International Journal of Educational Research and Development
www.journalofeducation.in
Online ISSN: 2664-7095, Print ISSN: 2664-7087
Received: 23-04-2022, Accepted: 08-05-2022, Published: 24-05-2022
Volume 4, Issue 2, 2022, Page No. 25-36

Productive articulation in aquaculture enterprises in Colima and Jalisco. Current conditions and prospects for partnership, innovation, and development

Juan José Huerta Mata, Ruth María Zubillaga Alva, Adriana Cordero Martín
[1] Professor, Department of Administration, University of Querétaro, Mexico
[2] Professor, Department of Administration, University Center of Administrative Economic Sciences, Mexico
[3] Associate Teacher, Department of Administration, University of Guadalajara, Mexico

Abstract
The Aquaculture sector in México has had in last decades a sustained growth, as a respond to the over-exploitation of marine species and devastation of the environment; for this reason cultivation system and the use of technological advances have been diversified to reduce their effects, the intervention of international institutions, Food and Agriculture Organization (FAO), and Nationals, Commission National of Pesca (CNP), ensure monitoring to determine the degree of progress in meeting the objectives in the field.
For the above is very important set the level of development in Aquaculture, which through this investigation addresses the Productive Articulation around the Production Centers, in two estates of West Center Zone in México, Colima y Jalisco, whose objective is to define the organization and characteristics of the grouping between the different social and economic actors, enterprises of various sizes, suppliers, aquaculture centers, universities, investigation groups, government agencies and producer associations.
The conclusions show the characteristics of the productive chains in afore mentioned federal entities, as well as their orientation for the development of innovation and internationalization of natural products, proposing alternative solutions to improve the operation and integration of the sector.

Keywords: productive articulation aquaculture innovation colima jalisco

Introduction
The decrease in the production of food of animal origin for human consumption at a global level, caused by the deficiency in the management of resources and some cases by the overexploitation of certain marine species in salt water and fresh water, has allowed in the last two decades to develop alternatives for the breeding and cultivation of aquaculture species in controlled environments in different countries and continents of the world.
This paper will establish the background of the research work carried out from 2005 to 2010. As mentioned by Huerta (2013) [10], returning to the responsible contacts of the organizations and groupings between the different social and economic actors, companies of various sizes, suppliers, aquaculture centers, universities, suppliers, research centers, government agencies and producer groups, to compare whether progress has been made in a better division of the work and obtaining a level of specialization and integration, aimed at promoting the internationalization of its products and services, thereby strengthening the sector in a systematized way.

Theoretical Framework
The literature of productive articulation has been analyzed in recent years since the concept of clustering appeared (Porter, 1998). The integration of this type of groupings, mainly in the high-tech sectors such as automotive, electronics and biotechnology, (Zubillaga, Huerta, *et al*., 2017) [17]; in addition to business networks and the analysis of the value and supply chain, particularly, according to what is addressed in this article, the creation of productive groupings in the aquaculture sector in different parts of the world. Next, the concepts of Productive Articulation, Aquaculture, and Innovation will be developed as a background to the research work.
According to the international literature, 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).
The policies for the creation of clusters around the world involve a wide variety of design policies, which essentially involve various actors aimed at the development of innovation in different sectors, stimulating the concentration of experts and knowledge in a geographical space, potentially creating poles of development related to the competencies of economies of scale, facilitating the dissemination of knowledge, promoting a culture of learning and contributing to the development of a common vision between actors in certain regions and achieving collective objectives (Pro-Inno Europa, 2003b).
According to Solvell (2009), the dominant policies involved in the creation of clusters are: a) Science and Innovation, investment for the development of science and technology; b) Competition, rivalry is one of the key

ingredients in the dynamics of clusters; (c) Business, the relationship of markets around the world is of fundamental importance; d) International integration, the interaction of countries in the global network allows major exchanges in all areas of economic development e) Regional, clusters can contribute to regional programs, and f) Social, concerning the importance of access to efficient public services, improves the attraction of new resources from abroad. Additionally, the objectives in the cluster initiatives could be human resources, cluster expansion towards the increase of a significant number of companies, business development, international cooperation and interaction, innovation objectives, and the creation of business environments.

The development of cluster initiatives in small and medium-sized enterprises (SMEs) has been studied in developing countries in the context of increasing competitiveness and collective efficiency. Public policies for the creation of a Cluster, in addition to focusing on the relationship between companies, should focus on a group of policies to improve technological capabilities (human resources, external use of knowledge), improving intermediary institutions of financial and technical services, business transactions for infrastructure, access to the global market by maintaining open trade and reducing specific export tariffs for SMEs, (Albaladejo, 2001). In the same sense, Bortagaray and Tiffin (2004), point out that innovation in clusters involving SMEs is fundamental for the industrial and social development of Latin America.

Arteche, M, Santucci, M, and Welsh, V. (2013) referred to the importance of the construction of networks and clusters for innovation and knowledge transfer in the regional growth of Argentina, analyzing the main clusters, improving innovations as well as positive externalities for the community. In particular, the national policy of support to SMEs had as an expectation that the clusters could stimulate learning and collective action between enterprises. As proposed (Etzkowitz, 1997), the initiatives are supported between the academic sector, the government, and companies, as suggested by the triple helix model, now with one more propeller as it points out (Sanguesa, 2007), the participation of society is fundamental for the creation of innovation and value.

Regarding the emergence and operation of cluster initiatives linked to Aquaculture, references can be found in different continents, among others the one documented by Gonzáles and Hurtado, (2018) [8]. Regarding the organization of small blue mussel producers in Chile and institutional factors, the study incorporates an analysis of the value chain from a quantitative perspective; focuses on product flow and marketing. The Cluster initiative integrated by the fish farmers has allowed over ten years, the consolidation of the grouping, and generate stable economy from the income through the exports of the product. The participation of the Chilean State has been fundamental to support producers through incentives for research, training, and financing programs to strengthen production and marketing and the gradual integration of the same.

The advantage of the proximity of fish farmers to large cities facilitates the positioning to innovation, unlike those found in rural areas far from these population concentrations. The agglomeration of farms and contact between farmers, stimulates specialization and a better understanding of diversification, allowing relative gains from the economy of specialization in certain products, (Chaoran, H., Xiaobo, Z, Hernández, R, 2017).

