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Perspective of the aquaculture in Chile and Mexico, productive articulation approach and business networks for international development

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Abstract
World food production is a permanent challenge for humanity, particularly in reference to the capture and reproduction of marine species for human consumption such as fish, mollusks and algae, which they have diminished their wild population, affecting the production volumes for their commercialization. According to FAO for the year 2025, these organisms will have to be produced in controlled environments in the sea, bodies of water, lakes, lagoons, rivers and artificial ponds to satisfy the demand of the population nuclei and to lessen the effects of the food shortage.
Chile and Mexico are committed to the need to promote food sustainability, the distribution and marketing of these products. Both countries have been concerned over the last two decades for the permanent growth of aquaculture companies, leading to the creation of direct and indirect jobs, small complementary service companies, but above all, the improvement of human development of the population through the consumption of proteins.
The goal in this paper is to describe the current situation in Chile, Los Lagos zone and Mexico, West Zone, articulation characteristics of public organizations, aquatic companies, producer's association and academic organizations, degree of internationalization of the products and finally to establish the specific policies for the development of this sector in both countries.
This is the first of several articles that will determine how to improve the participation of all stakeholders in the sector and propose alternative solution to increase food production though aquaculture.

Keywords: aquaculture productive articulation networks mexico chile

1. Introduction
Worldwide Aquaculture is used to increase the Food production of marine organisms under controlled conditions. The most cultivated species are fish, mollusks, amphibians and plants, in salt water and seawater production centers, promoting a sustainable development of the organisms and the environment in which they are located, and taking care of the Vedas of natural organisms without affecting the wild populations that have slowly diminished their number.
This activity has increased its global volume at a rate of 3% per year, compared to the capture of natural species through fishing, whose production has decreased slightly in the same percentage, FAO (2018).
Chile with natural tradition for catching fish through the artisanal fishery, has become in the last 20 years a leading Salmon exporter, occupying second place worldwide, after Norway and followed by Canada and Scotland, Sernapesca Chile, 2018
Mexico has developed, since the pre-Hispanic era, fish farming and other organisms, currently producing in various areas around the country, whose focus is on self-consumption for families with scarce resources, but also the generation of employment, business and economic development of the country.
The Government's participation has been very important in both countries. In Chile, the Government through the National Fisheries and Aquaculture Service (SERNAPESCA), a regulatory body that establishes regulations to avoid the exploitation of biological and natural resources, they represent the thirteen regions of the country. While in Mexico, the Federal Government is in charge of the aquaculture sector and its organization, Secretary of Agriculture, Livestock, Fisheries and Food, which in turn has a decentralized organism. The National Fisheries Commission, both organisms with representation in the Governments of each of the federal entities (states), in addition to the State Commissions of Fisheries and Rural Development Directorates; also, the fundamental function of these organisms is to impulse the aquaculture enterprise with support programs to the activity in different areas.
Based on the generalities described above, the article is structured in five parts: 1. Methodology used for research; 2. General background of aquaculture worldwide; 3. Theoretical framework of the productive articulation and its importance; 4. Research findings of aquaculture activity in Chile and Mexico; productive articulation and participation of the business sector, government

agencies, specialized organizations, universities and research centers; 5. Conclusions and future lines of research.

2. Methodology Used for Research

The approach used for field work was based on qualitative analysis, which allowed to expand the information gathering without limiting the answers to scales or closed questions. The general objective for the research project was: To Establish the relations of the aquaculture companies of the Lagos Region in Chile and the central Western Region of Mexico with other Government agencies, Universities and Research Centers, Producer Associations, Consultants, Service Providers and the society in general to determine the degree of articulation and present improvement proposals for their performance and optimization of resources.

The hypothesis linked to the research objective was as follows: The interrelationships generated between aquaculture companies or farms in Chile and Mexico and other business organizations, academic and government agencies are presented from their technological development and its export orientation of their products.

The characteristic of the study was Non-experimental exploratory, with empirical information; Obtained from the place where the phenomenon was presented mainly in government offices, companies and aquaculture farms, corporate headquarters, human resources areas, processing plants, freshwater and sea Aquaculture production centers.

The research was carried out in two stages: the first in Mexico, during the month of June and July of 2018 in the State of Jalisco, Colima, Michoacán and Nayarit; Responsible for the investigation of public bodies at the federal/central level, representatives of producer associations and support institutions for the aquaculture sector.

