Formation of a Fishing and Aquaculture Cluster as a Tool for Regional Competitiveness

María Francisca Peñaloza-Talavera, Jaime Apolinar Martínez-Arroyo, and Marco Alberto Valenzo-Jiménez

Abstract The purpose of this research is to analyze the viability of the emergence of a fishing and aquaculture cluster in the state of Michoacán, with the aim of becoming a tool that promotes the regional Competitiveness of the territory. To determine the feasibility of the formation of an agglomeration of companies, in this work the methodology proposed by (Fregoso in Factores determinantes en las asociaciones para formar clústers industriales como estrategia de desarrollo regional. Tesis Doctoral, Instituto Politécnico Nacional, México, 2012) is used, where the use of coefficients is considered to determine mathematically if the emergence of a cluster in the region. To apply the coefficients, we start from the proximity theory and the number of companies in the sector and in the industry, the number of workers in the sector and in the industry and the employed population in the industry are used as essential factors for the calculation. The information is collected from the INEGI Economic Census INEGI (Recuperado el 10 de 09 de 2020, de, 2019) and, by substituting the data in the coefficient formulas, it is concluded that, given the state's agricultural and specifically fishing vocation, the emergence of a fishing cluster that promotes the Regional Competitiveness is a feasible possibility in the Infiernillo, Costa, Tierra Caliente, Pátzcuaro, Cuitzeo and Lerma—Chapala regions of Michoacán.

Keywords Cluster · Regional competitiveness · Company · Fishing · Coefficient

M. F. Peñaloza-Talavera · J. A. Martínez-Arroyo (✉) · M. A. Valenzo-Jiménez
Faculty of Accounting and Administrative Sciences, The Universidad Michoacana de San Nicolás de Hidalgo, Morelia, Mexico
e-mail: jmartinez@umich.mx

M. K. Terzioğlu (ed.), *Advances in Econometrics, Operational Research, Data Science and Actuarial Studies*, Contributions to Economics,
https://doi.org/10.1007/978-3-030-85254-2_16

1 Introduction

Nowadays, Small and Medium-sized Enterprises (SMEs) play vital roles in most countries involving various aspects of the economy, including manufacturing and services. Indeed, these enterprises are major providers of employment, evolution, and innovation, as well as the pioneers in novel technology inventions (Babkin et al. 2013). Accordingly, the development of SMEs facilitates domestic development of the country and accelerates industrial growth. Today, planning for the development ofSMEs, based on a clustering approach is considered as a method to achieve developmental goals in many countries (Karaev et al. 2007). In this way, clusters are a form of integration of economic entities, sectorial institutional structures, regional institutional organizations, based on mutually beneficial cooperation, technological exchange, qualification, which creates competitive advantages for the whole structure and its parts, contributes to the development of production, competitiveness, transaction costs reduction and effective access to foreign markets (Romanova et al. 2018).

This means that clusters are a suitable method for creating competitive advantage, not only for enterprises of the same cluster but also for the country on which the clusters are based (Shakib 2020). In such a way, the enterprises are influenced by the evolution occurring inside a cluster. However, the effects of many factors should be considered in a clusters' developmental plan and it is important to determine such factors, or variables (Danesh et al. 2017).

The development of cluster structures boosts regional and National economic processes, which has a positive effect on the investment attractiveness and socio-economic potential of the region and leads to the creation of Regional Competitiveness with new enterprises and jobs (Isaksen 2018).

It should be noted, In the twentieth century, clusters began to be considered the most important factor in regional development (Kozonogova, Elokhova, Dubrovskaya, & Goncharova). Regions with developed cluster structures are more competitive; clusters are a foothold for successful regional economies. The aggregation of enterprises and organizations into cluster makes it possible to increase their effectiveness (Kudryavtseva et al. 2020).

In this way, micro, small and medium-sized enterprises (MSMEs) benefit from these type of strategies since they are the ones that face the greatest difficulties, due to their size, difficulties ranging from lack of access to external sources of financing, unprofessionalized accounting, low level of investment in innovation, up to the lack of access to adequate sources of information for making rational decisions.

For these types of companies, the cooperation and networks they establish with others of the same size or with large firms is a strategy that allows them to take advantage of the competitive advantages of the companies with which they are related. When the established agreements include a large number of companies established in a common geographic site, a business fabric called a cluster is generated (Saavedra 2012). Briefly, the present study was carried out to identify the viability for the formation of a fishing cluster in the State of Michoacán, Mexico, to solve the problem

associated with the lack of development in MSMEs, therefore, the purpose of this research is to analyze the viability of the emergence of a fishing and aquaculture cluster in the state of Michoacán, with the aim of becoming a tool that promotes the regional Competitiveness of the territory. Finally, the proposed model is dynamic and comprehensive, since it is capable of evaluating different economic scenarios and activities to evaluate the potential possibility of forming a cluster.