The application of the Cluster model, in addition, has not worked accurately in this sector due to the lack of commitment of government figures in charge of the development of aquaculture, 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 by such means it leaves them out of any support, replacement, financial, or otherwise, there is no link with research and development institutions, (Chaoran, H., Xiaobo, Z, Hernández, R, 2017).

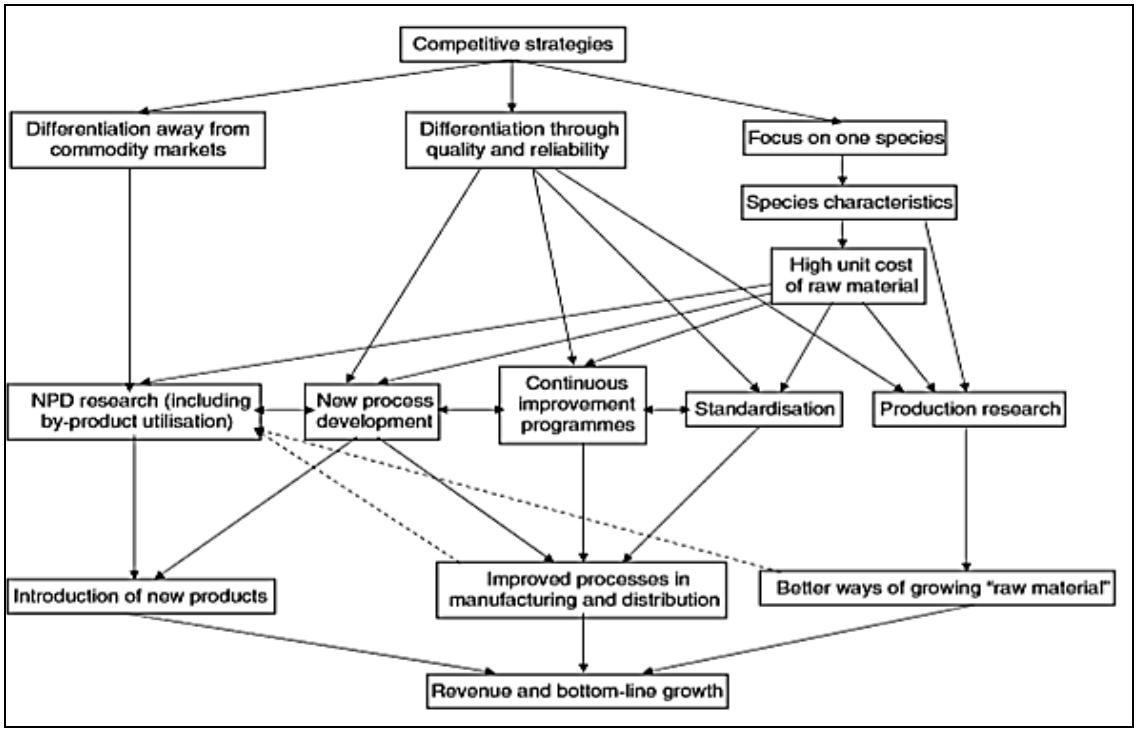
A fundamental aspect of the dynamics of the cluster is the trust that may exist between producers for joint investment. Experience shows that they have independent participation that means each one decides the quantities to produce, how much they will invest, the distrust between the fish farmers has been evident, so it shows the lack of commitment of some, (Flores, 2016). Cooperation between producers only occurs in some areas such as the purchase and transfer of trout to reduce costs, when fish farmers face difficulties such as food shortages or diseases in production, each of them takes individual actions to solve it. Therefore, cluster initiatives are not always successful, so appropriate mechanisms are required to favor their creation and subsequent consolidation, (Huerta, J. 2013*) [10].

Finally, concerning Innovation in SEAFOOD SMEs (Bhaskaran, 2006) [1], it analyzes the adoption of new products, methods, systems, markets, and sources of supply, and reviews the adoption of innovation in a broad and new context. According to the before-mentioned author, innovation is like strategic experimentation linked to risk-taking behavior. Activities such as the introduction of new differentiated products, the 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).

Sankaran and Suchitra (2006), establish the importance of improving processes by increasing production and profits in the seafood sector from the case study of the company NZ King Salmon (NZKS). The importance of seeing the value chain as the group of primary and supportive sequential activities that a company performs transforms its raw materials or inputs adding value to its products for its external customers. Innovation is "The introduction of a new or significant improvement to the products or services of the market, or the introduction of a new improvement to business processes"(Fallow, 2004) [6].

Morgan, *et al*. (2003) [11], adds 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.

The proposal by Sankaran and Suchitra (2006) points to the importance of considering three aspects: (1) product orientation; (2) process orientation; and 3) orientation to the market and its impact on innovation, and from these, the performance of the company from its strategic approach.



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

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

Methodology

This research work is entitled "Productive Articulation in Aquaculture Enterprises in Colima and Jalisco. Current conditions and prospects for partnership, innovation, and development, it was developed in three stages:

1st. Meeting of documentary and empirical background related to the subject in the question of the entities subject to investigation.

2nd. Field research visits to aquaculture farms, producers' associations, organizations responsible for fisheries and aquaculture of the federal and state government, managers of health and safety committees, research centers, universities, and social actors involved in the groups' formation of this sector in Colima and Jalisco.

3rd. Integration of the information and analysis of the data obtained for the elaboration of the research article.

The theoretical framework for this work addressed important aspects of productive articulation, aquaculture, and innovation. The qualitative approach was selected to discover opinions, assessments, observations, and images of the subjects at the event to achieve the objectives of the study based on the findings and the participation of actors in the reality they live in.

The main objectives of this research are as follows

1. Define the different modalities of productive articulation in aquaculture farms and other social and economic actors in the Central West Region.
2. Analyze and determine how the productive articulation and technological innovation are related to promoting the internationalization of its products and services in the State of Colima.

Research results

Documentary searches have been carried out in databases to establish state of art in the three central aspects of this research, productive articulation, aquaculture, and innovation. The literature reviewed so far, allows us to have an overview of the evolution of the theme from 2010* to date, finding relevant antecedents of the productive articulation and aquaculture. In countries such as Bangladesh, Chile, Mexico, Peru, Vietnam, where aquaculture crops of blue mussels, trout, and salmon among others, have been developed from the creation of clusters or business networks, documented in the articles indicated in the theoretical framework of this first research advance. The most relevant case so far is that of Chilean salmon, produced on farms through the grouping of companies that make up the cluster.

