Comparative analysis of competitiveness and knowledge-technological network in two shrimp producing groups in Mexico

Análisis comparativo de competitividad y red de conocimiento tecnológico en dos grupos de producción de camarón en México

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Abstract

This study is to compare the knowledge-technological flow networks to the competitiveness in two shrimp producing groups from the municipality of Ahome (Sinaloa). It has focused on an analysis of social networks and the information was obtained by the application of a survey to a sample of 60 shrimp producing companies (7 belongs to Sinaloa Aquaculture Cluster and the 53 left belong to the social and private sector). It was found that in the Sinaloa Aquaculture Cluster the network indicators and the competitiveness scale were higher than the rest of the farms. This means that there is a greater transfer of information between the actors, and they also play a key role within the structure, as well as the limited size of the population in the organizations that make up the cluster shrimp farming as well as being focused on geographic and sectorial ambits. For that, is not possible to assume a causal relation and generalize the findings neither. Unity and strategic organization are key factors for this type of productive articulations, as they constitute an important source of social welfare and have a favorable impact on regional development.

Keywords: knowledge of social networks, innovation, shrimp farming, Ahome.

Resumen

Con este estudio, se busca comparar las redes de flujo de conocimiento sobre tecnología en relación con la competitividad a partir de dos grupos productores de camarón en el municipio de Ahome (Sinaloa). Está enfocado en un análisis de las redes sociales, y la información se obtuvo a través de una encuesta, con una muestra de 60 empresas productoras de camarón (7 pertenecen al Clúster Sinaloa-Acuícola y las 53 restantes pertenecen al sector social y privado). Se encontró que, en Clúster Sinaloa-Acuícola, los indicadores de la red y la escala de competitividad fueron superiores al resto de las granjas. Esto significa que existe una mayor transferencia de información entre los actores, y también desempeñan un papel clave dentro de la estructura, así como el tamaño limitado de la población en las organizaciones que conforman el clúster camaronero, además de estar enfocados en ámbitos geográficos y sectoriales. Por eso, tampoco es posible asumir una relación causal y generalizar los hallazgos. La unidad y la organización estratégica son factores clave para este tipo de articulaciones productivas, ya que constituyen una importante fuente de bienestar social y tienen un impacto favorable en el desarrollo regional.

Palabras clave: conocimiento de redes sociales, innovación, producción de camarón, Ahome.

1 Introduction

Globally, fish and seafood products already constitute 16.6 percent of all animal protein intake, and this growth rate has been increasing in recent decades; where, given the onslaught of climate change, providing food to the population (9,600 million in 2050) has become a critical task for governments (Kobayashi *et al.* 2015).

The role and opportunity that aquaculture plays as a generator of aquatic species for human consumption today represent the agricultural productive sector with the highest growth rate as sources of food, nutrition, income, and livelihoods for hundreds of millions of people around the world (FAO 2016).

In Mexico, organizations (companies) in the aquaculture industry have become the food industry with the largest growth rate in the primary sector. By its volume, it is in the two places of fishery production and, by its commercial value, it is in the first place, compared with other items (cattle raising, pig farming, and agriculture). According to CONAPESCA (2017), the annual production growth rate in the last decade is 1.6 %, and its sales by the international market (North America, Vietnam, Europe, and Asia) posse a first place in aquatic species.

Sonora and Sinaloa are two localized entities on the Northwest Coast of the Pacific. They begin to appear in the development of shrimp in captivity, with 140 thousand tons produced in 2018. The state of Sinaloa obtained during 2017 around 84 thousand shrimp tons, registered from 773 producing units, and 61 thousand 417 tons were cultivated on aquaculture farms, obtaining $4 thousand 917 million of *pesos* (MXN); in other reasons, the impact of this activity about the job in coastal communities promotes the regional social sustainability. Shrimp farming has more important social and economic impacts in the northwest region. For the State of Sinaloa, shrimp aquaculture directly and indirectly generates an important source of jobs in coastal communities, reduces migration to urban areas and reduces effort fishing, as well as offers jobs in regions with few opportunities to obtain it (8,015 direct), and favors the obtaining of foreign exchange. However, this activity faced a strong crisis by diseases such as Taura Syndrome, White Stains, and early mortality syndrome in 2013, which caused millionaires' economic losses until 80 % of the total population (CONAPESCA 2017).