The second stage was carried out in Chile, in the months of September and October of 2018, in the X region with headquarters in Puerto Montt, this zone is where the largest number of salmon companies and fresh water-seawater production centers are concentrated, an in-depth interview was done with open questions related to the characteristics of the organisms and their participation in the aquaculture activity; Information processing was made from the interpretation of the answers taking into consideration the research objectives and questions. The main actors were High-level public officials of the Central/Federal public Administration in, aquaculture companies in both countries, groupings of producers in Chile mainly in Puerto Montt, Region X and the Central West region of Mexico, which include the States of Colima, Jalisco, Michoacán and Nayarit.

The Instrument for the collection of information was a questionnaire of 25 total questions with 7 questions of general data, 13 closed questions of the characteristics of the aquaculture companies, and 5 open questions related to the articulation Production of aquaculture companies with other organisms.

3. Global Aquaculture Background

The growth of the world population facing the first half of the 21st century will be 9 billion people, Causing a major impact on climate change and degradation of natural resources, (FAIO, 2018). The objectives set out in the Agenda for Sustainable Development of Nations for the 2030 offer a unique, transformative and comprehensive approach to follow the path towards sustainability and resilience.

The overall level of fish production in 2016 reported a record number of 171 million tons, Aquaculture represented 47% of the total and 53% in non-food uses, thanks to the relative stability of capture and to the reduction of the irrational use of marine resources also to the permanent increase of aquaculture, this production has caused a record number in the Per capita consumption of 20.3 kg per year in 2016, which has increased to double since 1961, very similar to the growth of the population, showing that the fishing sector is crucial to reduce the rates of hunger and malnutrition around the world.

Given The title, we could start with a small description of the world's reality... And then continue with Mexico...

In Chile, the formal antecedents date back to the NINETEENTH Century, when there are introduced in 1850, exotic species. It was until the beginning of the 1900´s that the salmon began to be imported, Aquafeed (2018); The first hatcheries were done in Lake Nahuel Huapi, in Argentina, located in the Andes mountains, around three to five kilometers away from the Chilean border.

In 1908, 25.000 trout eggs were sent from the Nahuel Huapi incubation plant to Santiago de Chile, from Buenos Aires to Valparaiso, at the request of the Chilean government, and to be cultivated in a small farm.

Due to the large extension of the South American country, of 4329 kms. Being the longest in the world, it developed its natural vocation to the artisanal fishing, through its almost 8000 kms. of coastline and a width of just 180 km, (Universidad de Chile, 2018), For this reason the fishing activity in the sea has been promoted and, consequently, in the last thirty years, the sowing, harvesting and commercialization of salmonids species such as trout and salmon, being the country that occupies the second place of export worldwide. SERNAPESCA, Chile 2018.

Regarding this information, Chile and Mexico, these two countries that, by their territorial extension and kilometers of coastline, permanently promote fishing and aquaculture activities, Chile with almost 8000 kms. Of coast and with an extension of 756.102 km2., and Mexico with 12.500 kms. Of the coast, bathed by the Pacific and Atlantic Ocean (Gulf of Mexico) and a territorial extension of 1,964,375 km2 (see table No. 1), they grow systematically to increase their statistics and to promote their participation in the international panorama, finding both among the first places of world fishing and aquaculture production.

Mexico on the other hand presents unreached volumes before, fishing and aquaculture production, 1 ´ 335 and 377 mill. Tons. Respectively in 2017 reached a total of 1,712,000 tons. These are the results of the hard work of the various public bodies, in the generation of public policies, aimed at increasing the number of farms, improving health, safety, food quality and diversifying the products, where in addition to the Shrimp, tilapia, and trout, also have been incorporated other species such as the Bull Frog and ornamental fish (Table No. 1).

Table 1: Chile and Mexico territorial characteristics, fisheries, aquaculture and population

Chile and Mexico territorial characteristics, fisheries, aquaculture and population			
Features	**Chile**	**México**	Observations
Total Area in Km^2	756,102*	1 964,375	*180 kms. Width
Coastal and Marine Systems	8,000 kms	12,500 km2	*Two Pacific and Atlantic Oceans (Gulf of Mexico)
Water Resources	33,570 km* Ríos Loa, Elqui, Aconcagua, Maipo, Rapel, Maule, Biobío	*633,000 kms. ** Riós Yaqui, fuerte, mezquital, Lerma, Santiago y Balsas, Bravo, Pánuco, Papaloapan, Grijalva y Usumacinta	* Central Government of Chile * * Federal Government of Mexico.
Production capture	1´499,531mill.ton.*	1´311,089 mill. Ton. **	* SERNAPÈSCA, Chile ** Sagarpa, México
World Place	12th	16th	*FAO **Sagarpa, México
Aquaculture Production	1´259,730 mill.ton. *	377,000**	* 2017 ** 2016
Main Aquaculture Products	*Atlantic salmon, coconut salmon, trout, mollusks, oysters	**Shrimp, tilapia, trout and bull Frog	*Sernapesca ** Sagarpa /Comisión Nacional de Pescan (
World Place	7th	16th	* FAO, 2018 ** SAGARPA, Mex.
Total Population of the country	18´610,601	133´075,228	Countrymeters
Men	9´201,090	65´628,433	Countrymeters
Women	9´409,511	67´447,799	Countrymeters