*** Research for doctoral thesis in the Central West Region of Mexico, Juan José Huerta, 2010.**

Although, the development of aquaculture in Mexico poses a primary activity that, as it continues to develop into action, is profitable, using innovative techniques. Also, in the future, there is a trend for the population to be

provided with food, therefore, it is crucial to boost the farms that are generated in this sector, as business units of intensive or semi-intensive production types.

Colima

In this Federative Entity the most important activities for this research related to the primary sector and the repercussions to the gross domestic product are livestock with 11.6%, and fishing and aquaculture with 3.4% (INEGI, 2015). It is worth mentioning that Colima ranks 29th nationally in livestock production and 10th place in fish production. Since coastal and hydrological resources and the proximity of its ten municipalities to the sea. Its population is distributed in 89.9% urban, in the capital and municipal capitals, and with 10.1% rural. It has a population density of 126; inhabitants/km2., its main crops and production are lemon (21.9%), sugar cane (17.7%), papaya (9.5%), banana (8.9%), Pastures (7.8%); likewise, in fishing, its largest contribution is Tuna (56.0%), Shrimp (25.1%), Kite (7.2%), Mojarra (2.1%), Guachinango (2.0%), SAGARPA (2015).

In Colima, Aquaculture is composed of aquaculture production centers, its main characteristic is that they are rusticators and intensives, however, there are farms that have technology applied to crops,(interview to subdelegate of Fishing CONAPESCA, SAGARPA 2018); one of the important bodies in the Entity is the Aquaculture Health Committee, whose basic function is to advise the farms to reduce the problem in terms of health and management of the organisms; coordination is also carried out with the Government of the state of Colima to testify the production units as far as possible and to provide training in various subjects to the producers themselves, who mostly produce shrimp and tilapia.

One of the products grown in the State is tilapia with production units in its ten municipalities, which is oriented to the self-consumption of the rural population and some urban centers. In 2015, a production of 788 tons was recorded in Colima in controlled systems and aquaculture fisheries, which generated an economic spill of 14.5 million pesos in the region. According to documents from the National Commission of Aquaculture and Fisheries, (2016), all indicate that the federal government promoted the development of aquaculture as a productive activity. Thus, generating food of high nutritional quality and causing a regional economic spill; in the same State, tilapia producers are reorganized with the support of 23 aquaculture representatives from the ten municipalities of the entity, integrating a representative before the National Committee of the Tilapia Product System.

As for shrimp, it is relevant to point out that, according to the Tierra fértil publication, (2018), in 2017 Colima achieved the national leader in the production of freshwater shrimp. Being the beneficial climate for the activity, innovation in technology in the management of crustaceans, and the hard work of producers, which achieved a harvest of three thousand 500 tons with a value of 350 million pesos. The innovation in the production of farm shrimp makes the harvest of more than 10 tons per hectare, a yield that makes a radical difference over other entities producing sweet shrimp.

In 2007, Colima produced one thousand 500 tons of this variety of crustaceans, a value of 80 million pesos. By 2013 it already occupied fifth place in the crop with two thousand 500 tons that produced 120 million pesos. And in 2017, when shrimp farming was favored by the climate and supported development with reefs, it strengthened its national leadership.

One of the organisms that have been promoted in the State is the bullfrog with 2 farms, however, the interest is focused on the commercialization of shrimp and tilapia.

Regarding the conduct of the research, in 2018, the first stage of research began. Contact was established with public and private organizations in the state of Colima to arrange research visits and conduct interviews with public servants responsible for the Federal Delegation of SAGARPA, Department of Fisheries or Rural Aquaculture, Aquaculture Health Committees, Input System Product by species depending on the specific orientation of each state and Producer Organizations; likewise, personnel of the National Fisheries Commission (CONAPESCA)were contacted, see Table 1.

Table 1: Interviews conducted Aquaculture Sector, Colima 2018

Charge	Interviewee	Product in cultivation	sector
Directorate of Fisheries and Aquaculture	Dr. Claudia García Olea	coordination	State Government
Colima Fisheries Sub-Delegation	Mtra. Elena Telina Cárdenas Zermeño	coordination	federal government
Aquaculture Health Committee	Ing. José Antonio Fernandez Meneses	coordination	Government - Enterprise
Catfish Farm	Eng. Oscar Jauregui Quince	Tilapia and Shrimp	business
Aquafruit Farm	Mtro. Carlos Hernández Solórzano	shrimp	business
Jala Aquaculture Center	Mtro. Maximiliano Sánchez Barajas	Tilapia	government
Directorate of Fisheries and Aquaculture	Dr. Claudia García Olea	coordination	State Government

Colima Fisheries Sub-Delegation	Mtra. Elena Telina Cárdenas Zermeño	coordination	federal government