The term "cluster" became popular in the late 1980s and is currently used to refer to one of the tools in effective regional development. Today, clusters are studied by scientists around the world. During the twentieth century, a lot of research, within the theoretical frameworks for economic growth and development, focused on ways of optimizing the locations of enterprises and industries in terms of transport and resource constraints (Kudryavtseva et al. 2020). Sustainable cluster development is widely discussed in the scientific literature; it focuses on the idea that clusters can be central to not only a region's economy, but also its sociology, ecology, and innovation spheres (Chen et al. 2020). For example, some studies only estimate the cluster's economic performance and make conclusions that focus on its efficiency (Putri et al. 2016). Alike, many researchers have paid contributed to the study of innovative clusters, defining the research sector's large role in cluster development (Wiratmadja et al. 2016).

The clusters are productive articulations of companies that arise from the identification of the productive vocation of a territory. One of the advantages offered by this type of network is that it gives companies the ability to generate economies of agglomeration that lead them to increase the competitive capacities of the region, making efficient use of resources and thus achieving high levels of productivity and competitiveness (Bonales et al. 2016). In fact, according to the Global Cluster Initiative Survey conducted on 500 clusters around the world, 85% of cluster initiatives have improved their competitiveness, 89% have helped the cluster to grow, and 81% have met their goals. In contrast, only 4% have been disappointing and did not lead to much change (Otsuka and Ali 2020).

So that, three main reasons can be noted for the existence of these agglomeration forces. The first is access to efficient labor markets with a specialized labor supply and easier matching processes between workers and firms. The second is the reduction of transaction costs due to the spatial integration of different steps of the production process. The third and main argument for the analysis is the existence of knowledge spillovers via proximity interactions (Hassine and Mathieu 2020).

The purpose of this study is to analyze the feasibility of a cluster emerging from the Michoacán fishing sector, in order for the companies engaged in this activity to find an opportunity to improve their possibilities and their ability to compete in a global market, using a tool that encourages regional competitiveness, thereby seeking not only to improve productivity but also the quality of life of the population of the territory. The cluster represents the community of industry and related companies on the basis of cooperation and competitive links. This community is capable of mutually reinforcing competitive advantages based on synergy. Sectorial clusters are inseparably linked. Cluster, as a stable network of interrelated economic entities, has a production potential higher than the sum of the potentials of its participants. This

is achieved as a result of network cooperation and within the network competition. The cluster approach allows to effectively solve the problem of the competitiveness of various levels of economic entities in the National Economy, to create an effective basis for implementing the state policy of economic growth, to increase the effectiveness. To strengthen cooperation and integration of large and small businesses, to accelerate solution of social problems of regions and the National Economy as a whole (Romanova et al. 2018).

It is necessary to look for alternatives that promote fishing activity in Michoacán since during the last two years, the lack of strategies to promote the sector has led to a considerable decrease in activity as shown in Fig. 1. Based on the above. This research considers it pertinent to analyze the situation of the fishing activity in Michoacán in order to expose the possibility of creating a fishing cluster in the state and thereby show the opportunity to improve the competitiveness of the regions studied. In this sense, the question that guides this work is: What regions of the state of Michoacán have the capacity to form a fishing cluster? Based on the question, the main objective of the work is to: Identify the regions of the state of Michoacán that have the capacity to develop as a fishing cluster. In order to answer the research question and fulfill the objective of the work, in this work the theoretical foundation of the study is first presented. For this, concepts such as competitiveness, regional competitiveness and the cluster are addressed.

Competitiveness is a variable widely analyzed today because its promotion not only has positive effects on macroeconomic indicators, but also on the quality and living conditions of citizens (Sarmiento 2019; Domínguez y Gutiérrez 2017; Ordóñez Tovar 2011; Vázquez y Reyes, 2013). According to recent studies, competitiveness at the nation and region level depends largely on the way in which companies take advantage of the natural and created competitive advantages that the territory offers, such as the availability of natural resources, the climate, the culture, institutions, policies, infrastructure, etc. (Granados et al. 2016; Sarmiento et al. 2015; Ruiz-Velazco 2015; Sarmiento 2019; Morales de Llano 2014; Burbano et al. 2011; Quero 2008).

Despite the large number of studies carried out on the subject of competitiveness, there is no single and generalized definition of this term, because, as pointed out Saavedra y Milla (2012) competitiveness is an extremely complex concept, which

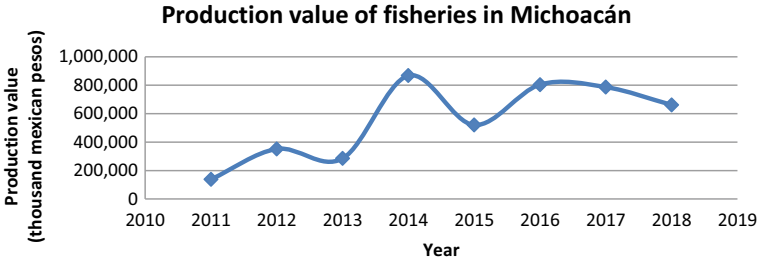

Fig. 1 Source: Own elaboration using data from SIAP

can be studied from different approaches and perspectives. Given the breadth of the concept of competitiveness, some of the main definitions of the term that are useful to understand the concept under the context of analysis of this research are presented below.