With the adverse contexts presented in the last decades', particularity by the pathologic and productive crisis, the producers have modified their production processes and adopted the learning and technological innovation inside their plants. The shrimp aquaculture, being a primary activity with limited capacities in innovation and technology, required continuous scientific-technological intervention that permits the rentability, reduce diseases, minimize production costs, and let it be competitive (Beltrán 2017, León *et al.* 2019). For that, for the fish farmers, it is important to acquire the technological transference and scientific knowledge spillover through the various external sources to the organization, as they are higher education institutions and technology, research centers, aquaculture health committees, national and international suppliers, various inputs, competitors, clients, private consultants, etcetera.

The present research aims to contribute to the empirical study the role that social interactions play, which are developed from the exchange between productive entities and multiple agents-actors, mainly when it comes to technical knowledge that contributes to the processes of innovation and updating in the aquaculture business technologies sector. For this work, we start from the study of an agricultural activity «shrimp farming», implemented in the northwestern region of Mexico, north of the state of Sinaloa —*municipio* of Ahome—. We have the following specific objectives: *i)* to shape social relations through graphs for two sets that cover the study of the structures in a general way of their information transfer links, especially those created between shrimp farming organizations and their entities providers of technical and scientific-technological information —this, through the ARS approach—; *ii)* identify the main peculiarities of knowledge transfer networks in the aquaculture industry in terms of hub, density, size, structure, degree, intermediation, authority, and the comparative analysis between the study groups, and *iii)* estimate the connections that favor a higher positioning within the network; for example, the level of centrality and those that are related to the characteristics of the interconnections that are built with other actors within the network: strength, size and connectivity (diversity) of ties.

The structure of this document is as follows. In section 1 a conceptual framework is presented that addresses the relevance of knowledge networks in technological innovation mechanisms; section 2 highlights the benefit and advantages that social network analysis (ARS) represents in the study of technological innovation capacity; section 3 presents the methodology used for our study. Section 4 consists of results and discussion of these. In section 5, you will find the conclusions of the study and, at the end, the references used to support this research work are listed.

2 Theoretical framework

2.1. The importance of technological knowledge of networks on the innovation processes and sustainable performance in companies

In the last decades, knowledge management as a source of innovation has potentialized the creation of competitive sustainable advantages. However, the quality and diversity of critical knowledge depend on the transference of the company to acquire in an effective way the resources extramural created to the company. So that the innovation decides the conditions of greater effectiveness to produce and use stocks of technological knowledge as competitive advantages in the company (Lundvall 1992).

Companies look for rebuilding information and turn it into useful knowledge, that involves the necessity of more work in the quality of the network of contacts and the volume in knowledge flows created (Steinmueller 2002).

Particularly, companies of low intensity and development (I + D) must be adjusted to new models of business based in knowledge economics which are more and more dynamic.

León *et al.* (2019) point that companies from the private sector are at disadvantage to the competition, because they have not laboratories for I + D; for that, they must go to external knowledge resources to complete their intern resources. Thus, it requires creating cooperation and collaboration networks, that allow increased connectivity and share knowledge producing for each one of the members in the team or network, becoming this strategy an option to the sustainable achievement for companies (Nagles 2007).

According to the mentioned, one of the first authors who approached the study of social networks was Mitchell (1969), who mentions that social networks can be used to know the behavior of the actors belonging to a network. However, Putnam (2002) delves deeper into the concept, and alludes that dense social networks promote reciprocity and cooperation between social organizations, which can lead to an increase in your productivity. This theoretical conception can be evidenced in works such as those of Aguilar-Gallegos *et al.* (2016), Breznik (2016), and Woods *et al.* (2019), which show that companies are linked with a greater number of actors, laboratories or other member companies of a cluster, and present higher degrees of activity in innovation.

2.2. Clusters structure: knowledge and competitiveness networks in the industries

According to Porter (1990, 1998, 2000), the synergy between competitiveness and productivity acts as parameters to measure the social welfare and economy of the nation. Microeconomic factors such as innovation, competition, export position, quality in human resources, generation of scientific and technological knowledge, networks and information flows, and intensity of these interrelations located in the same geographical region (clusters), increase industrial competitive performance against rivals.

Based on the last part, Porter (1999) points to the importance of companies' conglomeration as a source to increase innovation, competitiveness, and productivity in a region or nation, together with the level of interrelations through social networks. Corrales (2017) mentions the participation of local companies as small and medium businesses (SME), that through industrial clusters detonate collective competitiveness, effects spillover (transfer of scientific/ technological knowledge, networks, market, and production processes), and greater investment on innovation, maximizing the result to entrepreneurs' unification between the business association and socioeconomic benefits.