Source: Own elaboration from field research interviews, Jalisco, 2018

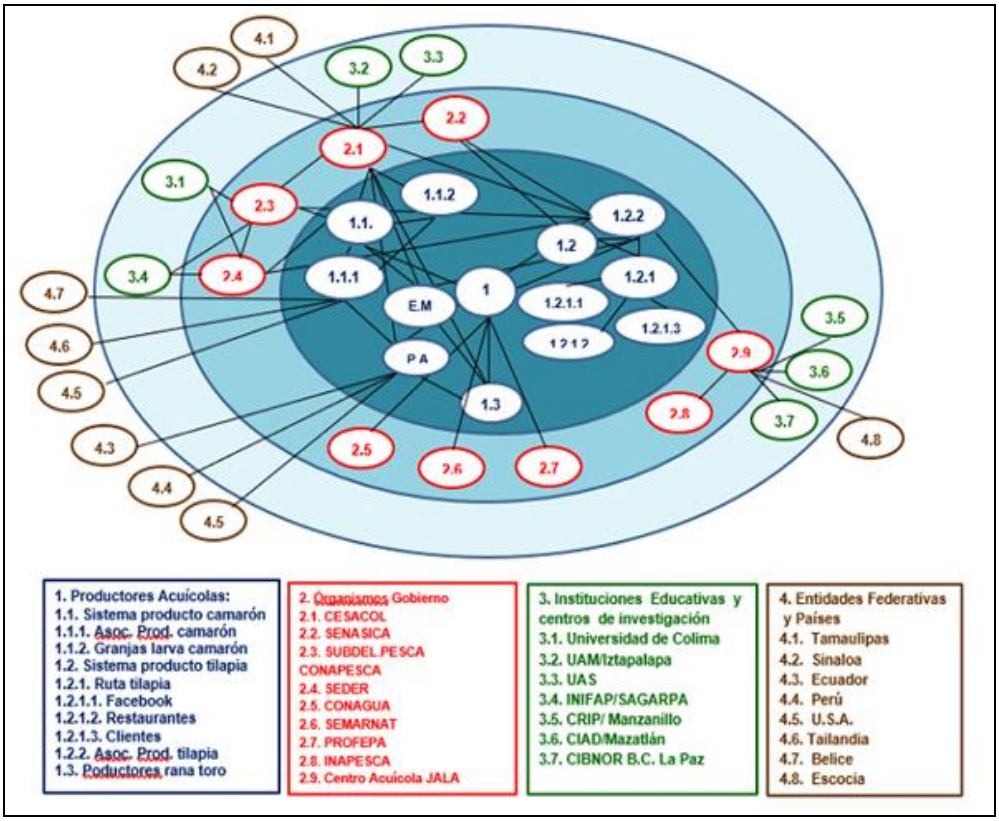
As for the Productive Articulation, figure no. 2 shows the relationship between the various actors involved in shaping the production chain in the aquaculture sector of the state of Colima. As a central part of the grouping, are the producers (production units) since it is where the organisms (tilapia and shrimp) are grown; the public bodies of federal and state government, which are responsible for providing advice and support for the aquaculture sector; the educational institutions that generate this link with company-government-university to prepare professionals and generate applied research and subsequently making participation agreements with other states in the country and abroad where similar activities are carried out successfully.
It is basically grouped into four subgroups:

Group 1 Aquaculture producers
Shrimp product system, shrimp producer associations, and shrimp larval farms.
Tilapia product system, Facebook is integrated with the tilapia route, restaurants and customers, association of tilapia producers.
Bullfrog producers.

Group 2 Government Agencies
Aquaculture Health Committee (CESACOL), Senasica National Aquaculture Safety, Quality and Health Service, Sub-Delegation of the National Fisheries Commission in Colima (CONAPESCA), Secretariat of Rural Development (SEDER), National Water Commission (CONAGUA), Secretariat of Environment and Natural Resources (SEMARNAT), Federal Attorney's Office for Environmental Protection (PROFEPA), National Fisheries Institute (INAPESCA), and the Jala Aquaculture Center.

Group 3 Educational institutions at the higher level and research center
University of Colima; Universidad Autónoma Metropolitan, Iztapalapa (UAM); Universidad Autónoma de Sinaloa, (UAS); Institute of Forestry, Agricultural and Fisheries Research (INIFAP-SAGARPA); Manzanillo Regional Fisheries Research Center (CRIP); Center for Food Research and Development, (CIAD-Mazatlan); Northeast Biological Research Center, CIBNOR B.C. La Paz.

Group 4 Federative Entities and Countries
Tamaulipas, Sonora, Ecuador, Peru, USA, Thailand, Belize, and Scotland.



Source: Own elaboration with data obtained from field research interviews, Colima 2018

Fig 2: Chain of the aquaculture sector in Colima

Analyzing the groups broken down above presents different levels of productive articulation, from permanent relations of coordination to sporadic activities that some cases, benefits for their participants do not exist.

In the case of Group 1, the most active, its shrimp and tilapia producers, have varying degrees of technology, in the case of shrimp, the profile of the entrepreneurs is mostly professional training, more complex facilities are required, and therefore, greater training and exchange of experiences between the members of the shrimp product system and regular contact with the Aquaculture Health Committee of the Entity, the production centers are mostly a few meters from the coast, especially depending on the water for their crops.

The tilapia profile, unlike shrimp producers, is basic, or preparatory and few of them have a university education. Most of the production units are in the rural area, and some combine fish farming with other agricultural products, coconut, lemon, papaya, their level of technology is basic, and although there is the tilapia product system, there is low participation in the coordination meetings organized by SEDER.

The level of articulation of Group 1 producers is permanent with Group 2 of government, both of the federal government through the delegation of the national commission of Fisheries and the Secretariat of Rural Development of the state government, the regulation and regulation by these organizations is permanents, occasionally the producers come when they are interested in obtaining some financial support, but their degree of interaction between the producers is greater among those of shrimp than in relation to those of tilapia, however, the latter have linked a commercial tourism project promoting the route of the tilapia promoted in FACEBOOK; it should be mentioned that there is also a government aquaculture production center in the town of Jala, provides support to tilapia producers, offering them breeding grounds and fry for start-up or repopulation.

The Aquaculture Health Committee has a crucial involvement with producers for health and safety purposes, regularly verifying the operating conditions of the farms.

As for Group 3, higher education institutions and research centers, the relationship with producers is occasional, to bring students to know the production units, some specific projects to improve the genetics of resistance of species to various diseases. However, studies prepared by the University of Colima, UAM Iztapalapa, UAS, INIFAP Colima, CRIP, CIAD, and CIBNOR, are not continuous.

As for Group 4, there is a link with the states of Tamaulipas and Sonora to compare cultivation practices and experiences and try to improve locally. As well as with specialists from Ecuador, Peru, E.UA., Thailand, Belize, and Scotland to know the production processes of Shrimp and Tilapia.

Regarding the innovation of the aquaculture sector in the entity focused on shrimp farming, producers frequently make improvements to the biological input (shrimp larva), to the processes of cultivation, harvest, and marketing; the interrelationship with specialists from other countries such as Ecuador, Belize, and Thailand, have allowed them through benchmarking to improve their working methods, however, it is occasional, as well as in the relationship with universities and research centers for the same purpose; the educational level of shrimp producers, who in some cases have university training even with postgraduate studies, guides to the continuous improvement of their farms and the sector.

In the production of tilapia, the degree of technology is rudimentary. Traditional systems of culture in natural ponds or geomembrane are used, basic devices of aeration with pallets and recirculation of water, the egg is not genetically manipulated to give it greater resistance to diseases and the processes of hormone and masculinization are the traditional ones; the marketing processes are word of mouth, although some producers are carrying digital marketing through Facebook, promoting the consumption of the product and tourist activities such as the route of tilapia in the State.