One of the most cited definitions of competitiveness is the one proposed by the World Economic Forum, an institution that defines it as "the set of institutions, policies and factors that determine the level of productivity of a country" (World Economic Forum 2010, p. 4). Based on this definition, productivity is a complementary variable to competitiveness and it is necessary to clarify that they do not have the same meaning. In that sense, for there to be competitiveness in a nation, it is required that it have solid bases of productivity. In addition to generating economic benefits, competitiveness based on productivity produces significant changes in the level of prosperity and well-being of citizens, which is why it is considered a necessary element for the development of a country (Suárez 2005).

For Porter (1991), the competitiveness of a nation is associated with the productivity of its companies, which depends on the efficient use of natural, human and capital resources. Thus, competitiveness is associated with the ability of swarms or agglomerations of companies to use their human, natural and capital resources productively. (Ibarra et al. 2017; Arana y Ballesteros 2016; Valencia y Zetina 2017). Under the same approach, La barca (2007, p. 161) points out that competitiveness refers to the "possibility that its citizens have to achieve a high and growing standard of living" and this possibility depends on the "productivity with which national resources are used, the product per unit of work or capital used". In that sense, competitiveness can be achieved when existing economic units achieve higher productivity. The perspective of Labarca (2007) is very consistent with the definition proposed by the World Economic Forum (2010) and with the ideas of Porter (1991); All three approaches consider that the variables productivity and quality of life are fundamental for competitiveness.

According to Porter (1999) competitive advantage is created and sustained in localized processes, that is, at the territorial level or what is the same at the regional level, and the main objective of competitiveness is to increase productivity. And thus lead to improving the quality of life of the population residing in a specific region (Krugman 1994). At the territorial level, regional competitiveness helps to subsidize competitiveness at the company level. And it is that, finally, who competes and acts in the market is the company as such. Upon emerging from the local context, the strategies and processes developed by the companies are clearly influenced by the culture of the territory, in that sense, their actions are largely supported by socialized processes or explicit collective action of a territorial nature. For this reason, it is common for territories to generate networks and business agglomerations (Camagni 2005).

In sum, the concept of competitiveness is closely related to the productivity and well-being of citizens in a given territory. Productivity is associated with the performance of natural, human and capital resources possessed by the economic units of a country, a region or a productive system. The way in which companies located in a specific territory take advantage of their resources has a direct impact on the quality

of life of the population that belongs to a region. Under this logic, it is possible to affirm that competitiveness is widely related to the productivity of production systems, which are generally located in geographic regions with a specific productive vocation and that give rise to the so-called agglomerations of companies or clusters.

Clusters are geographic concentrations of companies and institutions that share a common interest and are considered a tool to boost the regional competitiveness of strategic sectors; thanks to the proximity, the process of exchange of information, knowledge and technology between economic units is facilitated (Arana y Ballesteros 2016). In the last decade, the success of industrial districts in developed countries has stimulated the creation of the cluster approach to explain the agglomeration of small companies in developing countries. (Bada y Rivas, 2010; Rabellotti y Pietrobelli, 2005). Therefore, when forming a cluster, one of the most important criteria is the maximization of the potential of the cluster structure. However, the objective function may be not necessarily the criterion for the formation of the system. Corporate processes and self-organization in open and non-equilibrium systems lead to their dynamic stability (Romanova et al. 2018).

Cluster is defined as a geographically approximate concentration or group of interconnected companies and associated institutions in a common interest in a specific economic and strategic sector and linked to complement each other (Porter 1999). The analysis of clusters and their importance as a factor of competitiveness can be understood from different theories that explain their emergence. Among the theories that try to explain the emergence of clusters, five main ones can be pointed out: the theory of location and economic geographic, the theory of backward and forward linkages, the theory of the interaction of industrial districts, the theory of Michael Porter's competitive advantage and the theory of economic growth based on consumer goods. Each of the aforementioned theories explains the causes that give rise to the emergence of clusters in the territories and, all of them "share the notion that the competitiveness of each company is strengthened by the competitiveness of the group of companies that make up the group" (Bonales et al. 2016).

The theory of location and geographic economic to evaluate the feasibility of the formation of a cluster, explains the reasons why productive activities are located in specific geographic areas and are not randomly distributed in the territory (North 1995; Krugman, 1995). This indicates that the costs of distance and transport affect the location of the companies; Under this logic, some of the activities are located especially in territories close to natural resources and other activities are located in areas close to the markets that will supply. In this sense, the variable that explains the origin of a cluster under this approach is proximity to resources and markets (Bada y Rivas, 2010).

2 Methodology

This research uses the theory of location and geographic economic to identify a potential fishing cluster in Michoacán. Although there are a large number of studies and methods for analysis, most of them focus on the qualitative characteristics of the territories and, those few studies that use quantitative data generally do not include in their formulas the relationship between work and the number of companies in the territory as key indicators for the identification of a true conglomerate of productive units (Fregoso 2012).