***Source*:** Elaboration authors from official data, 2018

4. Theoretical Framework of the Productive Articulation and its Importance

The literature of the productive articulation has been analyzed in the Last Decades, (Porter, 1998) [23]; Studying the integration of this type of groupings in the sectors of high technology, automotive, electronics and biotechnology, (Zubillaga, Huerta, *et al*., 2107) [28]; But also in concepts of business networks, value chain and supplies; In particular this article deals with the relationship of these concepts in the creation of productive groupings of the aquaculture sector in different parts of the world. Clusters are interconnected geographic concentrations of companies, specialized and service providers, Companies in related industries and institutions in specific areas (universities, agencies and business associations, (Porter, 1998, p. 197) [23].

The policies for Cluster creation around the world involve a wide variety of design policies, which essentially involve various stakeholders in the development of Innovation in different sectors, stimulating the concentration of Experts and knowledge in a geographic space, creating potentially development poles related to the competencies of economies of scale, facilitating the dissemination of knowledge, promoting a culture of learning and contributing to Development of a common vision among stakeholders in certain regions and achieving collective objectives (Pro-Inno Europa, 2012).

According to Solvell (2009) [34], the main policies involved for cluster creation are: a) Science and Innovation, investment for the development of science and technology. b) Competition, rivalry is one of the key ingredients in cluster dynamics. c) Business, the relationships of markets around the world are of fundamental importance. d) International integration, the interaction of countries on the global network allows for important exchanges in all areas of economic development. (e) Regional, clusters can contribute to regional programs. (f) Social, in relation to the importance of access to efficient public services, improves the attraction of new resources from abroad. In addition, the objectives in the cluster initiatives could be human resources, cluster expansion towards increasing a greater number of companies, business development, international cooperation and interaction, objectives of innovation and the creation of business environments.

Arteche, M, Santucci, M and Welsh, V. (2013) [3] point out the importance of networking and clustering for innovation and knowledge transfer in Argentina's regional growth, analyzing the main clusters of the country, improving innovations as well as positive externalities for the community, in particular the national policy of support for SMEs had as an expectation that clusters could stimulate learning and collective action between companies. As Etzkowitz (1997) [13] puts it, the initiatives are underpinned by academics, government and business, as proposed by the triple helix model, now with a more as helix points out(Campbell, Garayannis and Rehman, 2015) [8], society's participation is fundamental to the creation of innovation and value.

Regarding the emergence and operation of cluster initiatives linked to Aquaculture, references can be found on different continents, including that documented by Gonzales y Hurtado, (2018) [17], regarding the organization of small producers of blue mussels in Chile and institutional factors, a study that incorporates a value chain analysis, from a quantitative perspective, focuses on product flow and marketing. On the other hand, as an important element in the analysis of production groups, is the value chain, in the case of aquaculture innovation in Bangladesh. (Chaoran, H., Xiaobo, Z, Hernandez, R, 2017), the authors note that the high rate of clustering in aquaculture producers is associated with a higher probability of intensifying the use of more modern supplies, food, medicines, tools and equipment for species are diverse and the components of the value chain allow for further modernization of their facilities.

The advantage of the proximity of farmers with large cities facilitates the orientation of innovation unlike those in rural areas away from central population. Therefore, the agglomeration of farms and contact between farmers stimulates specialization and

a better understanding of diversification, allowing relative gains from the economics of specialization in certain products, (Chaoran, H., Xiaobo, Z, Hernandez, R, 2017).

Another study indicates that the formation of clusters of trout producers and the articulation with the target market in the Puno Region, Peru (Flores, E, Sayco, Y. 2016), depends on the knowledge of the strategy for cluster integration, this may limit the growth in productive activity.

The application of the Cluster model has not worked properly in the sector, due to the lack of commitment of the government figures in charge of the development of the aquaculture sector, there are even companies that have had to close for reporting few or no profits. Due to the bureaucracy of the institutions, some entrepreneurs, work without the necessary documentation so that leaves them out of any reactional, financial, or other support which does not exist linking with research and development institutions (Chaoran, H., Xiaobo, Z, Hernandez, R, 2017).

