regional Economies, Ten Years Later. *European Urban and Regional Studies*. 2(3): 191-221.
- Strauss, A. and Corbin, J. (2002). *Bases de la investigación cualitativa: Técnicas y procedimientos para desarrollar la teoría fundada*. Edición Universidad de Antioquia, Colombia.
- UN (2006). *United Nations Conference on Trade and Development*. Transfer of Technology for Successful Integration into the Global Economy. A Case Study of the Salmon industry

in Chile. United Nations New York and Geneva. ISSN: 1817-3225. United Nations Publication

Vera, J. (2009). El Cluster de Salmón en Chile: Análisis de los factores de competitividad a escala internacional. *Revista venezolana de gerencia*. 47: 342-369.

Yin, R.K. (2003). *Case Study Research, Design and Method*. 3rd edition, Sage Publications. Newbury Park.

CONTRIBUTIONS TO EVALUATE DESIGN INVESTMENT IN PORTUGUESE ORANGE FROM SILVES

Filipa Pias¹

ABSTRACT

Food reminds us every day that we are a part of nature and with our daily choices it is we who preserve or not biodiversity and species. It is we who promote or not the production of more health and fresh food. In an increasingly informed society about the benefits of having a balanced diet, meals started to be seen as tasting flavours and aromas, a moment of well-being, where the origin, production and method of preparation of agricultural products play a leading role. Because the market has changed, it is no longer anonymous it became personalized and essentially motivated by what you can enjoy, which implies a willingness to participate and build its own experience.

In general, the companies believe that design collaboration is an advantage but if they do not have means of measuring design's cost/benefit, it will not be easy to understand design as an investment that brings value to business. The purpose of this research is to draw the attention for the importance of design management, by evaluating the return of design's investment in the Portuguese agro-food industry and by developing a model that allows them to assess the return on investment in design.

Keywords: Agro-food, Design Value, Investment, Return.

JEL Classification: Q13.

1. INTRODUCTION

Food reminds us every day that we are a part of nature and with our daily choices it is we who preserve or not biodiversity and species. It is we who promote or not the production of more health and fresh food. In an increasingly informed society about the benefits of having a balanced diet, meals started to be seen as tasting flavours and aromas, a moment of well-being, where the origin and production and method of preparation of agricultural products play a leading role. Because the market has changed, it is no longer anonymous it became personalized and essentially motivated by what you can enjoy, which implies a willingness to participate and build its own experience.

The Mediterranean diet global economic value is esteemed to represent 1.9% of the national GDP and the endogenous assets are esteemed to account for about 8% of national exports and above 12% of employment (Dieta Mediterrânica, 2014, p. 53). Despite being a small farmer, Portugal has natural conditions (climate and soils) to allow a competitive offer and a bid of excellence for agricultural products, namely wine, olive oil, milk, fruit, vegetables and forest products. The variety of Portuguese products found in the Mediterranean diet has the potential to meet the demand observed for local and national products which origin is a synonymous of quality, reliability and environment friend.

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However, to trust you need to know. To know that behind these products there is a history, a tradition, a way of being. There are people in love with what they do, committed to improving the quality and food safety of domestic agricultural products. Who most often choose to produce native species which make them the guardians of the biodiversity of a region, biodiversity that shapes the landscape and offers the resources required to differentiate and generate wealth for the local economy. Because more than a culinary program, Mediterranean diet is a way of life, a way of living and sharing the table, which is reflected in the production, preparation and tasting of the food (Petrini, 2012, p.15).

Design is a management process that starts at a close observation to develop solutions with and for people, taking into account technical, environmental and economic constraints associated. Through design we can develop partnerships, complement the offering, create educational activities to children and young people about the health benefits in eating the products of the season and the importance of the fruit's life cycle to the region's biodiversity, promote the street markets or markets for farmers, with secure access and mobility in order to provide a warm and participating moment, contributing to improve the quality of life in the community and to boost the local economy. Because nowadays a sustainable company, even an agricultural one, means less and less a product's offering and increasingly an immaterial offering that associates experiences, quality and wellness.

