Available online at www.centmapress.org

Proceedings in
System Dynamics and Innovation in Food Networks 2022

DOI: http://dx.doi.org/10.18461/pfsd.2022.2214

INTERNATIONAL JOURNAL ON FOOD SYSTEM DYNAMICS

Value chain Performance of *Anadara tuberculosa* (Concha Prieta)

Eveligh Prado-Carpio[1], Moisés Enrique Martínez-Soto[2], María de Lourdes Olivo-Garrido[3], Manuel Quiñonez-Cabeza[4], Carlos Rodríguez-Monroy*[5]

[1] Universidad Técnica de Machala, Machala, Ecuador; e-mail: eprado@utmachala.edu.ec,
[2] Universidad del Zulia, Maracaibo, Venezuela; e-mail: moimartinezsto@gmail.com
[3] Universidad Central de Venezuela, Caracas, Venezuela; e-mail:lourdes_olivo@yahoo.com
[4] Universidad Técnica Luis Vargas Torres de Esmeraldas, Ecuador; e-mail: manuel.quinonez@utelvt.edu.ec
[5] Universidad Politécnica de Madrid, Madrid, España; e-mail: crmonroy@etsii.upm.es

Abstract

The bivalve mollusk, Anadara tuberculosa (Concha Prieta), is found in the mangroves of the American Pacific, where it is subject to subsistence extraction. This article characterizes the performance of its value chain in Ecuador. A descriptive methodology of a quantitative type, non-experimental design, field, cross-sectional, and ex-facto was applied. Similar questionnaires were designed, validated, and applied to each link in the chain to collect information. It is concluded that there is a poor performance of the value chain with reduced productivity, loss of competitiveness, and deterioration of the participants' quality of life.
JEL: D24, Q22, Q54

Keywords: Ecuador; Bivalve mollusks; Concha Prieta; Agribusiness; Value chain; Productivity; Competitiveness; Quality of life; Mangroves

Introduction

Fishing and aquaculture are fundamental activities in Latin America and the Caribbean, from the social, economic, and nutritional point of view, since 85% of the fish and shellfish catches consumed at the family level come from artisanal fishing, and it is the medium life of 1.8 million families (FAO-CEPAL, 2020).

It is highlighted that small-scale aquaculture contributes to global aquaculture production and the development of rural livelihoods through providing food, livelihoods, and income-generating possibilities, thus improving social equity and quality of life of poor rural communities (FAO, 2018).

In Latin America, the participation of bivalve mollusks in international trade is practically nil since their importance is limited to local or intra-regional consumption. Chile is the largest producer and exporter in the region, followed by Brazil and Peru, reporting that Chilean bivalve production represented 29% of the total for 2018, the main species being mussels and scallops (FAO, 2020).

There is great potential for economic growth in the international trade of marine and aquaculture products, above all, due to the ease of being produced in aquaculture systems of various kinds and integrated into global value chains in a sustained manner.

The bivalve mollusk (Anadara tuberculosa), whose common name is "concha prieta or black shell" (CP), Class Bivalvia, Subclass Pteriomorphia, Order Arcoida, Superfamily Arcacea, Family Arcidae, and Genus Anadara Gray, 1847, is one of the numerous species that sustain the mangrove wetland located in the marine coastal zone of the American Pacific. This mollusk inhabits the roots of the red mangrove, Rhizophora mangle Linnaeus, in the intertidal zone

where it receives saline and continental water inputs and the direct influence of tides and marine currents, with mostly muddy soils. Its presence has been reported from Peru (Punta Telégrafo) to Mexico (Laguna San Ignacio, Baja California Sur), highlighting that it reproduces naturally and is traded in Peru, Ecuador, Colombia, Panama, Nicaragua, Costa Rica, Guatemala, El Salvador, Honduras and Mexico (Lazarich-Gener, 2009).

This economic activity has developed intuitively and spontaneously, based on the empirical knowledge of an ancestral production in this relevant coastal wetland, the mangrove forest. It is characterized by being a domestic and subsistence economy for the fishing communities, who find in the extraction, commercialization, and preparation of the black shell a source of local income, with significant economic, social and environmental relevance.