A key aspect in the dynamics of the cluster is the trust that may exist among producers for joint investment, however, in Mexico's aquaculture cluster, shows that they have an independent stake, each decides on the quantities to be produced, how much it will invest and mistrust among farmers. The above generates a lack of commitment (Flores, 2016);low levels of cooperation between producers, what it comes up just in some areas such as buying and moving trout to reduce costs, when farmers face difficulties such as food shortages or diseases in production, each takes individual actions to solve it. Therefore, cluster initiatives are not always successful, so adequate mechanisms are required to promote their creation and subsequent consolidation, (Huerta, J. 2013).

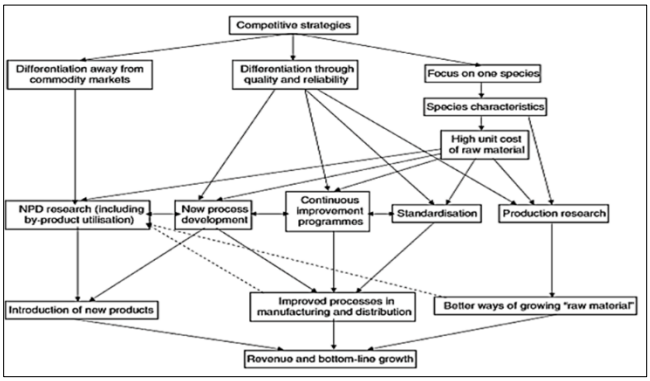
Finally, with regard to Innovation in Sea Product SMEs, Bhaskaran (2006) [5] analyzed this concept and determined that it is as a strategic experimentation linked to risk-taking behavior, among other activities include the introduction of new differentiated products, extension of product lines, development and implementation of strategies to enter the market (geographies and new market segments), identification and development of new sources of supply (imported and domestic), creation of new sales formats (e-business, franchises) and new forms of organization (value to partners and business networks)between others.

For their part Sankaran and Suchitra (2006) [20], according to the analysis of the company NZ King Salmon (NZKS),established the importance of innovation by carrying out tasks to improve increasing production and profits in the marine food sector, highlighting the importance of seeing the value chain as the primary and support in gender group of sequential activities that a company conducts to transform your raw materials or supplies by adding value to their products for their external customers; so innovations considered to be "The introduction of a new or significant improvement to the products or services of the market, or the introduction of a new improvement to the business processes", (Fallow, 2004).

Morgan, *et al*. (2003) [22], he added to the concept of innovation the incorporation of technical, commercial, financial steps, the marketing of new or improved products and the commercial use of new or improved processes for the successful development of organizations. In the case of NZKS, they invest a percentage of its sales in research and development, particularly in the creation of new products and processes in both manufacturing and distribution, but also in the developing new markets.

The proposal by Sankaran and Suchitra (2006) [20], see Figure No.1, points to the importance of considering three aspects: (1) product orientation; 2) process orientation; and, 3) market orientation and its impact on innovation, and from these, the company's performance based on its strategic approach.

Process model of value chain innovation at NZ King Salmon



***Source*:** Jayaram and Suchitra, 2006, p. 398.

Fig 1: process model of value chain innovation at NZ King Salmon

5. Research findings of aquaculture activity in Chile and Mexico; productive articulation and participation of the business sector, government agencies, specialized organizations, universities and research centers.

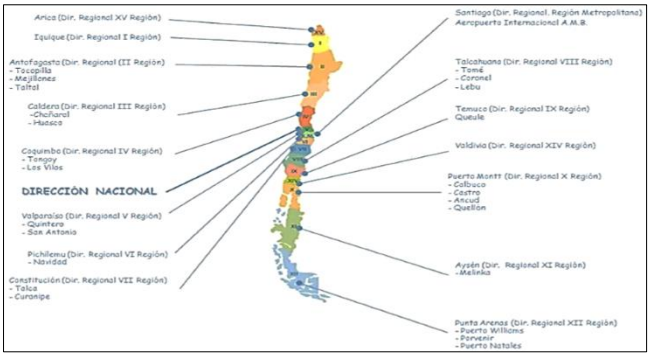
5.1. Aquaculture in Chile

Chile is a potential exporter of fishery and aquaculture products, occupying 8th place, FA0 (2016), reaching 2014 levels of 3.5 million ton. Landed and 1.2 million. Harvested, generating more than 10 thousand permanent jobs. The export volume was 1,179,721 ton. Worth $5.4 million, the main destinations were Japan, China, the European Union, USA, Brazil, South Korea and Peru, Sernapesca (2018).