Table 2: Relevant data about the aquaculture sector in Colima, 2018

Secretary of Rural Development, Directorate of Fisheries and Aquaculture, Colima	**Aquatic Health Committee**	**Secretary of Agriculture and Livestock, Food and Fishing CONAPESCA**
There is an association of shrimp farmers that make consolidated purchases, established in 2004 and in force as of 2018	Association of aquaculturists only shrimp farmers in some polycultures. Shrimp farming is more accelerated, aggressive and risky than tilapia activity	Disconcentrated organ, is in charge of the sanitary part. The fishing sub-delegation depends on the CONAPESCA.| There are no relationships with national and international organizations only in central offices
Tilapía producers integrated into the product system from 2006 in force to 2018. Shrimp producers less than 20 and in tilapia between 50 and 60 a bullfrog farm in Coquimatlán (1 year operating), with a production of 4 tons	The committee is obliged to monitor the productive units for working with federal resources. It matches the interests of the union members and the federal institution. It is suggested to review the laws as obsolete, at the national level, since they affect aquaculturists	Tilapia Product System Committee made up of the Federal Government, producers, links and government representatives of the federal government of CONAPESCA and the state Government by the director of fisheries and aquaculture of the SEDER was installed at the end of2016
Collaboration agreements Sub delegation of Fishing	Importance of aquaculture equipment form Asia Relationship	Two groups of shrimp and tilapia are not all associated producers. There are little

CONAPESCA, director of Fisheries and Aquaculture of SEDER, for programs to support producers, modernization of fishing vessels, rural aquaculture in which the State government provides resources	with UNiversity of Colima researchers and the Fish Committee the relationship is not frequent	than 20 shrimp producers of tilapia there are between 50 and 60 Star of activities with bullfrog no more than one year with two producers. Subdelegation of Pesca/CONAPESCA, Input Product Committee contributes to the consolidated purchases of food, prepares a project to prepare food.
Relationship University of Colima FONDEM Project, for dredging of navigation channels Laguna of Cuyutlán, Linkage SEDER, University of Colima, training of technicians for mairculture fishermen (50 participants)	The case of shrimp is critical or acute mortality diseases in early stages of culture, aeration problems or excess of organisms in ponds, inadequate management in general or the farm. Shrimp farmers are always ready for technological improvements.	The most important support that SAGARPA grants through CONAPESCA, infrastructure , equipment, biological resources (hatchling or fingerlings) genetic resources, commercialization, training, promotion of consumption, fairs and exhibitions, points of sale (promotion of fishing and aquaculture property) commercial aquaculture, mariculture and rural aquaculture
In shrimp farms there are health problems; early death, small ponds. Wáter costs in tilapia farms their problems are costs and fat telling time, high feed costs.	The main problem in tilapia producers is financial, lack of funds, they do not have equipment to check parameters, they don't have a business plan they don´t market, it is rudimentary	The growth of the aquaculture sector is permanent. It's necessary to highlight the riches to exploit its potential at the national level of mariculture. The relationship with CONAGUA is permanent, aquaculture is classified as an industrial activity, which affects producers due to the high cost
INIFAP project to develop aquatic feeds from vegetable and animal protein, Producer´s main problem is the cost of food	CESACOL provides services to registered producers and they pay fees; they are made a weekly visit to monitor the ponds, fresh analysis reviews, micro biologicals, algae checks, water quality are made	In shrimp, producers avance by adopting their own technology, changing little by little. There are two producers of shrimp larvae, one of them is Aqua granjas of Pacific
Important shrimp farms Agroindustry´s Rafen/Tecoman, Ponds Praderas anda Flores/Coquimatlán, Aqua cultives of Real/Tecoman, Aquafruts, Crops of shrimp of México, Sanja Prieta	Tilapia in the strongest are those with attached restaurant Mixcuate in -Villa of Alvarez; one in Coquimatlan, for tilapia production, is not enough for the demand, in some cases they have to buy in Jalisco	The tilapia producers are mostly rural areas, small farms and their level of academic training is basic. Promotion of the tilapia route, (https://www.facebook.com/rutadelatilapia .2137002259081127/), producers and extension workers install restaurants along the farm

Source: Own elaboration with data obtained from the interviewees, 2018

Jalisco

According to information from SADER (2020), Jalisco contributes to production, livestock and fishing a volume of more than40 million 481 tons to the country, which places it in the leading Federative Entity in these aspects; The Entity represents the Central West Region, its biodiversity characteristics is one of the main attractions, within its territory there are international beach destinations and large areas of land dedicated to the production of agricultural products, livestock and in smaller quantities of fishing and aquaculture.

The population employed in the primary sector reaches approximately 309,252 inhabitants dedicated 75%in agricultural activities, 24% in livestock, and 1% in fishing and aquaculture. In recent years, the agricultural and fisheries sector has had significant growth in the value of production; among the most outstanding agricultural products are agave, corn, grain, and sugar cane; in livestock, egg, meat in bovine carcasses and pigs; in fishing the mojarra, carp, and guachinango.

As for the Aquiculture, the infrastructure that has been developed in the last ten years by the Government of Jalisco has allowed a sustained growth of the sector, with the impulse of six centers s of production of tilapia offspring in Las Pintas, Tizapán, El Nogal in Tapalpa, Las Peñas in Huejúcar, Ajojucar in Teocaltiche and the Estribón in Yahualica.

There are also 46 private aquaculture farms for the fattening of fish, only 23 operate, in the municipalities of Chapala (rivera), Sayula, Tuxpan, Cihuatlán, Jesus María, Pihuamo, Tala, Tototlán, and Villa Corona. It also has at the state level 22 frog farms, Jalisco is a leader in the production of tilapia, bullfrog, fry, and ornate fish.