This is extremely important, because a large part of the economic activities that are practiced in Mexico are carried out by contract, in that sense there are sectors where one or two companies control the activity and employ almost all workers in the sector. When this situation exists and it is sought to identify a cluster with the traditional formulas that do not use the number of companies within the analysis, the result may be wrong by showing the existence of a potential cluster by concentrating a high number of workers in the sector, forgetting that few companies employ them; in those cases, when those signatures disappear, the potential cluster also disappears. Sforzi (1987), pointed out that a necessary condition for the correct identification of an industrial district is that the employed personnel are employed in a greater number of firms and not grouped in an oligopoly (Sforzi 1987).

Therefore, it is important to use a coefficient that analyzes the concentration of employment in an activity and that, in turn, is capable of relating the number of workers with the number of potential companies in the cluster. One way to achieve the above and geographically delimit a territory is through the mathematical model exposed by Fregoso (2012), which consists of geographically identifying a region that is a cluster by relating the number of workers with the number of companies located in the territory using ratios and quotients. The indicated method is based on the geographic delimitation variable, understood as the concentration and proximity between the companies located in a geographically delimited region. For this type of study, it is necessary that concentration and proximity be defined in quantitative terms For this reason, the size of the companies in terms of workers per company, personnel employed in the sector and in the industry and, the number of companies or economic units in the sector and industry.

The model exposed by Fregoso (2012), It is based on the theory of location and economic geography and is mainly based on the location coefficient, also called the specialization ratio, from which two coefficients are derived that measure the relationship between employment and the number of companies. The location coefficient represents the relationship between the share of sector i in region j and the share of the same sector in the national/regional total. This coefficient is then a way to measure the relative specialization in a territory, in that sense it works as a measure of regional concentration of a certain activity or economic sector. To evaluate this indicator, various variables such as Gross Domestic Product, Value Added and Employment can be used. In this case, it is considered appropriate to use this last variable, employment.

The use of the employment variable to calculate the location index has its theoretical basis in the center-periphery model exposed by Krugman (1991). According to this author, companies and workers tend to concentrate in delimited geographical areas because there is a strong relationship between labor mobility, growing company returns, and trade costs. In this sense, with the employment values, the location coefficient can be calculated, weighing the weight of the number of workers in the activity studied with respect to the total in the region and comparing with the proportion that the same region has at the national level. The values generated by the coefficient define the viability of the emergence of a cluster specialized in the activity studied within a geographically delimited territory (Lira y Quiroga, 2009).

According to Soler (2000), the original mathematical expression of the localization or specialization coefficient is as follows:

$$CE_{ij} = \frac{X_{ij}/X_j}{X_i/X_T}$$

where:

X_{ij} = value of employment in sector i in territory j.

X_j = total value of employment in territory j.

X_i = value of the employment variable for sector i.

X_T = total value of employment in the entire reference territory.

Based on the above proposal formula, Fregoso's (2012), To geographically delimit a territory, the evaluation includes not only the employment factor, but also the number of companies in the territory, since only in this way is it possible to verify that there is an agglomeration of companies in the area and not only a concentration of employees in some business accounts. Based on these adjustments, Fregoso's model (2012) is expressed in three coefficients: cluster coefficient (CC), coefficient of economic unit per work in the sector (CULS) and coefficient of economic unit per labor in the industry (CULI).

The cluster coefficient (CC) is based on the specialization coefficient and its purpose is to determine whether in a territory there is specialization in any economic sector based on the employment variable. In this sense, this coefficient is calculated by weighting the weight of the number of workers in the sector with respect to the total number of employees in the industry and comparing said weighting with the proportion that the same industry maintains at the regional level. The formula for the cluster coefficient (CC) is as follows:

$$CC = \frac{TTS/TTI}{TTI/PTE}$$

where:

TTS = Total labor value in the sector. Expressed in number of people.

TTI = Total labor value in the industry. Expressed in number of people.

PTE = value of the working-age population in the region. Expressed in number of people.

The interpretation of the CC is the same as that performed for the specialization coefficient. The CC formula can yield three different results: less than, equal to or higher than one. When the value of the coefficient is equal to or greater than unity, it indicates that there is specialization in the economic activity analyzed in the region. In this sense, a value greater than one will indicate that there is a potential cluster in the studied region since most of its population of working age works in industry. In addition to the above, it should be added that the higher the CC value, the greater degree of specialization there is in the region. When the result of the cluster coefficient is less than one, it is understood that there is no specialization in the economic activity studied and, therefore, the cluster is not a relevant possibility in the region since most of the working-age population is working in another industry (Lira y Quiroga 2009; Fregoso 2012; Soler 2000).

With the results of the CC value, it is possible to affirm or reject the possibility that a potential cluster exists in a region. However, Fregoso's model (2012), differs from the rest of traditional models because in addition to seeking to establish the viability of a cluster with the CC, it includes the mathematical analysis of two reasons that indicate whether the condition that Sforzi (1987) had already indicated as necessary for an industrial district to exist is fulfilled, this is that the employed personnel are employed in a large number of firms and are not agglutinated in a few companies. For this analysis, the economic unit coefficient per labor in the sector (CULS) and the economic unit coefficient per labor in the industry (CULI) are used, whose formula is the following:

$$CULS = \frac{TTS}{UES} > CULI = \frac{TTI}{UEI}$$

where:

TTS: Total labor value in the sector. Expressed in number of people.