The development of aquaculture activity in Chile is represented by the Ministry of Economy Development and Tourism, Under secretariat of Fisheries and Aquaculture, Institute of Fisheries Promotion and National Fisheries and Aquaculture Service (Sernapesca), the latter is responsible for implement of regulations and establish contact with producers in different regions of the country, their basic functions are to monitor compliance with fisheries and aquaculture standards, as well as to provide services to facilitate their proper implementation and effective health management, in order to contribute to the sustainability of the sector and to the protection of hydrobiological resources and their environment, Ministry of Economy Development and Tourism, (2018).

Sernapesca, with a presence in each of the country's 15 regions, consists of six operational sub-directorates; aquaculture, fisheries, foreign, legal and administrative trade, three are related to aquaculture activity and the other three support and administrative activities, (Figure no. 2.).

SERNAPESCA Structure, Central Government of Chile, 2018



***Source*:** Sernapesca 2018.

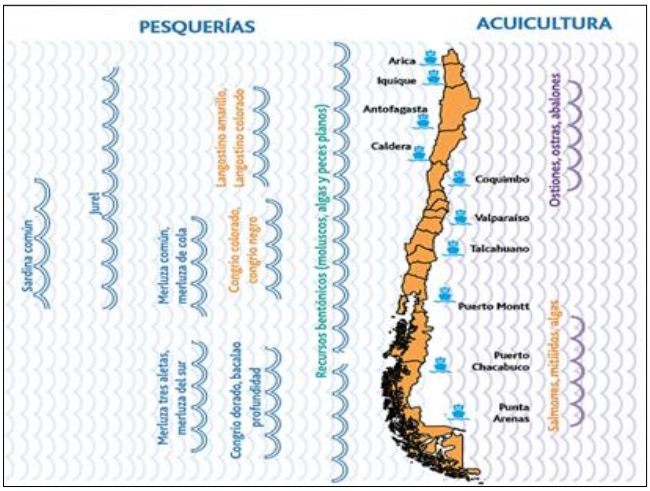
Fig 2: SERNAPESCA Structure, Central Government of Chile, 2018

The species cultivated in the X region, whose capital is Puerto Montt, are Atlantic salmon, rainbow trout, coho salmon, king salmon and some other species of mollusks and oysters.

Sernapesca's essential role established in its Mission is to contribute to the sustainability of the sector and to the protection of hydrobiological resources and its environment, through comprehensive control and health management that influences behavior promoting compliance, Sernapesca, (2018). It should be noted that after the 2007 crisis, the product of the ISA virus, aquaculture regulation has been constantly adjusting with the intention of creating a culture of prevention and harmonious development of the environment among producers, species natural settings, (Figure No. 3).

Despite the difficulties it has faced by biological risk factors, the growth of Chile's aquaculture sector has been favorable. In the year XXXX there are 3678 freshwater and seawater aquaculture centers, 3237 concessions and 441 fish farms/hatchery, distributed in the Lagos region, Aysén region and Magellan region, favoring the prominence of Chile in the global salmon industry, 2018 in 2018 in exports (SOURCE).

Main fishing and aquaculture development areas in Chile



***Source*:** F ishen es and Aquaculture sector in Chile, S ubsecretary of Fisheries & Aquacultura, Central Goverment Chile, 2017

Fig 3: Main fishing and aquaculture development areas in Chile

The Sernapesca National Control Plan establishes three updated levels: 1. General Control, levels of coverage of sectoral agents, monitoring and control of basic requirements for safety control in raw materials and agents sectoral sectors, among others; 2. Specific, non-strategic but relevant audit; 3. Strategic audit, greater impact, giving rise to the Interinstitutional Control Committees (COFI) at the regional level, acting in the areas of audit, surveillance and control.

In the business sector, salmon producers are integrated into two civil associations Salmon Chile, which includes 80% of the companies, and Salmons Magallanes with the remaining percentage, the fundamental objective of salmon Chile is to group the main companies producing Atlantic salmon, coho, trout, and their suppliers to work together on the health, environmental, regulatory, social and economic challenges of the salmon farming sector, both nationally and internationally.

Salmon companies supply more than 70 international markets daily, under the most demanding international quality certifications, with an emphasis on occupational safety and health, food safety and the environment, to deliver to a sustainable and recognized product as one of the healthiest and most nutritious foods for human health.

The production centers are mainly located in the regions of La Araucania, Los Lagos, Aysén and Magallanes, generating more than 70 thousand direct and indirect jobs, of which 60% and 40% women correspond to women' labor, causing a profit and important for localities and improvement in the human development index for the general population.

***ISA virus, infectious salmon anemia, Atlantic salmon viral disease (salt jumping), affects species culture centers in Canada, Scotland, Norway and Chile.**

Salmon Chile created the Competition Council of the Salmon Aquaculture Industry, the Salmon Network and the Labor Skills Certification. In the scientific and technological area, it has the Institute of Salmon Technology (INTESAL), an articulating company and generator of this type of information that supports partners in the making of health, productive, environmental and safety decisions, among others.