This bivalve mollusk has great economic, social, and environmental importance in the Republic of Ecuador, with a high consumption throughout the country and an attractive potential for international marketing. However, its production chain is rudimentary, and it currently faces a series of problems related to overexploitation, lack of competitiveness, pollution and reduction of the mangrove area, low quality of life of shellfish collectors, undeveloped administrative processes, and scarce innovation, among others (Prado-Carpio *et al.*, 2018).

In line with the above, the objective of this article is to characterize the *A. tuberculosa* agribusiness considering the performance of its value chain in the three dimensions identified: productivity and competitiveness of the CP resource and the quality of life of the participants in each intervening link of the value chain.

2 Background

Marine and coastal areas are interrelated with development as they are essential to building a balance between the well-being of the population and their environment. Both for their natural values and the practices associated with their management, they offer opportunities to demonstrate the importance of conserving biological diversity and environmental services to achieve sustainable development.

Among the sustainable development goals (SDGs), especially SDG 14 (Life below water), the fundamental role of food and agriculture, including fisheries, is considered to achieve the global goals, emphasizing the importance of the conservation and proper use of marine resources to accomplish sustainable development and nutrition for the population (United Nations-UN, 2015; United Nations Food and Agriculture Organization - FAO, 2020).

On the other hand, the world is facing a severe crisis due to the COVID-19 pandemic, with severe repercussions for the world economy and in the food production and distribution sector, including fishing and aquaculture (United Nations Organization for Food and Agriculture- FAO and Economic Commission for Latin America and the Caribbean- ECLAC, 2020).

Artisanal fishing has been homogeneously impacted throughout the region, observing that all countries have considerably decreased their demand due to the closure of markets and restaurants (FAO-ECLAC, 2020).

In this sense, it is estimated that world fish production reached about 179 million tons in 2018, of which 82 million tons came from aquaculture production. Of the available total, 156 million tonnes were destined for human consumption, equivalent to an estimated annual supply of 20.5 kg per capita. Aquaculture represented 46% of total production and 52% of fish for human consumption (FAO, 2020).

In the last two decades, Asia has dominated aquaculture production (89%), with the leading producers being China, India, Indonesia, Vietnam, Bangladesh, Egypt, Norway, Chile. It should be noted that the vast majority of bivalve mollusks (oysters, mussels, clams, scallops, and others) of importance in international trade are cultivated. They are not produced as a result of the capture of specimens from natural populations but through various aquaculture production systems; Japan, Spain, France, Italy, and Korea produce significant quantities of this item (FAO, 2020).

At an international level, bivalve mollusks represented the second group in production (17.7 million tons) after finfish (54.3 million tons) for 2018. The most-traded species were mussels, clams, combs, and oysters. For that same year, shell mollusks (17.3 million tons) contributed 56.3% of marine and coastal aquaculture (FAO, 2020).

A substantial proportion of bivalves is consumed in the country that produces them, with a low quantity traded internationally (FAO, 2007). In addition, they are highly perishable and potentially dangerous to human health if not appropriately handled since their most desired consumption is raw and fresh, without any processing.

The marine and coastal aquaculture production of aquatic animals (fish, crustaceans, and others) in the Americas is estimated at 2,587 thousand tons, live weight. Of these, mollusks represent only 640 thousand tons in live weight (FAO, 2020).

The contribution of the *A. tuberculosa* to the Ecuadorian Gross Domestic Product (GDP) is estimated between 3.4 and 6.8 million USD. If the value represented by restaurants and cevicherías is added, it could exceed 10 million USD per year.

Although there are few statistics and production references available on this resource (Rendón and Mejía, 2004), it was observed that its economic importance was relatively low for 2019, if compared, for example, with the Ecuadorian shrimp or banana sectors. However, it presents an interesting growth potential, based on its own national consumption and international trade (Cabanilla, 2007), with neighboring countries (Colombia and Peru) and even towards locations abroad, such as Spain, in which the Ecuadorian emigrant colonies are important and could become a target market (Rendón and Mejía, 2004).

From the employment point of view, recent reports show that the number of people employed in fisheries and aquaculture in America has been declining (FAO, 2020). Lazarich-Gener (2009) reports that in Nicaragua, the number of people dedicated to extracting black shells was estimated to range from 1,600 to 2,000 in 2005.

In Ecuador, in the case of the *A. tuberculosa* production chain, it is estimated that some 4,000 people work as shellfish collectors, in addition to about 500 more people who work as boatmen-transporters of shellfish collectors, merchants, shellfish counters, shellfish transporters, and other related tasks (Subsecretaria de Recursos Pesqueros -SRP, 2013).