TTI: Total labor value in the industry. Expressed in number of people.

UES: Value of economic units in the sector. Expressed in number of companies.

UEI: Value of economic units in the industry. Expressed in number of companies.

The economic unit coefficient per work in the sector calculates the number of employees per company, in that sense it is a comparison of the number of employees in the economic activity with cluster potential with the number of companies in the sector (CULS). The calculation of the CULS is necessary because it is finally a measure that helps to establish whether the sector has an agglomeration of companies

and employees in the region or if this agglomeration is only of employees in a few companies. The same expresses the coefficient of economic unit for labor in the industry (CULI), it indicates if the employees are agglutinated in a few companies within the industry or if they are distributed in a greater number of companies.

The numerical analysis of these coefficients must meet the condition expressed in the formula: CULS > CULI. When the condition is met, it is confirmed that there are enough companies in the sector to absorb employment in the place where the economic activity under analysis is concentrated, this also shows the importance of the number of companies within the sector and corroborates that the agglomeration in the region does not it is only of workers but also of economic units. When the condition of the formula is not fulfilled, that is, when CULS < CULI, it is verified that mathematically it is not possible to absorb the employment of the place with existing companies in the sector, so that the cluster is not a viable option for the region because there are not enough economic units that truly form an agglomeration (Fregoso 2012).

The proper functioning of the model described here is subject to the fulfillment of some technical conditions. The first condition that must be met before starting the application of the model has to do with a previous analysis of the activity, it is essential to identify if there is an agglomeration of companies in the study region, since if there is no indication of agglomeration no matter how small, the evaluation of the CC would not make sense. A second condition that must be met is to identify, prior to the application of the model, the territory where the cluster will be geographically delimited, since if the area is not delimited, it is not possible to correctly define the values of the variables to be used.

The third condition that must be met is to agree with the definition of the cluster concept since there are many conceptualizations and each one of them highlights different important elements for the analysis. And, the fourth condition for the correct operation of the model has to do with the information necessary for the calculation of the coefficients, it is required that there are updated databases that contain the values of the variables used in the model; Specifically, it is necessary to have current information on the number of workers in the sector and in the industry, the number of companies in the sector and in the industry, and the number of people of working age in the region (Lira y Quiroga 2009; Fregoso 2012; Soler 2000).

The model described can be applied and correctly evaluate the mathematical viability of the emergence of a cluster in practically all the productive activities belonging to the three economic sectors (primary or agricultural, secondary or industrial and, tertiary or services) as long as the four conditions indicated above are met. The fourth condition is especially important since if the information is not current, the result obtained may reflect a situation that no longer represents the real conditions of the region. For this reason, in the case of Mexico, the lack of updated databases makes it difficult to apply the model in key activities for the country such as agriculture, livestock and mining; For these activities, the latest available database presents information for the year 2007 (Censo Agrícola et al. 2007, INEGI). The activities belonging to the industrial sector and the services sector in Mexico show a different panorama for the model, since the databases that contain information regarding these activities are updated every 5 years (Economic Censuses).

In the case of this study, the model is applied to the Michoacán fishing sector and two economic activities of the same are analyzed and evaluated: Fishing and Aquaculture, activities 11,411 and 11,251, respectively, in the North American Industry Classification System 2018 (SCIAN). The data used to apply the method is updated and has been obtained from the National Institute of Statistics and Geography (INEGI), specifically from the information available in the 2019 Economic Censuses. The analysis is carried out at the national level, at the state level and at the regional level within the state of Michoacán. To determine the value of the factors in each region, a summation of the individual value of each municipality is made within the region to which it belongs. In total, the ten administrative regions of the state are studied, in which the 113 municipalities that compose it are contemplated.

3 Results

This section presents the results of the calculation of the coefficients of clusters CC, CULS and CULI in order to verify the viability of the emergence of a fishing cluster in Michoacán. Firstly, Table 1 presents the results obtained from the analysis of the activity 11,411 corresponding to Fishing; the study is applied at the national, state and regional levels.

Based on the statistics obtained in the Economic Census (INEGI 2019) and the application of the equations to quantitative data determines that the emergence of a fishing cluster at the national level is not viable, as well as in the Meseta, Tepalcatepec, Oriente and Bajío regions. The analysis of the quotients using data from fishing in Michoacán shows that Michoacán is a territory with a productive fishing vocation with cluster potential, its CC is greater than 1 and the comparison of CULS and CULI confirms the existence of companies close to the natural resource studied here and it has been confirmed that the number of existing companies is sufficient to absorb the labor available for the sector at the state level. For this reason, it is accepted that in Michoacán there is the possibility of forming a fishing cluster that contributes to improving the productivity of the companies involved in terms of the use they make of available resources.