The participation of universities in the aquaculture sector and SERNAPESCA, relates to scientific and technical aspects such as epidemiological surveillance, export analysis, marine toxins, food safety analysis, microbiological analysis, dermatological analysis, some help with the topic of phytoplankton for the theme of the red tide; Among them are the University of Chile, Universidad Austral de Chile, Universidad de Valparaíso, Universidad Católica de Valparaíso, Universidad de Concepción, Universidad de Los Lagos, eventually working in the operational with universities, in the auditing, research or information generation, in 2018 the project was called ¨The Program for The Health Management of Aquaculture´.

SERNAPESCA heads the vice-chair of the Commission on Aquatic Animal Standards of the World Organization for Animal Health OIE, which is part of FAO.

5.2. Aquaculture in Mexico

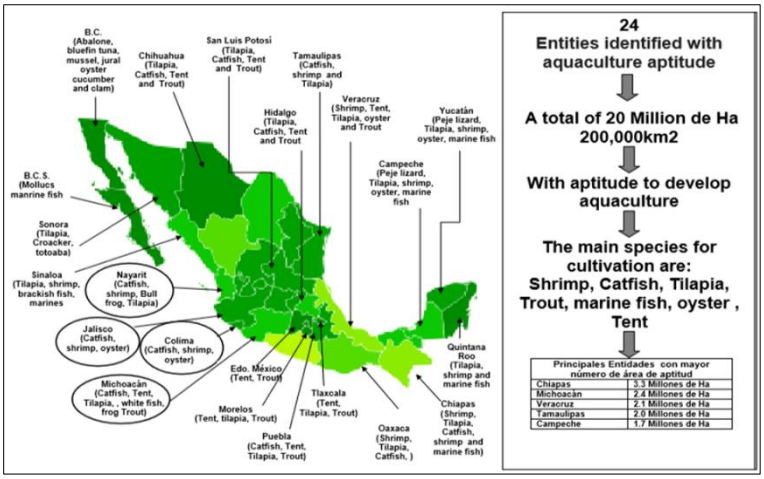
The body responsible for Fisheries and Aquaculture in Mexico is the Secretariat of Agriculture, Livestock, Rural Development, Fisheries and Food, SAGARPA, now SADER, Government of Mexico, 2018, through the decentralized body, National

Commission on Aquaculture and Fisheries (CONAPESCA), which directly administers the regulations, operation and supervision of aquaculture production units throughout the country, its fundamental mission is to promote and develop coordination mechanisms with different bodies to implement policies, programs and regulations that lead and facilitate the competitive and sustainable development of the country's fisheries and aquaculture sector.

The CONAPESCA structure consists of five general addresses: 1. Planning, programming and evaluation; 2. Organization and Development; 3. Fisheries and Aquaculture Management; 4. Infrastructure; and 5. Inspection and Surveillance, CONAPESCA (2008), has 32 fishing sub-delegations one for each federal entity and 102 local fishing offices located in Mexico's most important fishing and aquaculture influence zones.

There is a significant distribution of fishing and aquaculture activity in Mexico across eight economic regions, see Figure No.4, the main production areas are located in the Pacific Ocean, from Baja California (northern border with the U.S.) to Chiapas (Guatemala), is concentrated in the states of Michoacán, Colima, Jalisco, Nayarit, Sinaloa and Sonora, cultivating species such as shrimp, tilapia, oysters, carp, trout, catfish, and other species of fish and algae in smaller proportions.

Zones of Aquaculture Skills



***Source*:** SAGARPA, México, 2018

Fig 4: Zones of Aquaculture Skills

Business participation is presented with aquaculture farms a total of 9,230, with 412 processing plants, 112 that export to the U.S. and 43 certified that export to Europe; they have around 300.000 employees in the fishing and aquaculture activities.

In the case of the federal entities taken for research there is a diversity of farms according to the characteristics of climate, water temperature and facilities for the distribution and marketing of products as well in Colima white shrimp, tilapia and bull frog; Jalisco tilapia, bull frog; Michoacán trout, tilapia, catfish, bull frog, white fish and carp; Nayarit trout, oyster, white shrimp, see table no. 2.