An estimate of the numerous restaurants that serve this shellfish in towns on the Ecuadorian coast and throughout the country needs to be added. These establishments have a varied offer of dishes for their guests, but it should be noted that *A. tuberculosa* is added as part of the food mix, and in other cases, it is also offered as the main ingredient in prepared dishes. It could be estimated at 8,000 jobs that are related to the agribusiness of the A. tuberculosa in Ecuador to a greater or lesser degree.

It is recognized that the size of the economy of the *A. tuberculosa* is relatively small in the Ecuadorian macroeconomic context, as well as the jobs it generates, but its importance at the local microeconomic level is highlighted. The *A. tuberculosa* agribusiness is highly relevant for supporting small coastal fishing communities along the Ecuadorian Pacific coast and mainly in the provinces of Esmeraldas, Guayas, Manabí, and El Oro. This product presents a high nutritional value (Cruz *et al.,* 2012) and even aphrodisiac (Cabanilla, 2006). Furthermore, this economic activity is attractive due to its nearby location, relatively constant production throughout the year, low investment, and reduced risks of failure in its extraction (Orquera, 1999).

Despite the advantages mentioned above, shellfish workers and other participants in the *A. tuberculosa* production chain experience a reduction in quality of life levels, with incomes well below the basic family basket in Ecuador and high poverty levels (Prado-Carpio *et al.,* 2020a).

Proper management of the *A. tuberculosa* agribusiness may contribute to preserving and sustainable use of the mangrove ecosystem on the Ecuadorian coast. This coastal wetland is subject to different anthropogenic activities such as urban growth, pollution, development of tourist infrastructure, and mainly to the implementation of shrimp aquaculture. Beitl *et al.* (2018) report that there has been a net loss of 49% of mangroves from 1985 to date. However, López Rodríguez (2021) states that 2008 evaluations report mangrove losses in guarded areas, but recovery of the coastal wetland has been identified in some sectors.

The analysis carried out by Flores-Aguilar *et al.* (2021), in the mangroves of the Jambelí archipelago, Santa Rosa canton, Oro province, evidenced the most significant decrease in the

mangrove forest surface in 1997, with the reduction to 6,921.93 ha, and a recovery in 2016, to 8,468.94 ha.

3 Methods

The Jambelí archipelago, El Oro province, Ecuador, the target of this research (Figure 1), is one of the most relevant shellfish capture areas in the Republic of Ecuador due to its high landing volumes (Zambrano *et al.*, 2017). In 2011, a total catch was estimated in the main landing ports of the Ecuadorian coast in the order of 30 million individuals, of which approximately 40% were taken in the Jambelí archipelago (Mora *et al.*, 2012), data that justifies the selection of this area for the study of the production chain of *A. tuberculosa*.

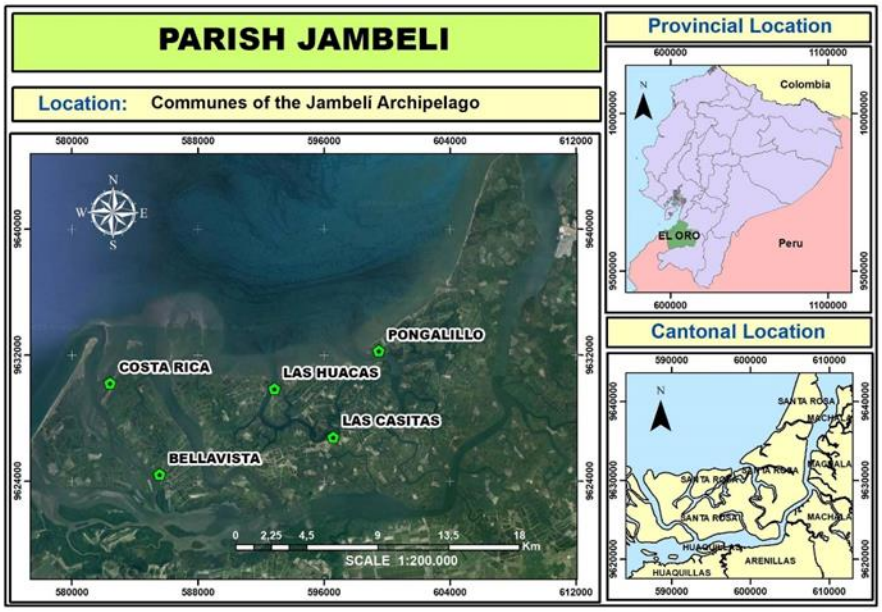

Figure 1. Research Zone: Jambelí archipelago, province El Oro, Ecuador.