Within the Michoacan territory, the regions identified with the possibility of forming a fishing cluster are the following six: Infiernillo, Costa, Tierra Caliente, Pátzcuaro, Cuitzeo and Lerma Chapala. These six regions present a CC greater than 1 and the comparison of CULS and CULI verifies that the conglomerate of companies related to the activity in each region are sufficient to occupy the available labor in the territory and are close to the source of the resource from where they obtain the product and to the market where they commercialize it (see Table 1). Based on the result, it is stated that the fishing cluster can be an adequate tool to promote the competitiveness of the indicated regions, since through the linking of companies it is more feasible to improve the productivity of organizations, with which it can improve the well-being of citizens, well-being that can be promoted from the same

Table 1 Fishing sector

Region	TTI	TTS	UEI	UES	PTE	CC	CEULS	CEULI	Reasons
National	233,554	179,478	24,372	19,627	27,132,927	89.27	9.14	9.58	False
Michoacán	8632	5861	842	420	779,733	61.33	13.95	10.25	True
Infiernillo	1454	1282	181	157	18,449	11.18	8.16	8.03	True
Costa	1664	1549	114	95	57,136	31.96	16.30	14.59	True
Tierra Caliente	217	131	41	13	20,573	57.23	10.07	5.29	True
Pátzcuaro	587	449	122	67	33,816	44.06	6.70	4.81	True
Meseta	901	1	49	1	119,129	0.14	1	18.38	False
Tepalcatepec	67	12	25	7	53,549	143.14	1.71	2.68	False
Oriente	522	12	145	12	62,407	2.74	1	3.6	False
Cuitzeo	1424	1063	83	36	229,941	120.53	29.52	17.15	True
Bajío	251	9	25	9	70,014	10.0	1	10.04	False
Lerma—Chapala	842	470	57	30	115,576	76.61	15.66	14.77	True

Source Own elaboration using data from Economic Census, 2019 (INEGI 2019)

territory with the grouping of companies around a fishing cluster that contributes to using the available resources more efficiently.

When performing the mathematical analysis in the aquaculture sector at the regional, state and national levels, it is concluded that this activity does not meet the values required by the coefficients to consider the possibility of the emergence of a cluster, as can be seen in Table 2. In Michoacán, the aquaculture activity is in full growth and the potential for its development is wide given the conditions of the territory. Therefore, when applying the CC, the value turned out to be greater than 1, however the possibility of the emergence of a cluster could not be confirmed with the values of CULS and CULI. In this sense, at this time, the formation of a cluster at the Michoacán level is not considered mathematically feasible. In each of the ten regions that make up the state, the value of the CC and/or the comparison of the result of the CULS and CULI, show that there is no potential for an aquaculture cluster in the territory.

4 Discussion

Beneficial effects of clusters, manifest themselves through improvements in the quality and efficiency of labor. By improving competitiveness, the economy and the transformation of the industry toward a more productive growth pattern, the main strategy would be the clusters as they play an important role. Although many studies confirm that industrial conglomerates are beneficial for the performance of companies, some issues remain controversial, such as the economic impact of conglomerates in traditional industries and developing countries. The research results confirms the existing theory and complements with new contributions in show the viability of creating a fishing cluster especially now that would be after the crisis experienced.

Alike, higher levels of interactions increase the rate of learning by doing thus increasing labor productivity. In a parallel development, cluster effects enable the release of resources that can be used to attract new, and upgrade the quality of existing, human capital.

The findings of this study show that it is feasible to form a fishing cluster that contributes to improving the productivity of the companies involved in addition to creating a positive impact in the region.

The analysis of quantitative data related to fishing and aquaculture in Michoacán, reveals that mathematically it is possible the emergence of clusters related to the activity. Specifically in the fishing activity, it was found that six Michoacan regions are susceptible to the formation of a cluster that promotes regional competitiveness through the linkage of fishing companies. By studying the theoretical information and comparing it with the empirical data, it is possible to affirm that business clusters are a viable option to facilitate the productivity of fishing units. With strategies such as the cluster, the decrease in fishing production can be stopped and, in this way, reverse the negative effect that the situation is generating on the levels and quality

Table 2 Aquaculture sector

Region	TTI	TTS	UEI	UES	PTE	CC	CEULS	CEULI	Reasons
National	233,554	33,768	24,372	3666	27,132,927	16.79	9.21	9.58	False
Michoacán	8632	1179	842	342	779,733	12.33	3.44	10.25	False
Infiernillo	1454	63	181	46	18,449	0.54	1.36	8.03	False
Costa	1664	115	114	16	57,136	20.37	7.18	14.59	False
Tierra Caliente	217	86	41	26	20,573	37.57	3.30	5.29	False
Pátzcuaro	587	138	122	55	33,816	13.54	2.50	4.81	False
Meseta	901	31	49	25	119,129	4.54	1.24	18.38	False
Tepalcatepec	67	12	25	6	53,549	143.14	2	2.68	False
Oriente	522	344	145	131	62,407	78.78	2.62	3.6	False
Cuitzeo	1424	165	83	42	229,941	18.71	3.92	17.15	False
Bajío	251	10	25	10	70,014	11.11	1	10.04	False
Lerma—Chapala	842	12	57	8	115,576	1.95	1.5	14.77	False

Source Own elaboration using data from Economic Census, 2019 (INEGI 2019)

of life of the population of the territory. Finally, competitiveness not only seeks to generate productivity but also to improve people's quality of life.