In general, the companies believe that design collaboration is an advantage but if they do not have means of measuring design's cost/benefit, it will not be easy to understand design as an investment that brings value to business.

2. METHODOLOGY

We started this study with a literature review of "Design value", with special focus on Brigitte Borja de Mozota and Xenia Viladas work, by the Design Council that has been conducting different studies about design value, namely the report elaborated in cooperation with the University of Cambridge *Company spending on design: exploratory survey of UK firms 2008*, by Finbarr Livesey and James Moultrie, and implementing SMEs² supporting programs, such as the *Designing Demand* and *Design Leadership Programme*. We would also like to highlight DME report - *Design Management Europe* by Gert L. Kootstra, the work developed by DBA Design Business Association and the recent project coordinated by Antti Pitkänen the *Design Roi - measurable design*. Also the different studies and programs elaborated or supported by the European Union in order to encourage the companies to invest in design, specifically the publications *Design as a driver of user-centred innovation*; *Design for Growth & Prosperity* and the *European Design Innovation Initiative* program - Measuring Design Value and the books of Robert Verganti, Roger Martin and John Thackara.

To work on this case study we propose to apply the Direct Observation method with mechanical support and Survey for data collection. With the former we want the data collection to take place on the company's premises. The visit will include a brief presentation of the research and the answer of a short survey, which aims to obtain information about the company's strategy, financial data - to apply to the financial indicators: ROI, ROA, payback and RODI. To characterize the company's use of design we apply *The Design Ladder*, that consists in 4 steps: *Non-design*, *Design as form-giving*, *Design as process* and *Design as strategy*. And to characterize the vehicles used by companies to communicate their identity to the market we use the Visibility Vectors develop by Xenia Viladas: *Products*, *Communication* and *The Spaces* (Viladas, 2010, p.39).

² Small and medium-sized enterprises.

3. ANALYSIS

Up to now about 20 SMEs were visited, the vast majority located in *Beira* regions and in the regions of *Oeste*, *Ribatejo*, *Alentejo* and *Porto*. These companies produce olive oil, fruit, wine, rice, cheese and chocolate.

The data collected so far indicate that most of these companies do not have Balance Sheet and Income Statement – nor financial data which would allow to use certain financial ratios to evaluate the return on investment in design. They usually invest in design, but as a technical skill, because despite they are interested on design skills, they don't know how it can add value to the business. Therefore, most of the SMEs visited are at step 1 and 2 of *The Design Ladder* this means that usually these companies do not use design or just use it from time to time design (*Non-design*), or use regularly design but in a perspective of a project conclusion (*Design as form-giving*).

4. MODEL

From the information obtained and based on our literature review and the management tool Balanced Scorecard, we built a model for investment evaluation in design, whose indicators depend on the objectives and targets to be achieved, and on the means available to evaluate them, so that they actually represent the purposes and the company's ability to accomplish and evaluate them. For as Deborah Mrazek ([sd], p.7) or Xenia Viladas (2010, p.141) stated when describing that even the most innovative companies, which usually are those that invest in design, have not accurate systems but define indicators according to the objectives and their capabilities.

The model takes as its starting point the definition of a purpose that comes from the strategy followed by the objectives and targets to be achieved. Although the model is composed by several phases, the development process is not sequential, because all stages are related and will be adapted to achieve the objectives. A relationship of cause and effect that allows you to monitor the process and fine-tune or fix the path outlined in one or more stages whenever necessary (Figure 1).

The model consists of two categories of assessment, one with strategic guidelines and the other with performance indicators, both categories are defined according to the needs, capabilities and means that the company has to evaluate. The first category is dedicated to the strategic guidelines and includes the phases of Project, Objectives, Targets and Initiatives.