Capó-Vicedo *et al*. (2007) argue that the geographic proximity between the actors (companies, institutions, and research centers), in terms of intensity and frequency, they represent a sustainable competitive advantage among the participants. The composition of social or inter-organizational networks in the case of small and medium-sized companies fosters is an important relationship between these and those external and internal agents to the territory in which they are located to acquire competitive advantages; for example, belonging to a network, they can participate in different markets, by not having to be directly involved in every detail of each market. It also allows each company to focus its efforts and resources on its «core competencies»; that is, to specialize in what it knows how to do well, and the rest is provided by other companies in the area. Continuing with Capó-Vicedo *et al.,* they point out that the network analysis has shown that the best-connected actors in the knowledge transfer network have a superior advantage over those partners who are disconnected or, where appropriate, with weak links.

For small and medium-sized companies, these links influence in such a way that they allow providers, competitors, Higher Education Institutions, government agencies, and research centers, to generate and transfer technological knowledge, demonstrating the importance of social knowledge networks with the absorptive capacity that the company must execute innovation activities, which allow the company to create new opportunities and new ways of competing (Becerra *et al.* 2013).

Therefore, the potential profile of innovation in the companies, regardless of their size, belonging to a cluster, drives the success of the regions where this type of industrial conglomerate operates, where the structures and type of organization are supported by SME with a competitive spirit, and integrity in cooperation between regional entrepreneurs (Corrales 2007).

3
Materials and methods

3.1. Design and participants

This study was made out under the focus analysis of the social networks (ASN), where the design was a quantitative cut and was take a sample of 60 white shrimp farming and producing companies *(Litopenaeus vannamei),* under a productive conglomeration (cluster) geographic in the north region of the state of Sinaloa, municipality of Ahome, during the period from November 2019 to February 2020. In this way, 7 belongs to Sinaloa Aquaculture Cluster (SAC) and the 53 left belongs to the social and the private sector. The type of sample used in ASN was different from the conventional analysis. As mentioned Leskovec and Faloutsos (2006), for the ASN are find three types of samples: *a)* random selection of nodes, *b)* random selection of links, and *c)* exploration techniques that simulate random walks. For the first study, it was used the number one, to establish a subnet that represents a total network and count with the original network properties (León *et al.* 2019).

3.2. Study context and information used

The research was developed through a quantitative application, where its objective is to relate the effect of social networks of knowledge for the transfer of innovation and technology with the level of competitiveness of the shrimp organizations of the Sinaloa Aquaculture Cluster, of the municipality of Ahome.

In this empirical study, it is taken as units of analysis the population made up of organizations dedicated to the cultivation and production of Pacific white shrimp *(Litopenaeus vannamei),* under a geographic conglomeration (cluster) in the northern region of the state of Sinaloa, Ahome municipality.

According to the Association of Aquacultures of Ahome A.C., the Sinaloa Aquaculture Cluster, as well as government agencies (CESASIN, SAGARPA, and CONAPESCA), the aquaculture cluster is unique in its kind as an industrial conglomeration in aquaculture in northwestern Mexico.

It is positioning itself as the most prominent cluster in terms of the contribution in production of farmed shrimp for the state of Sinaloa and Mexico. Furthermore, its product exports are destined for markets such as the United States of America, Asia, and Europe. Therefore, the social benefits that it brings to rural communities are based on the generation of direct and indirect jobs, such as foreign exchange spillage, among other factors that affect regional development in the northern area of the municipality of Ahome (Figure 1).