In the case of aquaculture, it was found that the creation of a cluster over it is not feasible because the existing companies are not enough to monopolize the available labor. This situation found is not conclusive due to the limited statistical information found on said activity. As the data does not reflect the total number of aquaculture units that exist in the municipalities the exact amount of labor in the sector, it is not possible to affirm that aquaculture is irrelevant in the territory, this mainly because the data presented in COMPESCA reports (Comisión de Pesca del Estado de Michoacán, México) reveal that it is an activity with great development potential and that every day it involves more productive units, in fact, in the latest report of said institution Michoacán is identified as the second largest aquaculture producing state at the national level. Given this situation, it is considered appropriate to point out that the results obtained with the application of the coefficients on aquaculture activity are not conclusive; in future research the activity can be analyzed in greater detail and define whether or not it is possible to develop a cluster.

References

Arana O, Ballesteros A (2016) Los clúster como herramienta para dinamizar la competitividad. Dictamen Libre 18:83–93

Babkin A, Kudryavtseva T, Utkina S (2013) Formation of industrial clusters using method of virtual enterprises. Proc Econ Finance 5:68–72

Bada L, Rivas L (2010) Los clústers agroindustriales en el estado de Veracruz. Investig Adm 105:73–100

Bonales J, Martínez J, Valenzo M (2016) Modelo competitivo de clusters de empresas exportadoras del estado de Michoacán. Memoria del IX Congreso de la Red Internacional de Investigadores en Competitividad

Burbano E, González V, Moreno E (2011) La competitividad como elemento esencial para el desarrollo de las regiones. Una mirada al Valle del Cauca. Revista Gestión y Desarrollo 8(1):51–78

Camagni R (2005) Economía urbana. Barcelona

Chen X, Wang E, Miao C, Ji L, Pan S (2020) Industrial clusters as drivers of sustainable regional economic development? An analysis of an automotive cluster from the perspective of firms' role. Sustainability 12(7):1–22

COMPESCA. (s.f.). Recuperado el 05 de 10 de 2020, de http://compesca.michoacan.gob.mx/michoacan-con-gran-potencial-pesquero-compesca/

CONACYT. (s.f.). Sistema Nacional de Investigadores. Recuperado el 08 de 07 de 2019, de https://datos.gob.mx/busca/dataset/sistema-nacional-de-investigadores/resource/3ecd4bae-63a2-43c5-82e0-8619175e29a2

Danesh SM, Toloie EA, Alborzi A (2017) Identification and evaluations of factors involved in industrial clusters development, applying fuzzy DEMATEL. Int J Appl Manag Sci 9(2):135–152

Domínguez J, Gutiérrez A (2017) La competitividad y el desarrollo económico de las empresas exportadoras de orégano seco en la región Tacna. Universidad San Ignacio de Loyola, Facultad de Ciencias Empresariales, Lima

Fregoso G (2012) Factores determinantes en las asociaciones para formar clústers industriales como estrategia de desarrollo regional. Tesis Doctoral, Instituto Politécnico Nacional, México