As for the research work carried out in the State of Jalisco, eight interviews were conducted with different actors of the aquaculture sector in the entity (see table 3), three of them with representatives of the State Government,

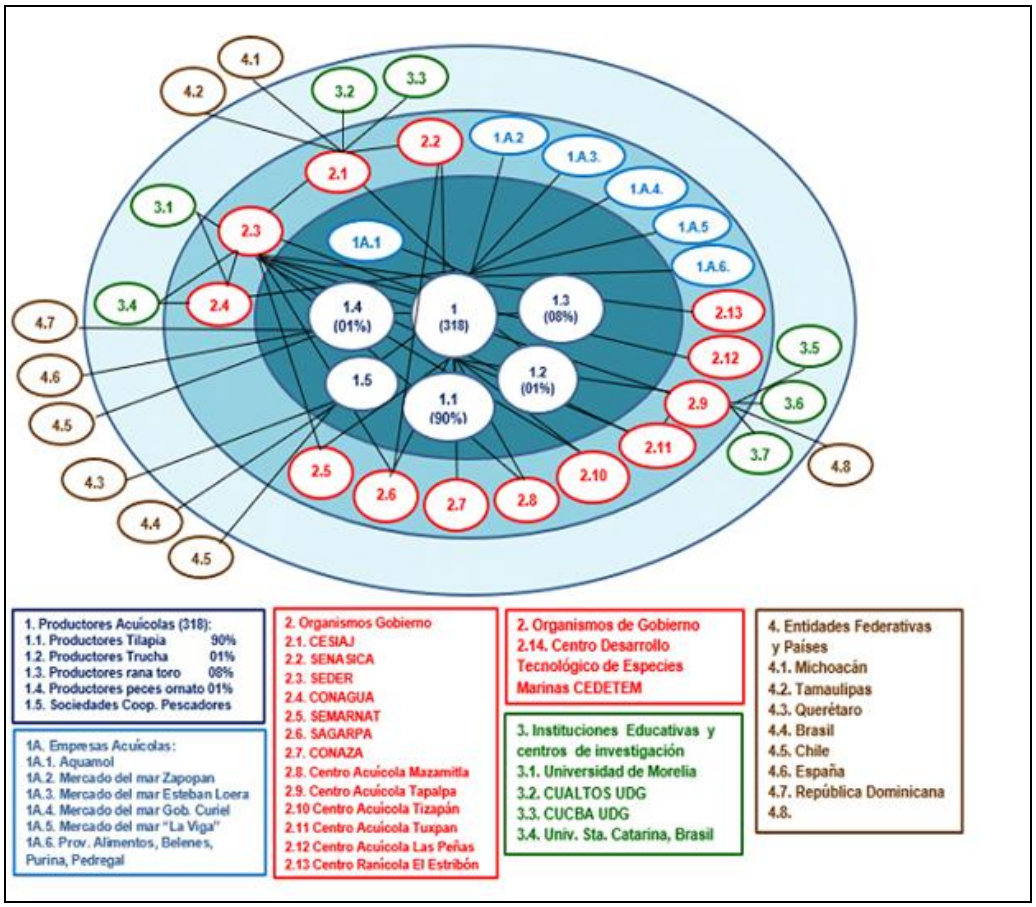
Aquaculture Coordination, two heads of aquaculture production centers in Yahualica and Huejúcar (bullfrog and tilapia, respectively), the representative of the Aquaculture Health Committee and four entrepreneurs of aquaculture farms, three of tilapia and one of bullfrog; it was not possible to interview the delegate in Jalisco of the National Fisheries Commission since his agenda did not allow it.

Table 3: Interviews conducted Aquaculture Sector, Jalisco 2018

Charge	Interviewee	Product in cultivation	sector
Fisheries and Aquaculture Coordination	Mtro. Rubén Ruiz Medina	coordination	State Government
El Estribón RanícolaCenter, Yahualica	Tec. Jose Jaime Ruvalcaba Perez	bullfrog	State Government
Las Peñas AquacultureCenter, Huejúcar	Biol. Elvia Luano Torres	Tilapia	State Government
Aquaculture Health Committee	Mtro. Julio Cesar López Martínez	coordination	Government - Enterprise
Tilapia Farm Rancho Las Tortugas	Ing. Guillermo Haro	Tilapia	business
Violet Frog Farm	Evangelina Contreras Navarro	bullfrog	business
Hacienda Guadalupe Farm	Alvaro Jimenez Gomez	Tilapia	business
Yahualica Farm	Ing. Francisco J. Becerra Zamorano	Tilapia	business

Source: Own elaboration from field research interviews, Jalisco, 2018

Concerning the Productive Articulation (see Figure 3), the relationship was established between the various actors, aquaculture producers, tilapia, bullfrog and ornate fish, producers' associations, the sea market in the Metropolitan Area of Guadalajara, aquaculture food suppliers; their link with government agencies, as well as the infrastructure of government production centers; existing exchanges between producers, government and educational institutions, universities, technological institutes, and research centers and finally the links between producers, government, governments of other states and other countries.



Source: Own elaboration with data obtained from field research interviews, Jalisco 2018

Fig 3: Chain of the aquaculture sector in Jalisco

Therefore, it was possible to identify four groups within the aquaculture chain in Jalisco

Group 1 Aquaculture Producers
Producers of Tilapia, trout, bullfrog and ornate fish, fishermen's cooperative societies, Aquamol companies, sea markets in Zapopan, Esteban Loera, Gobernador Curiel, La Viga (CDMX.), food suppliers Belenes, Purina and Pedregal.

Group 2 Government Agencies
State Center of Sanidad e Inocuidad Acuícola del Estado de Jalisco (CESIAJ); National Service of Health, Safety and Aquaculture Quality (SENASICA; Ministry of Rural Development (SEDER-Jalisco); National Water Commission (CONAGUA); Ministry of the Environment and Natural Resources (SEMARNAT); Ministry of Agriculture, Livestock, Fisheries and Food (SAGARPA); National Commission for Arid Zones (CONAZA); Government Aquaculture Centers, in Mazamitla, Tapalpa, Tizapán, Tuxpan, Huejúcar (Las Peñas) and Yahualica (El Estribón); Technological Center of Marine Species (CEDETEM).

Group 3 Educational Institutions and Research Centers
University of Morelia, University Center of Biological and Agricultural Sciences UDG, University of Santa Catarina in Brazil.