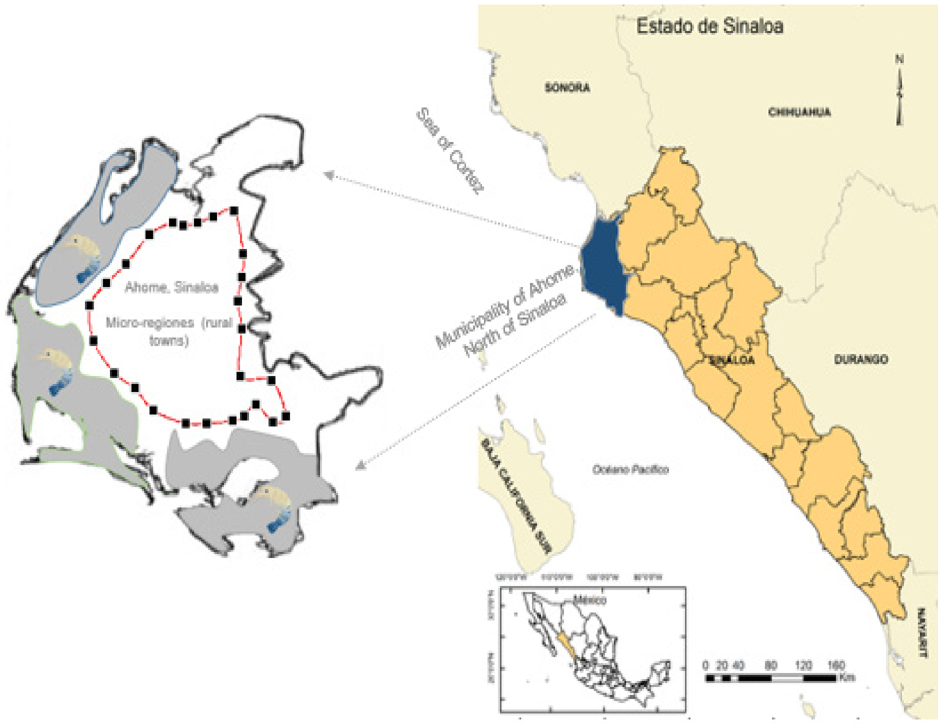

Figure 1
Location of the Sinaloa Aquaculture Cluster (farms)
Source: self-elaboration.

3.3. Instruments and measurements

We were applied a questionnaire, which was divided into three sections: *a)* productive variables: where was include some employees, antiquity, and sector to which they belong; *b)* social network variable: the participants did a list of contacts whom they came to acquire technical knowledge, and *c)* competitiveness variable: a scale of six questions, type Likert from 1 by 5, based on the Jansen *et al.* (2005), and Tepic *et al*. (2012) works («Annexed»).

The social network variable is for visualizing a complete outlook of the interactions of the shrimp producers through a graph. At the same time, through ASN, it is possible to obtain different measures to characterize the network structure. The following were used for this study:

Degree: it is the number of the actor (individuals or companies), whom each one is directly related to, or close to, it (Sanz 2003). The grade is representing by:

$$CD(n_i) = \sum_j x_{ij}$$

Density: it is represented by some links that exist between the network actors, with the maximum number of links that could be if all the actors were connected among them (Sanz 2003). The density is representing by:

$$den = 2L/n(n-1)$$

Where *L* is the number of links and *n* the number of actors. When the value gets closer to 1, the likelihood of the entire network being linked is greater.

Betweenness: it measures the frequency with which an actor is on the shortest route of links between any pair of actors (Giles *et al.* 2015). It is represented as:

$$C_B(n_i) = \sum_{j<k} g_{jk}(n_i)/g_{jk}$$

Where g_{jk} is the number of shortest steps from node *j* to node *k,* and g_{jik} the number of shortest paths from *j* to *k* that pass through node *i.*

Authority distribution: it measures the importance of the actor in the network (Kleinberg 1999). When the value gets closer to 1, the authority of the actor is greater. It is represented as:

$$a_i = \sum_{j \in B(i)} h_j$$

Where a_i represents the authority weight of node *I,* while *B*(*i*) denotes the reference set of node *i.*

Hub: it measures the link quality that the actor has (Kleinberg 1999). The closer the value is to 1, the higher the quality. It is represented as:

$$h_i = \sum_{j \in F(i)} a_j$$

Where h_i represents the weight of the hub of node *i,* and *F*(*i*) denotes the reference nodes of node *i.*

While the competitiveness variable is made up of 6 items on a 5-level Likert scale, where 1 = much less and 5 = much more. It is measured according to its score; the higher the score, it is considered as an organization with high competitiveness.

3.4. Analysis of data

To analyze data on the social network including measures of Degree, Density, Betweenness, Authority, and Hub, the software Gephi 0.9.2 was used. And, regarding descriptive statistics, the statistical program STATA v13 was used.

4
Results

In this section the results of this study are explained. In the first place, we were presented the information about the organization's constriction, followed by the visualization of the network and, finally, the descriptive and comparative measures of the variables divided by two groups of shrimp aquaculturists will be presented.