Table 2: Census of aquatic farms, West Center Zone of Mexico Comparative 2009-2018

	dtu	dun	eld	old	Bu	Bu	Tro	Tro	Catf	Catf	'Oth	'Oth	Tot	Tot
Locati	200	201	20	201	20	20	2009	2018	2009	2018	2009	2018	200	201
Colim	25	20	29	60		01			01				55	81
Jalisco	03		10	07	10	15	09		37			42	166	64
Micho			65	125	03	26	150	216	45	25		02"	263	394
Nayari	140	535	50	47	04				01			Or	195	586
Total	170	555	24	239	17	42	159	216	84	25		48	679	112
'White fish or carp "oyster Puente: Research work aouculture farms,														

However, despite the growth seen from fieldwork research at two different times 2009 and 2018, the potential for international marketing has not been exploited and it is only a few farms that allocate a percentage of their export production.

On the other hand, as far as business groups in aquaculture are divided into those promoted by the Federal Government, one of them is the Supply Product System, a concept that was replaced in Mexico for the production chain scheme, its purpose is to reflect the economic relations that carry out various sectors and actors involved in all phases of the economic cycle (production, marketing, consumption and accumulation). INEGI (2013), integrates each of the main biological organisms produced by entity, as well as in Colima there is shrimp and trout; Jalisco, trout and bull frog; Michoacán, trout and trout; Nayarit, shrimp and trout.

In the same way, the Aquaculture Health Committees, under the National Health, Safety and Food Quality Service SENASICA, agencies of the SADER Ministry of Agriculture and Rural Development, are formed; fundamental objective of these Committees to assist in health actions related to the prevention of diagnosis and control of diseases, as well as in fish and aquaculture safety and quality, some of their basic functions are epidemiological surveillance and periodic review of farms; this agency receives a budget from the Federal Government so they are obliging to fulfil their task of providing support to farmers, with one for each federal entity, in the western central region of Mexico, being the agency to which they naturally attend producers to seek advice and technical guidance for their farms.

The main financial support programs are aimed at the development of rural aquaculture, consisting of infrastructure and equipment, breeding foot supply and repopulation, aquaculture management, consumer promotion actions, development of production chains, transformation and marketing of products, acquisition of genetic lines, construction and adaptation of infrastructure, facilities, and equipment of laboratories. Mexico, 2017.

As regards the intervention of universities in the aquaculture production unit or with the Government, it is relative depending on scientific projects related to the biology of the species being grown, occasionally for visits to farms aquaculture students from schools of fisheries engineering, oceanography or sea studies and visits by foreign researchers for international projects.

6. Conclusions

To respond to the overall objective of research: To establish the relationships of aquaculture companies in the Lagos Region in Chile and the Central West Region of Mexico with other central/federal and state government bodies, universities and Research, Producers' Associations, Consultants, Service Providers and society in general to determine the degree of articulation and submit proposals for improvement for their performance and optimization of resources; and The scenario linked to the objective: The interrelationships that arise between aquaculture companies or farms in Chile and Mexico and other business, academic and government bodies are presented on the basis of their technological development and their orientation to export of its products; the main conclusions are as follows:

6.1. Chile / Puerto Montt Region

1. There is a strong interrelationship between the business, government and academic sector in Chile's aquaculture activity, specifically in the X region of Puerto Montt; freshwater and seawater production units cultivate bodies with international food standards, the participation of governments in the countries of Norway, Scotland and Canada to oversee the health, safety and quality of products to be exported allows a constant improvement of processes in production centers, transfer of organisms in different stages of cultivation, filleting or packaging plants of products, distribution and logistics to place the product in markets mainly from Europe and Asia.
2. Epidemiological surveillance is constant and permanent both external by the World Organization for Animal Health OIE/FAO and internal by SERNAPESCA, to avoid mortality and to decrease production volumes for consumption and export with the ISA virus like in 2007 and 2008 in Chile; monitoring is permanent in production units and biological supplies such as eggs and small fish to prevent diseases that can cause deadly diseases for species.
3. Funding provided by government bodies to producers in Chile focuses on rural aquaculture for sustainable projects that support the family economy in areas far from population centers; in the case of larger aquaculture entrepreneurs, they have commercial alliances with Norwegian or other investors or from important corporate companies with the possibility of developing the export-oriented sector at all times, such is the case of the last two acquisitions by AGROSUPER in food in the aquaculture sector and INVERMAR with salmon farms.
4. The participation of producer associations is relevant from SALMN CHILE, which groups 80% of salmon producers and only two other groups that concentrate the remaining 20%; the main task of Salmon Chile is to provide support and guidance to producers on health, safety and food quality, as well as to intervene in the export process of producers.
5. The exchange between the business sector and government with the academy, is sporadic not to strengthen relations between the three instances, it is only for very specific technical and scientific projects that result in the biology of the species, care of the environment sustainable environment and sustainability of production facilities.
6. There are ongoing relationships with companies that provide complementary outsourcing services for aquaculture activity among them are: oceanographic consultants, specialized divers, laboratories for the preparation of special studies.