The Project is a starting point for achieving certain goals outlined by the strategy. Objectives should focus on the creation of value based on the three pillars of sustainable development: social welfare, environmental friendliness and economic prosperity. Targets translate into value what you want to achieve at a pre-defined period of time. The Initiatives are the operationalization of the Project to achieve the Targets, namely the create of a program of activities where design is present through: Products that comprise the offer, Communication that comprises the corporate identity and Spaces where the company's activities are developed. In the second category the performance indicators include the Qualitative and Quantitative Metrics to evaluate the process and the Outcomes.

Figure 1. Model to Evaluate the Investment in Design



Source: Own elaboration

5. CASE STUDY - SILVES, CAPITAL DA LARANJA

Silves town is applying the design evaluation model in investment in the new brand - “Silves, capital da laranja”. Its goal is to give notoriety to orange and producers in that region by associating to the name of Silves, recognized for its tangible and intangible heritage, and to the quality and accuracy with which orange is produced.

The collaboration began with the presentation of the model and a joint work to think and define all parameters that make up the model starting at the identification of Objectives focusing in the creation of value sustainable development: social welfare, environmental friendliness and economic prosperity (Figure 2).

6. CONCLUSIONS

Generally, the companies usually invest in design, but as a technical skill, because despite they are interested on design skills, they don’t know how it can add value to the business. Design is a management process starts at a close observation to develop solutions with and for people, taking into account technical, environmental and economic constraints associated. Through design we can develop a narrative that shows that behind these products there is a history, a tradition, a way of being.

The model that we propose contextualizes the intervention of the design which can be of social, environmental and economic range and identifies its collaboration: product, communication and space. We believe that it can help the companies, and Silves town to evaluate the investment in design in the new brand, as well as to turn the collaboration in

the development more profitable. It provides an overview that helps to focus on the essential and to monitor the development process.

Table 1. Application the Model to Evaluate the Investment in Design in the New Brand – Silves, Capital of the Orange

STRATEGY			
01. PROJECT			
Silves, capital of the orange			
02. OBJECTIVES - Sustainable development			
SOCIAL	ENVIRONMENT	ECONOMICS	
To help to improve the eating habits of children and youth.	Quality and sustainability of the used resources.	To add value to the brand - Silves, capital of the orange	
To have a more informed society about the benefits of consuming orange	Add value to the brand - Silves, capital of the orange	To add value and attractiveness to the territory	
To invite the Silves community to be ambassadors of this initiative			
03. TARGETS			
SOCIAL	ENVIRONMENT	ECONOMICS	
To improve the consumer's satisfaction	To reduce CO2 emission	Public recognition of the brand	
To improve the producer and retail satisfaction	To preserve biodiversity	To increase the product's distribution	
04. INITIATIVES - Design is present at			
PRODUCT	COMMUNICATION	SPACES	
To promote partnerships with restaurants and hotels to promote the brand	To develop educational activities, to inform about the seasonality of the fruit and its importance for the sustainability of the region, as well as the main features and benefits to health by consuming oranges	Site and social networks to: useful information about the brand, describe the production process, from the tree to the final consumer, invitation to get involved	
To Participate in local activities such as food festivals	Packaging with sustainability information used	Camper van or kiosks to sale Silves oranges products: jam, fruit, juice...	
	To support a social cause and or an action for the environment	Partner of research's meetings about health, environment and agriculture	
		Improve farms local market	

INDICATORS											
05. METRICS QUALITATIVE						06. METRICS QUANTITATIVE					
			Consumer, retail and producer feedback survey						RODI		
			Number of followers						ROA		
			Mentions and “likes” in social media						Increase sales		
			Accession of producers						Market share		
			Kick-off event						Average stock		
			Brand value						Distribution in new locations		
			Patents and awards						Net income		
			Reduction of CO2 emissions								
			Biodiversity								
			Add value to the territory								
OUTCOMES											