The studied organizations are divided into two aquaculture groups: the first (SAC) is made up of 11.7 % of the producers and the second aquaculture group, by social and private organizations 88.3 %. At the SAC, 57 % of organizations employ between 51 to 250 people: for his part, in the second aquaculture group, 64 % employ between 1 to 50 people. The SAC is characterized by being older, since 57 % of its organizations have between eleven to fifteen years of operation; on the other hand, in the second group, 45.3 % of their aquacultures have between one to ten years of productive operation. Seventy two percent of the SAC aquaculturists have an aquaculture biologist; 14 %, a chemical food engineer, and 14 %, an engineer in aquaculture biotechnology. The age of aquaculture producers is 71 % over forty five years old and 29 % are between forty-forty five years old. The SAC reports approximate 2,868 hectares of planting and cultivation of Pacific white shrimp, with a system of semi-intensive and intensive farming (some farms implement technological alternatives and innovation in their production systems through raceways).

The commercialization of the product is destined for international markets (USA, Spain, France, and China), as well as the Mexican market, where their point of sale is mainly the farmhouse.

In Figure 2, the structure of the SAC network is observed. It is evident that it is a network (graph) that does not depend on a single actor (node), but that different actors are responsible for linking the rest. In this case, producers belonging to the SAC start with the initials G/AH, followed by a number, while the rest of the nodes are the actors that provide technological information. The distribution of the network is classified by the authority measure; this means that the actors with a larger circle (*e.g.,* G/AH5 or the State Committee for Aquaculture Health of Sinaloa [CESASIN]) are the most important and who have greater ties.

As for the producer actor who has the greatest weight in the network (G/AH5), his degree is 11; this means that he is related to 11 actors in the graph. The betweenness is 204.49. This is the largest value within the network structure and has a great weight of intermediation between pairs of actors. The authority is .55; its importance as a producer within the network is the highest and its hub is .29. All these measures indicate that this actor is key in the SAC, since more information flows through it and this, in turn, is important for other nodes. However, producers G/AH2 and G/AH4 have similar measures to those of G/AH5; therefore, they also have a significant role within the cluster.