Group 4 Federative Entities and Countries
Michoacán, Tamaulipas, Querétaro, Brazil, Chile, Spain, and the Dominican Republic.
In the analysis of the mechanisms of Productive Articulation, it is possible to determine that the relations between Group 1 and Group 2, as established in Colima, the relations are very similar, to follow the regulations and specific sanitary provisions of the sector, as well as in due course request financing for the acquisition of equipment, spare parts, or for new entrepreneurs for advice and creation of business plans.
A different aspect to that is taken part in the neighboring entity, Colima, which regularly works for self-consumption and local consumption, in terms of the commercialization of products; the Metropolitan Area of Guadalajara, has three seafood markets: the Zapopan, Esteban Loera, and Gobernador Curiel, from that place, is commercialized aquaculture and marine products for the whole republic, but a significant number of products is distributed in the market of "La Viga" in Cd. Mex., ensuring the placement of practically the entire product.
The interrelationship of aquaculture producers with food suppliers is permanent, the companies with which we have business contacts are Belenes, Purina, and Pedregal.
Government agencies fulfill their role by establishing permanent contact; nevertheless, there is a lack of coordination between federal and state authorities, even aquaculture statistics differ, the degree of updating is relative depending on the variation in the census of aquaculture production units in the country.
The participation of government aquaculture centers favors producers with sometime in the activity and those of recent income for the acquisition of fry, breeding, and biological input for repopulation at low costs, in some cases by donation, which drives the increase of aquaculture farms in Jalisco.
Educational Institutions and Research Centers maintain a sporadic relationship with aquaculture entrepreneurs and the government sector, only for guided tours of production units, training, and specific applied research projects.
Finally, the interaction at the level of state and international governments exists for the exchange of experiences in the different species, for example, with Tamaulipas and Querétaro for tilapia, Michoacán bullfrog, Brazil, Chile, Spain, and the Dominican Republic for exchange of experiences in aquaculture, training of technicians and advice for specific problems of the species in culture.
About innovation in the aquaculture sector of Jalisco is still incipient, there are greenhouse-type aquaculture centers with systems of aeration and recirculation of water with state-of-the-art technology, geomembrane pond, however, it is not the whole, it is sought to make genetic improvements in aquaculture companies of ornate fish; the corrals for raniculture are made of material with intensive care for the cleaning of the same to prevent the spread of diseases, the participation of the Aquaculture Health Committee is important for this purpose not only for the timely detection of diseases, but also for the exchange of experiences with specialists from other countries of the world; however, but no research or formal scientific studies are also carried out to improve the quality of organisms and their resistance to different types of diseases.
The equipment with advanced technology is promoted by the government agencies to promote a greater and better development of the aquaculture sector in the entity.

Table 4: Relevant data on the situation of the aquaculture sector in Jalisco, 2018

Secretary of Rural Development, Jalisco State Commission	Aquatic health Commission	Secretary of Agriculture ana Livestock, Food and Fishing-CONAPESCA
There is the association of tilapia farmers. In tilapia farms their problems are high feed and water	The committee is obliged to monitor the productive units for working with federal resources, it	The most important support provided by SAGARPA through CONAPESCA, infrastructure, equipment, biological

costs. Important farms Aquamol, La Violeta, Aquaculture center government, in Mazamitla, Tapalpa, Tizapan, Tuxpan, Huejucar (The Peñas) and Yahualica (The Estribon)	makes the interests of the union members and the federal institution coincide. It is suggested to review the laws as obsolete, at the national level, since they affect aqua culturists.	resources (hatchlings and fingerlings), genetic resources, marketing, training, promotion of consumption, fairs and exhibitions, points of sale (promotion of fishing property and aquaculture), commercial aquaculture, agriculture and rural aquaculture
Tilapia producers integrated into the Product System from 2006 to 2018	The main problem for tilapia producers is financial, lack of funds, they don't have equipment to check parameters, they don't have a business plan, they don't have a market, it is rudimentary. CESAJAL provides services to producers registered and paid their dues; They are made a weekly visit to monitor the ponds, fresh analysis, microbiological checks are made, algae check, water quality	Tilapia Product System Committee made up of the Federal Government; producers, links and government representatives of the Federal Government of CONAPESCA and the State Government by the Director of Fisheries and Aquaculture of SEDER
Collaboration agreements. Fisheries Sub delegation, CONAPESCA-SEDER State Fisheries and Aquaculture Commission, for programs to support producers, modernization of fishing vessels, rural aquaculture, in which the State Government provides resources	The growth of the aquaculture sector is permanent, niches must be highlighted to exploit its potential, at the national level mariculture. The relationship with CONAGUA is permanent, aquaculture is classified as an industrial activity, which affects producers due to its high cost.	Tilapia and Bullfrog Product System, not all associated producers are present. The producers of tilapia, bullfrog and fingerlings, distribute their products nationwide with the Mar de Zapopan, Gobernador Curiel and Esteban Loera markets in Jalisco and La Viga in CDMX

Source: Own elaboration with data obtained from the interviewees, 2018

Conclusions and Concluding Comments

Based on the research objective proposed for this work, it is important to highlight the following aspects:

1. The current situation of Aquaculture in Mexico is relevant, having significant results in the Entities of Colima and Jalisco.
2. Colima has developed shrimp farming due to the weather and hydrological conditions, its entrepreneurs have the desire to promote it by investing in technology and improved production practices.
3. In the case of tilapia producers in Colima, they operate with a lower level of development, carrying out aquaculture activities with basic and poorly technical production systems.
4. The productive articulation in the aquaculture sector is still essential for commercial relations of exchange and occasionally for research purposes or improvement of farms. It is noteworthy that it is not yet possible to have permanent exchanges at the national and international levels.
5. In Jalisco the main products are tilapia, bullfrog, and ornate fish. In the first product, the government of Jalisco with aquaculture production centers, stimulates the participation of producers of recent entry to the sector and those with some years in the activity.
6. The productive articulation is incipient, oriented more to personal effort than to associativity, so it will have to stimulate the creation of business networks, and clusters focused on aquaculture.
7. Innovation in Jalisco aquaculture is focused on improving the infrastructure for production, improvement of the species, and to a lesser extent of the marketing of its products.
8. There are pending lines of research around technological innovation for the development of the aquaculture sector and the sustainability of companies in their organizational environment.

Finally, it is necessary to emphasize that in Mexico, aquaculture is a strategic area that will have to be consolidated during the next three decades of the XXI century, since in the future it will help to solve, to some extent, the problem of feeding in contracted environments, but also with sustainable and sustainable practices that allow us to move towards aspects of safety and environmental impact, it is therefore necessary. Linking the production units through producers' business associations so that this sector is promoted and subsequently generates sources of employment. This helps to potentiate the economic development of the region particularly of Colima and Jalisco.

References

1. Bhaskaran S. Incremental Innovation and Business Performance: Small and Mediumsize Enterprises in a Concentraded Industria Environment. Journal of Small Business Management,2006:44(1):64-68.