Source: Own elaboration

REFERENCES

- Beiras descobrem o poder da maçã e das marcas DOP* (2014). Accessed in 28th of June 2014, on the Web site of: Conferências “Empreendedorismo Agrícola - Cultivar o Futuro”: <http://cultivarofuturo.globalnoticias.pt/2014/05/03/beiras-descobrem-o-poder-da-maca-e-das-marcas-dop/>.
- Borja de Mozota, B. (2006). *The Four Powers of Design: A Value Model in Design Management*. DMI – Design Management Review. 17(2).
- Certification of Protected Designation of Origin - PDO*. Accessed in 10th of June 2014, on the Web site of: <http://ec.europa.eu/agriculture/quality/door/list.html>.
- DBA Design Business Association, Design Effectiveness Awards* (2013). Accessed in 2th of November 2011, on the Web site of: DBA Design Business Association: <http://www.effectivedesign.org.uk>.
- Design as a driver of user-centred innovation* (2009). Accessed in 17th of October 2011, on the Web site of: Commission of the European Communities: http://ec.europa.eu/index_en.htm.
- Design delivers for business, Design Leadership Programme* (2012). Accessed in 10th of September 2013, on the Web site of: Design Council: <http://www.designcouncil.org.uk/>.
- Design for Growth & Prosperity - Report and Recommendations of the European Design Leadership Board* (2012). European Commission. ISBN: 978-92-79-25946-3
- Designing Demand: Make design deliver lasting success for your business - Solutions for business funded by government*. Design Council 2010.
- Dieta Mediterrânica - Valor Económico e Perspetivas de Sustentabilidade* (2014). Conferência “O valor económico e sustentável da dieta mediterrânica”. Espírito Santo Research. BES Arte & Finança, Lisboa.
- Kaplan, R.S. and Norton, D.P. (1996). *Linking the Balanced Scorecard to Strategy*. California Management Review. 39(1).

- Kootstra, G.L. (2009). *The incorporation of design management in today's business practices. An analysis of design management practices in Europe*. Accessed in 19th of October 2011, on the Web site of: Design Management Institute: <http://www.beda.org/index.php/resources/item/121-design-management>
- Livesey, F. and Moultrie, J. (2008). *Company Spending on Design: Exploratory survey of UK firms 2008*. University of Cambridge. ISBN: 987-1-902846-73-5.
- Martin, R. (2009). *The Design of Business*. Harvard Business Review Press. ISBN: 978-1-4221-7780-8.
- Mrazek, D., Lucente, S., Sato, S., Menter, A., Wai, C., Wakid, K. and Hartley, P. (2011). The holy grail of design measurement. *Design Management Review*. 22(2): 6-16.
- Petrini, C., Bogliotti, C., Rava, R. and Scaffidi, C. (2012). *The central role of food*. Congress Paper. Accessed in 1th of May 2014, on the Web site of: Slow Food: http://www.slowfood.com/filemanager/official_docs/SFCONGRESS2012__Central_role_of_food.pdf.
- Pitkänen, A. (2012). *Design Roi - Measurable Design*. Arts Promotion Centre. Finland.
- Plunkett Foundation (2012). *Making Local Food Work*. Accessed in 1th of May 2014, on the Web site of: Plunkett Foundation: <https://www.plunkett.co.uk/growing-projects>.
- Thackara, J. (2006). *In the Bubble, Designing in a complex world*, The MIT Press. ISBN: 978-0-262-70115-0.
- The Design Ladder, Danish Design Centre* (2001). Accessed in 10th of June 2015, on the Web site of: Danish Design Award: http://ddc.dk/wp-content/uploads/2015/05/Design-Ladder_en.pdf.
- The Designing Demand Review* (2008). Accessed in 1th of June 2011, on the Web site of: Design Council. <http://www.designcouncil.org.uk/sites/default/files/asset/document/designing-demand-review.pdf>
- The Value of Design Factfinder Report* (2007). Accessed in 1th of June 2011, on the Web site of: Design Council. https://www.designcouncil.org.uk/sites/default/files/asset/document/TheValueOfDesign_Factfinder_Design_Council.pdf.
- Verganti, R. (2009). *Design-driven innovation*. Harvard Business Review Press. ISBN: 978-1-4221-2242-6.
- Viladas, X. (2008). *Managing Design for Profits*. Indexbook, 2010. ISBN: 978-84-92643-39-4.



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