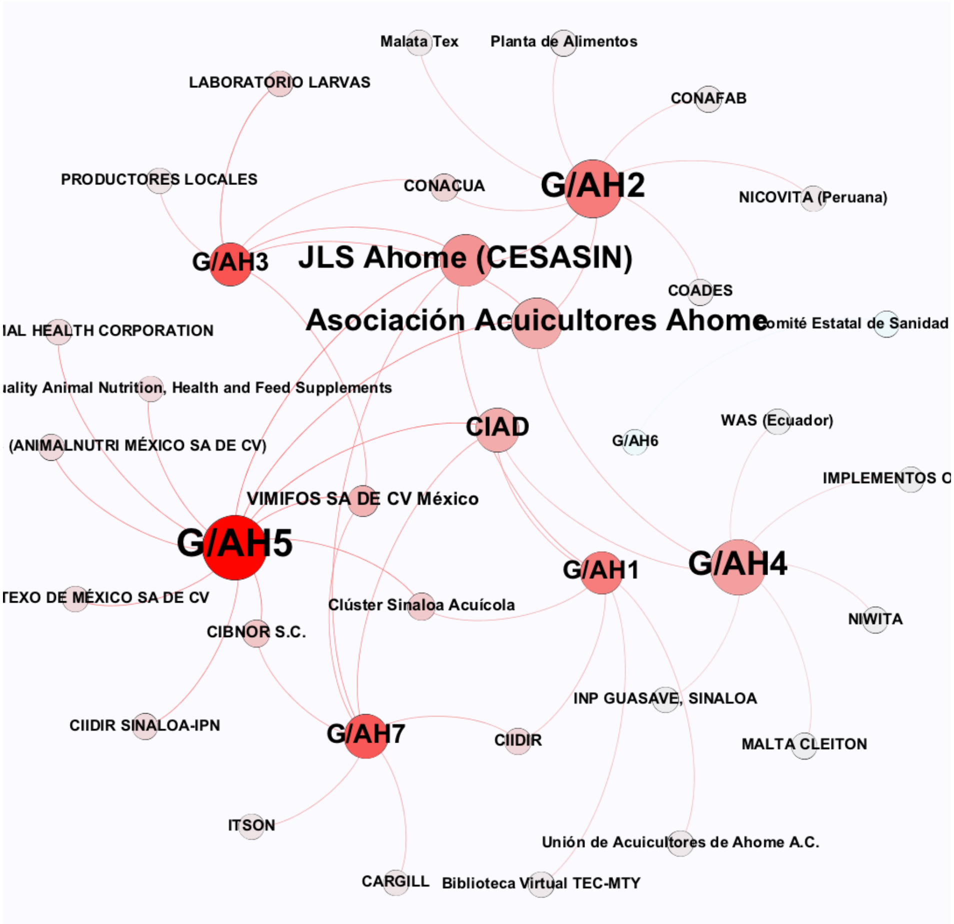

Figure 2

Sinaloa Aquaculture Cluster network

Source: self-elaboration.

In Figure 3, it is represented the structure of the second aquaculture group. Unlike the previous one, this one has a greater number of actors and, therefore, a greater number of links. In this network, a centralized structure is observed, where a large part of the interactions falls on the actor CESASIN. However, the node with the greatest weight representing producers is G/AH3, and with similar participation are the actors G/AH1 and G/AH2. Like the previous network, distribution is also classified with the authority measure.

In the second aquaculture group, producer AH3 is the heaviest producer in the network. His degree is 14, and the betweenness is 391.06; this indicates that his importance as an intermediary is especially high. The authority is .14; even though its value to intermediate is high, it does not have a high measure in the authority; this indicates that it is distributed among other producers, while its hub is .24. The measures indicate that this actor is important within the SAC. It has great intermediation between pairs of actors, but its authority and the quality of information that flows about it are not so high. This may be because CESASIN acts as a central node, and it concentrates the greatest load of information towards the entire network, unlike what happens in the SAC, where the greatest burden of authority and intermediation falls on a producer (G/AH5), and there are more distributed and do not fall on a single node.

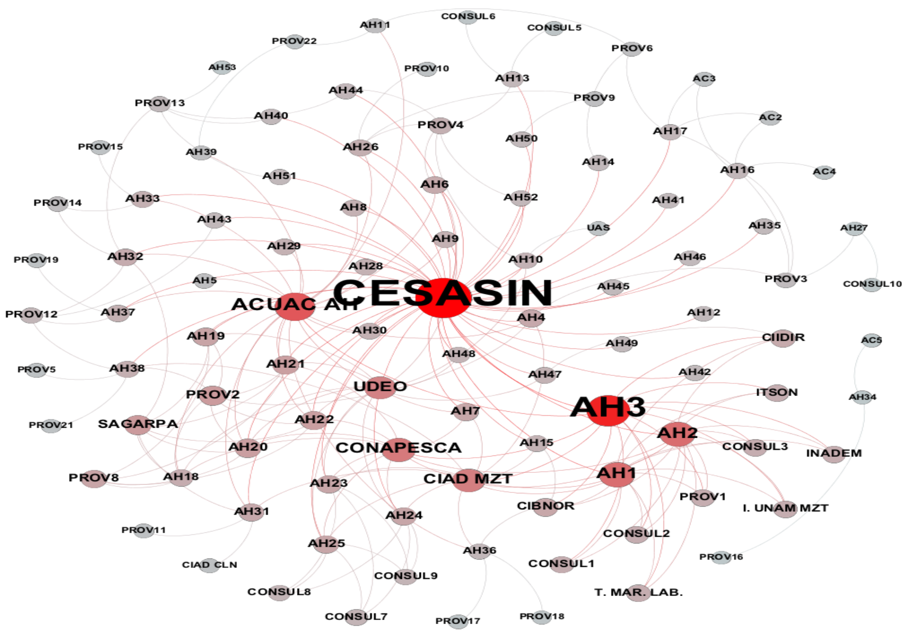

Figure 3

Technical knowledge of transfer network from the shrimp farms on the municipality of Ahome (Sinaloa, 53 farms)
Source: self-elaboration.

In Table 1 we can observe a recount of the network measures and random competitiveness. Here it is shown the Sinaloa Aquaculture Cluster, which presents measures of ASN and level of competitiveness slightly higher than that of aquaculture farms in the second group. It could be assumed that, due to the composition of its network, the SAC is more competitive than the rest of the farms. The results obtained can be contrasted with those of Bonales and Gallegos (2014), and Pigatto *et al.* (2020). The former report that there is a positive correlation between the networks of a group of producers in Lemon and their competitiveness. The latter found that there are positive relationships between the degree indicator and the levels of competitiveness.