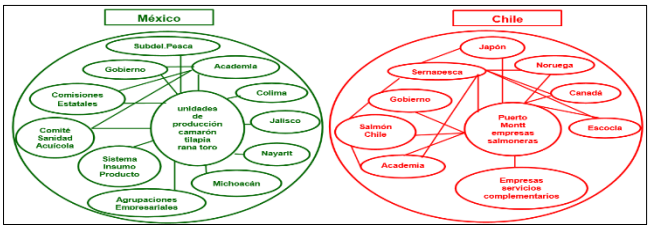
6.2. Mexico / West Central Region

1. The interrelationship between the business sector, government and academy in Mexico's aquaculture activity is very weak and only at the request of one of the parties with another, its natural orientation is to self-consumption and local marketing, except in the case of shrimp farms in Nayarit, two companies are linked to the U.S. and Canada market.
2. Despite the evident growth in the number of farms in the four entities of the Region, Colima, Jalisco, Michoacán and Nayarit, the placement of products at the national level in sea markets continues to be promoted mainly in La Viga, Mexico City and Mercado del Sea in Zapopan, Jalisco.
3. Epidemiological monitoring is carried out through the Aquaculture Health Committees and for food safety and quality effects through SENASICA. Despite occasional outbreaks of disease on farms, they manage to control the same without impacting the areas where the outbreak occurs.
4. The participation of producers in government aquaculture associations, whether Supply Product System or Aquaculture Health Committee, is for statistical purposes, advice and guidance. In addition to independent groupings in which they are organized primarily to achieve better price in biological supplies, food and medicines, not for long-term projects that affect the optimization of production units.
5. The Mexican State has an extensive program to support and fund farmers, however, there is no follow-up most of the time by public entities to verify the proper use of resources and therefore consolidation production units.
6. The academy maintains very short temporality relationships only for technical or scientific research projects most of the time related to the biology of the species; sometimes for visits of sea studies schools, fisheries engineering and oceanography, so they do not encourage a permanent exchange of long-term experiences and relationships.

Regarding the research hypothesis: The interrelationships that arise between aquaculture companies or farms in Chile and Mexico and other business, academic and government bodies are presented on the basis of their technological development and their orientation to export of its products, the production

articulation scheme of the aquaculture sector in Mexico and Chile, highlights the interrelationship of the countries of Norway, Canada and Scotland on a permanent basis with Chile, Quatri Nation, which favors a trade and business networks for the placement of salmon in international markets, but also for the permanent supervision of biological supplies subject to export and import to ensure their health, see figure no. 5.

Productive articulation scheme Mexico and Chile



***Source*:** Elaboration of the authors from Mexico-Chile research work, 2018

Fig 5: Productive articulation scheme Mexico and Chile

The concentration of entrepreneurs in the organization Salmon Chile allows a constant interaction of the guild with other types of actors of the chain, achieving important benefits aimed at marketing; state participation exists for regulatory, health and food safety purposes; only a small percentage of aquaculture companies in rural areas are supported to develop sustainable and self-financing projects. The academy's relations with salmon companies are isolated, generating at the request of SERNAPESCA for technical or scientific projects.

For its part, Mexico maintains a diverse production of aquaculture organisms per federal entity, depending on the characteristics of temperature and water quality; government interrelationship with production units is permanent for financing, health guidance, safety and food quality; farms are oriented to self-consumption and sustainability, only shrimp farms in Nayarit are export-oriented, which may occur occasionally dependent on international market demand; academy participation is sporadic and does not represent an opportunity for improvement for production units.

7. Future Lines of Research

The research work between the two countries only begins so that more interviews will have to be conducted with employers, external complementary service agencies and other sector actors involved in the ongoing growth of aquaculture activity; in the same way it is necessary to make visits to the countries with which Chile has Norwegian, Canada and Scotland conventions, "Quatri Nation", expanding the international landscape and carrying out comparative studies that can help the continuous improvement of the activity especially in Mexico.

Business networks between shrimp and salmon aquaculture companies should be analyzed as part of the value chain from origin to the final consumer, which allows the operation of the links to be assessed, and encourages the reduction of costs and expenses throughout the process, the contributions of the participants in it will facilitate the identification of its characteristics and its possible adequacy if necessary.

Finally, a line of research that must be taken as a complement to the work that has been carried out, is to analyze and measure the environmental impact of aquaculture in Mexico and Chile, in water, air and land and promote actions for sustainable development both of the agencies and the scenarios where the activity takes place, thinking of achieving international certifications of social responsibility both from the government and from private bodies.

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