Granados H, Giraldo Ó, Acevedo N (2016) Promoción de la competitividad y el desarrollo territorial en los municipios del Valle de Aburrá. Semestre Económico 19(40):93–116
Hassine HB, Mathieu C (2020) R&D crowding out or R&D leverage effects: an evaluation of the french cluster-oriented technology policy. Technol Forecast Soc Chang. https://doi.org/10.1016/j.techfore.2020.120025
INEGI (2007) Censo Agricola, Ganadero y Forestal. Recuperado el 15 de 10 de 2020, de https://www.inegi.org.mx/programas/cagf/2007/
INEGI (2019) Recuperado el 10 de 09 de 2020, de https://www.inegi.org.mx/programas/ce/2019/
INEGI CE (2019) Censos Económicos. Recuperado el 10 de 12 de 2020, de https://www.inegi.org.mx/programas/ce/2019/#Tabulados
INEGI (s.f.) PIB y cuentas nacionales. Recuperado el 05 de 08 de 2019, de https://www.inegi.org.mx/temas/pib/
Isaksen A (2018) From success to failure, the disappearance of clusters: a study of a Norwegian boat-building cluster. Camb J Reg Econ Soc 11(2):241–255
Karaev A, Koh SC, Szamosi LT (2007) The cluster approach and SME competitiveness: a review. J Manuf Technol Manag 18(7):818–835
Kozonogova E, Elokhova I, Dubrovskaya J, Goncharova, N (s.f.) Does state cluster policy really promote regional development? The case of Russia. In: IOP conference series. Materials science and engineering, vol 497, issue 1, p 120
Krugman, P. (1994). Competitiveness. A dangerous obsession. Foreign Affairs 73(2):28–44
Krugman P (1995) Development, geography and economic theory. MIT Press, Cambridge
Kudryavtseva T, Skhvediani A, Ali M (2020) Modeling cluster development using programming methods: case of russian arctic regions. Entrepreneurship and Sustainability Issues 8(1):150–176
Labarca N (2007) Consideraciones teóricas de la competitividad empresarial. Omnia 13(2):158–184
Morales de Llano E (2014) La dimensión territorial de la competitividad. Economía y Desarrollo 151(1):71–84
North D (1995) Location theory and regional economic growth. J Polit Econ 6:56–67
Ordóñez Tovar J (2011) ¿Competitividad para qué? Análisis de la relación entre competitividad y desarrollo humano en México. Revista del CLAD Reforma y Democracia (51):1–20
Otsuka K, Ali M (2020) Strategy for the development of agro-based clusters. World Dev Persp. https://doi.org/10.1016/j.wdp.2020.100257
Porter M (1991) La ventaja competitiva de las naciones. Javier Vergara, Buenos Aires, Argentina
Porter M (1999) Ser competitivo. Bilbao: Ediciones Deusto
Putri EP, Chetchotsak D, Ruangchoenghum P, Jani MA, Hastijanti R (2016) Performance evaluation of large and medium scale manufacturing industry clusters in east java province, Indonesia. Int J Technol 7(7):1269–1279
Quero L (2008) Estrategias competitivas: factor clave de desarrollo. NEGOTIUM Revista Científica Electrónica Ciencias Gerenciales 10(4):36–49
Quiroga B, Lira L (2009) Técnicas de análisis regional. Series Manuales (59)
Rabellotti R, Pietrobelli C (2005) Mejora de la competitividad en clusters y cadenas productivas en América Latina, el papel de las políticas. Washinton, D.C.: Banco Interamericano de Desarrollo
Romanova A, Abdurakhmanov A, Ilyin V, Vygnanova M, Skrebutene E (2018) Formation of a regional industrial cluster on the basis of coordination of business entities' interests. ICTE in Transportation and Logistics
Ruiz-Velazco A (2015) Territorial competitiveness and urban economic potential. Rev Lider 26:39–59
Saavedra M. (2012). Una propuesta para la determinación de la competitividad en la pyme latinoamericana. Pensamiento y gestión (33):93–124
Saavedra M, Milla S (2012) La competitividad en el nivel micro de la mipyme en el estado de Querétaro. XVII Congreso Internacional de
Sarmiento Y (2019) Nociones generales del estudio de la competitividad territorial para planificar el desarrollo. Retos De La Dirección 13(1):103–116

Sarmiento Y, González I, Pérez Y (2015) La competitividad territorial como insumo para la planificación. Revista Cubana De Ciencias Económicas-EKOTEMAS 1(3):1–17
Sforzi F (1987) Identificazione spaziale. En G. Becattini, Mercato e forze locali: il distretto industriale, pp 143–167. il Mulino, Bologna
Shakib MD (2020) Using system dynamics to evaluate policies for industrial clusters development. Comput Ind Eng 147:15. https://doi.org/10.1016/j.cie.2020.106637
SIAP (s.f.) Recuperado el 30 de 09 de 2020, de http://www.campomexicano.gob.mx/raw_pesca_gobmx/seccionar.php
Soler V (2000) Verificación de las hipótesis del distrito industrial: una aplicación al caso valenciano. Economía industrial 4(334):13–23
Suárez M (2005) La inserción de la pequeña y mediana empresa en el comercio exterior mexicano: un modelo de competitividad sistémica. Tesis de grado, UNAM, Facultad de Ciencias Políticas y Sociales
UNESCO (s.f.) Research and development spending. Recuperado el 18 de 06 de 2019, de http://uis.unesco.org/sites/all/modules/custom/uis_applications/apps/visualisations/research-and-development-spending/
Valencia K, Zetina A (2017) La cebolla mexicana: un análisis de competitividad en el mercado estadounidense, 2002–2013. Región y sociedad 29(70)
Vázquez A, Reyes A (2013) Fundamentos sobre la competitividad para el desarrollo en el sector primario. TLATEMOANI Rev Académica Investig (14):1–29
Wiratmadja II, Govindaraju R, Handayani D (2016) Innovation and productivity in indonesian it clusters: the influence of external economies and joint action. Int J Technol 7(6):1097–1106
World Bank Group (s.f.) Obtenido de https://datos.bancomundial.org/indicator/NE.GDI.FTOT.KD
World Bank Group (s.f.) Exportaciones de productos de alta tecnología (% de las exportaciones de productos manufacturados). Recuperado el 18 de 06 de 2019, de https://datos.bancomundial.org/indicator/TX.VAL.TECH.MF.ZS?locations=MX-JP-KR-US&view=chart
World Bank Group (s.f.) Gasto en investigación y desarrollo (% del PIB). Recuperado el 18 de 06 de 2019, de https://datos.bancomundial.org/indicador/GB.XPD.RSDV.GD.ZS?view=chart
World Bank Group (s.f.) Investigadores dedicados a investigación y desarrollo (por cada millón de personas). Recuperado el 18 de 06 de 2019, de https://datos.bancomundial.org/indicador/SP.POP.SCIE.RD.P6
World Bank Group (s.f.) Solicitudes de patentes, residentes. Recuperado el 05 de 08 de 2019, de https://datos.bancomundial.org/indicador/IP.PAT.RESD
World Economic Forum (2010) The global competitiveness report 2010–2011. Suiza, Geneva