Variables	Total of organizations [60]	Sinaloa Aquaculture Cluster [7]	Aquaculture farms [53]
Network variables			
Density	–	3.5 %	1.8 %
Grade	4.32 (3.14)	6.71 (2.98)	4 (3.05)
Intermediation	86.62 (89.55)	114.85 (67.91)	82.90 (91.90)
Authority	.08 (.09)	.29 (.17)	.06 (.03)
Hub	.11 (.06)	.15 (.09)	.10 (.05)
Competitiveness variable			
Competitiveness level	19.42 (4.65)	20.86 (2.26)	19.23 (4.86)

Note: the chart presents the measures, the DS in parenthesis, and the number of participants in brackets.

Table 1
Descriptive statistics of the social network and competitiveness variables with the two groups of aquaculture producers
Source: self-elaboration.

This result shows that, the greater the reinforcement of the network ties, the greater the tendency for individual and group competitiveness to be greater, as was the case with the SAC. Although it is true, the levels are not that different compared to the rest of the farms, in the intermediation and authority indicators of the cluster if they obtained higher values than that of the rest of the farms. This means that there is a greater transfer of information between the actors and they play a key role within the structure.

5
Conclusions

In the present work, we have tried to contribute to a better understanding of the relational structure of the existing networks in a regional industrial space, as well as to the study of the main characteristics that make up these social knowledge networks. For this, ASN knowledge techniques have been used, allowing to combine empirical results and graphics, contributing to a better understanding of the phenomenon analyzed.

Particularly, the following objectives have been met: *i)* configuration of social relations through graphs for two groups that cover the study of the general structures of their information transfer ties, especially those that are founded between shrimp organizations and its technical and scientific-technological information providers (civil associations/private participation, government agencies, research centers, universities, advisors, food suppliers, larvae laboratories *Litopenaeus vannamei,* etc.), through the approach ASN; *ii)* the main characteristics of the two knowledge transfer networks in the aquaculture industry were identified in terms of hub, density, size, structure, grade, intermediation, authority, and the comparative analysis between the two study groups, and *iii)* estimation of the connections that favor greater positioning within the network; for example, the level of centrality and those that are related to the characteristics of the interconnections that are built with other agents within the network: strength, size and connectivity (diversity) of the links. The last permitted to make the comparative and contrast analysis between the study of two groups.

The principal empiric discoveries permitted report the features and network settings on the aquaculture industry in the north of Sinaloa. In the first place, the second group of aquaculture organizations possesses more diverse actors, a less centralized network which gathers actors that produce new knowledge as universities, public and private institutions, local competitors, advisories, suppliers, research centers, and civil organizations. In comparison with the first group, it is showed that it is a network (graph) that does not depend on a single actor (node), but different actors exist, who linked the rest of the organizations.

In the network of 35 shrimp farms, it possesses a higher number of actors and a greater number of links. The SAC has an actor with greater volume in capacity and intensity on the new knowledge flows, which indicates that the actor is key for Agri-Food Cluster, as well as for the second group network, since more information flows through it and causes spillover of knowledge for other nodes. In other words, the more interactivity in network ties, the greater the tendency for individual and group competitiveness to be greater, as was the case with the SAC.

For the latter SAC, the unit and strategic organization result in a key factor that constitutes an important source of social wellness and impact positivity to the regional development. This business crowd helps the competitiveness of the aquaculture industrial district studied. However, external factor situations (public policies —lack of state and federal government support—), and possible internal scenarios (lack of trust, proximal envy, and selfishness) could damage permanence and productivity.

On the other hand, one of the work limitations is the limited size of the organization's population that makes up the groups studied and as well as being focused on geographic and sectorial ambits very concrete.

6
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7 Annexed

Survey on the absorption capacity of new technologies. The case of the aquaculture of the municipality of Ahome (Sinaloa)

CapAb Research

Company size according to number of employees	Age of the company	Sector to which the company belongs
From 1 to 50 ( ) From 51 to 250 ( ) More than 250 ( ) Exports the company: Sowing hectares: Cultivation system: extensive_semi-intensive_intensive and hyper-intensive_ Breeding foot: national ( ) ( ) international	From 5 to 10 years ( ) From 11 to 15 years old ( ) Other (specify)__ Producer profession: Aquaculture's age: From 25 to 35 ( ) From 40 to 45 ( ) More than 45 ( ) Raceways (YES) (NO)	Social ( ) Private () Local Board of Health to which it belongs: Ahome ( ) Product markets: local ( ) regional ( ) national ( ) foreign ( ) Points of sale: farm foot ( ) supermarkets ( ) local markets ( ) other