2. Becerra F, Serna H. Redes empresariales locales, investigación y desarrollo e innovación en la empresa. Cluster de herramientas de Caldas, Colombia Estudios Gerenciales,2013:29:247–257, www.elsevier.es/estudios gerenciales
3. Chaoran H, Xiaobo Zhang, Thomas Reardo, Hernandez R. Value-chain clusters and aquaculture innovation in Bangladesh. Food Policy, ELSEVIER, pag. 1 al 17, 2017. www.elsevier.com/locate/foodpol
4. De Arteche M, Santucci M. Redes y clusters para la innovación y la transferencia del conocimiento. Impacto en el crecimiento regional en Argentina Estudios Gerenciales,2013:29:127-138. www.elsevier.es/estudios gerenciales
5. Etzkowitz H, JM Carvalho y M, Almeida. Towards Meta-innovation in Brasil: The Evolution of the Incubator and the Emergent of Triple Helix. Research Policy,2005:34(4):411442.
6. Fallow B. Innovate and Make Money, Says Survey. New Zealand Herald, 27 de abril, 2004.
7. Flores E, Yapachura A. Formación de clústers de productores de trucha y la articulación con el mercado objetivo en la región de Puno – Perú. Revista Comuni@cción Páginas,2016:7:38-48. Base de datos Dialnet
8. González E, Hurtado C, Rojo C. Blue Mussel Aquaculture in Chile: Small- or Large-Scale Industry. Aquaculture, Science Direct,2018:493:113-122.
9. Huerta J. Articulación productiva para la innovación en las pequeñas empresas de la región occidente de México. El Agora, ISSN-e 1657-8031, 2011, 403-422.
10. Huerta J. Articulación Productiva para la innovación en las empresas acuícolas de la región centro occidente de México. Tesis Doctoral en Administración Universidad Autónoma de Querétaro. D.R, 2013.
11. Morgan CW, A Blake y JA. Poyago-Theotoky. The Management of Technological Innovation: Lessons from Case Studies in the UK Food and Drink Industry. International Journal of Biotechnology,2003:5(3/4):334-353.
12. Rivera A, Unibazo J, Vázquez-Lavin F *et al*. Stakeholder perceptions of enhancement opportunities in the Chilean small and medium scale mussel aquaculture industry. Elsevier, Aquaculture, 2017. www.elsevier.com/locate/aquaculture.
13. Sankaran JK. y M. Suchitra. Value Chain Innovation in Aquaculture: Insights from a New Zealand Case Study. Research & Development Management, 2006, 36 (4).
14. Sánchez F, Cruz M, Sánchez P. abril, 30). Industrial Location, Relations with Regional Agents, Formation, and Innovation in Spanish Aquaculture. Journal of Technology Management & Innovation,2011:6:41-49. 2018, mayo 23, De Ebsco Base de datos.
15. Sánchez F, Cruz M. septiembre 11). Desarrollo de Sistemas de Vigilancia Tecnológica en la Acuicultura Española. Journal of Technology management & Innovation,2012:7:214-226. 2018, mayo 12, De Ebsco Base de datos.
16. Steven E, Orchard. Impacts of aquaculture on social networks in the mangrove systems of northern Vietnam Ocean & Coastal Management 114 1e10 Contents lists available at Science Direct, 2015.
17. Zubillaga R, Huerta J. Los sectores de alta tecnología, biotecnología y automotriz, desarrollo económico e innovación tecnológica para el crecimiento social en Aguascalientes y Jalisco, Revista Universitaria Ruta,2017:19:2. ISSN0717-1048.
18. Comisión Nacional de Acuacultura y Pesca, Anuario Estadístico de Acuacultura y Pesca, Edición 2016; http://conapesca.gob.mx[v.e14/11/2018]https://www.gob.mx/conapesca/articulos/se-reorganizan-acuacultores-de-tilapia-en-colima-buscan-mejorar-productividad-y-comercializacion-74033
19. Secretaría del Foro de Alto Nivel de Expertos - Cómo alimentar al mundo en 2050.http://www.fao.org/fileadmin/templates/wsfs/docs/Issues_papers/Issues_papers_SP/La_agricultura_mundial.pdf (v.e.29/05/18)
20. Comisión Nacional de Acuacultura y Pesca. 2018, marzo 8. Recuperado de http://www.conapesca.gob.mx/work/sites/cona/dgppe/2014/ANUARIO_ESTADISTICO_DE_ACUACULTURA_Y_PESCA_2014.pdf
21. Comisión Nacional de Acuacultura y Pesca Fecha de publicación 14 de octubre de 2016 , Recuperado de: https://www.gob.mx/conapesca/prensa/se-reorganizan-acuacultores-de-tilapia-en-colima-buscan-mejorar-productividad-y-comercializacion
22. Comité Estatal de Sanidad Acuícola del Estado de Jalisco. 2018, marzo 15. Recuperado de: http://cesajal.org
23. Comité Estatal de Sanidad Acuícola del Estado de Nayarit. 2018, marzo 13. Recuperado de http://cesanay.org/cesanay/instalaciones-psicicolas/
24. Comité Estatal de Sanidad Acuícola del Estado de Nayarit. 2018, marzo 13. Recuperado de http://cesanay.org/cesanay/instalaciones-acuicolas-de-moluscos/
25. Secretaria de agricultura y Ganadería, Desarrollo Rural, Pesca y Alimentación SAGARPA; Análisis de las cadenas productivas del sistema producto camarón en el Llitoral del pacífico mexicano., septiembre 2015; Reporte detallado 211PP038
26. Secretaría de Desarrollo Rural. Gobierno del Estado de Colima https://www*seder.col.gob.mx/*
27. Secretaría de Desarrollo Rural Gobierno del Estado de Jalisco https://www.jalisco.gob.mx/es/gobierno/dependencias/seder
28. http://manzanillo.tv/noticias/2017/08/30/tecoman-tiene-la-granja-acuicola-mas-moderna-de-latinoamerica/ Recuperado 29 mayo de 2018) [

29. http://www.tierrafertil.com.mx/colima-numero-uno-en-produccion-de-camaron/Recuperado 28 mayo de 2018)
30. http://osiap.org.mx/senasica/sector-estado/colima/Acuicola,Organismos Auxiliares de Salud Animal, Sanidad Vegetal y Sanidad Acuícola e inocuidad,