Knowledge transfer networks

Please write down the name of the organization or agent with which you establish contact to provide technological information, when your company tries to make new products or processes, or to improve them substantially	**Sector to which this contact belongs** 1. Other aquaculture companies 2. Government sector 3. IES (universities) 4. Suppliers 5. Research center or public laboratory 6. Consultants 7. Clients other (specify)	How important is this partner as a source of information according to the frequency with which he contacts you and the importance/quantity of the information he provides? ***1: nothing important*** ***5: very important***				
		1	2	3	4	5
	☐	☐	☐	☐	☐	☐
	☐	☐	☐	☐	☐	☐
	☐	☐	☐	☐	☐	☐
	☐	☐	☐	☐	☐	☐
	☐	☐	☐	☐	☐	☐
	☐	☐	☐	☐	☐	☐
	☐	☐	☐	☐	☐	☐

Knowledge absorption capacity

Considering your real situation in the way in which your company accesses information on new technologies in the sector, to what extent do you agree that the following statements fit this one?

1 Strongly disagree	**2** Disagreement	**3** Neither agree nor disagree	**4** Agree	**5** Strongly agree

	1	**2**	**3**	**4**	**5**
R1. We collect information on the development of the sector through discussions with business partners in the aquaculture sector	☐	☐	☐	☐	☐
R2. Our company participates at least twice a year in sectoral seminars and conferences, organized to update and enrich our experience and knowledge	☐	☐	☐	☐	☐
R3. We allocate enough time to establish contacts with agents who can provide us with knowledge and information about innovations in the sector	☐	☐	☐	☐	☐
R4. We have sufficient skills to establish contacts with agents that can provide us with knowledge and information about innovations in the sector	☐	☐	☐	☐	☐
R5. Our company is always among the first to recognize changes in technical possibilities	☐	☐	☐	☐	☐
R6. Our company is always among the first to recognize changes in health regulation	☐	☐	☐	☐	☐
R7. Our company is always among the first to recognize changes in market competition	☐	☐	☐	☐	☐
R8. Our company is very skilled in detecting new possibilities to serve new customers	☐	☐	☐	☐	☐
R9. Our company allocates a lot of time to deliberate with the advisors to recognize the changes in the market in advance	☐	☐	☐	☐	☐
R10. Our aquaculture farm has sufficient skills to deliberate with the advisors, on how changes in the market can be used to make changes in the negotiation of our plant	☐	☐	☐	☐	☐
R11. We record and store newly acquired knowledge for future reference	☐	☐	☐	☐	☐
R12. Our plant quickly recognizes the usefulness of new external knowledge to our existing knowledge	☐	☐	☐	☐	☐
R13. We discuss at least monthly with external consultants how the trends in the market could be used to improve our business	☐	☐	☐	☐	☐
R14. We allocate a considerable amount of time for the translation of external information in adaptations to our business	☐	☐	☐	☐	☐
R15. We have sufficient skills to translate external information into adaptations to our business	☐	☐	☐	☐	☐
R16. We translate external information directly into new business applications	☐	☐	☐	☐	☐
R17. We apply external information to our business to contribute to our productivity	☐	☐	☐	☐	☐
R18. We have enough skills to turn external information into productive results	☐	☐	☐	☐	☐

Competitiveness

How do you consider the position of your company with respect to its competitors (other farms), in the following aspects?

1 Much less	**2** Less	**3** Same	**4** Higher	**5** Much older

	1	**2**	**3**	**4**	**5**
How do you consider your profitability compared to that of your competitors?	☐	☐	☐	☐	☐
Compared to your most important competitors, how is your share of the total market?	☐	☐	☐	☐	☐
Compared with its most important competitors, how is the growth rate of the company according to the number of jobs?	☐	☐	☐	☐	☐
Compared to your most important competitors, how is the quality of your products?	☐	☐	☐	☐	☐
Compared with your most important competitors, how are your exports?	☐	☐	☐	☐	☐
Compared to your most important competitors, how is your cost-benefit efficiency?	☐	☐	☐	☐	☐

Picture 1
Questionnaire applied in the survey on social networks of technological knowledge of companies dedicated to shrimp farming in northwestern Mexico