The descriptive methodology applied was quantitative (Tamayo and Tamayo, 2014). Its design was non-experimental, field, cross-sectional, and ex-post-facto (Hernández-Sampieri, 2004). The population under study was 565 individuals, comprised of shellfish workers, managers of shellfish associations, traders, and restaurants of the *A. tuberculosa* production chain. The information was collected from the Union of Artisanal Fisheries Production of El Oro, Ecuador (UOPPAO), the on-site review of the restaurants located on the islands, and the Association of Trade and Service Entrepreneurs of the province of El Oro.

The type of sampling to be used was probabilistic, random, and stratified. The sample size was estimated at 222 informants, with a confidence level of 95% and a maximum permissible error of 5.13%, through the formula proposed by Martínez-Miguélez (2005).

For information gathering, four similar questionnaires were first designed, validated (opinion of academic experts and managers of the shellfish association), and applied to each link in the production chain: 138 shellfish collectors, 12 shellfish managers, 27 traders, and 45 restaurants - cevicherías, which were used to measure the performance construct of the value chain, its respective dimensions, and indicators. Then the questionnaire was applied through the interview or structured survey method. The performance construct of the Anadara tuberculosa value chain had three dimensions: productivity, competitiveness, and quality of life, each of these with its sub-dimensions and indicators.

The questionnaire was structured by a classification section and another section for the variables under study. The predominant measurement scale was the Likert scale with values from 1 to 5, representing the value of 1 "never," the value of 2 "seldom," the value of 3 "sometimes," the value of four "almost always," and value of 5 "always. " This 5-degree scale

was transformed to a 100-point scale through extrapolation to convert it into an index that could be interpreted more intuitively, with 100 points representing the maximum desirable value for each dimension under study. Multiple scales and open questions were also applied for quantitative indicators (Martínez-Soto, 2011). The data recorded in the questionnaires were statistically processed with the SPSS v.23.0 through univariate tests, according to the objective of this research.

Once the data had been processed, considering the background obtained from the bibliographic review, the results obtained, and the researchers' experience, the most significant challenges for this supply chain were prioritized based on the performance achieved.

4 Results and discussion

The characterization of the performance of the value chain of *A. tuberculosa* is presented below, considering its structure and defining its main links. Next, the classification indicators for this value chain are presented and the results obtained in the competitiveness, productivity, and quality of life dimensions of the performance construct of the value chain of this species are shown.

4.1 Characterization of the performance of the *Anadara tuberculosa* production chain

The production chain identified for the *A. tuberculosa* is similar to that reported by Azabache-Cobeña (2016), which is made up of the collection, commercialization, and distribution links, as well as the one reported by Rivero-Rodríguez (2009), which points to collectors, traders, retailers, restaurants and cocktail bars, as part of the *A. tuberculosa* value chain.

According to Prado-Carpio *et al.* (2020b), its structure is more rudimentary, with few links and low levels of complexity, than those of other bivalve mollusks, such as mussels in the province

of Tierra del Fuego, Antarctica, and the South Atlantic islands, Argentina, which is made up of the seed capture, cultivation, harvest, conditioning, and market links (Bertolotti *et al*., 2014).

In Prado-Carpio *et al.* (2020a), the characterization of the participating links is presented: the first is that of primary production, collection, or extraction of the shellfish, which mainly consists of the transfer of the shellfish collectors in boats to the mangrove areas when the tides go down and leave the muddy soil exposed, to walk and put their hands in the mud to extract the live shells, store them in "jicras" or bags and transfer them to the commercialization areas that are mainly located at the ports of embarkation. Among the main practices applied by the shellfish collectors are the selection of shells larger than 4.5 cm and their washing at the time of collection.

The second link is that of the commercialization by retailers and wholesalers. It includes the reception and purchase of live shellfish at the shipping ports or collection centers for their physical cleaning and classification in large, small and medium-sized, as well as to separate the shellfish of the *A. tuberculosa* species (of greater demand and commercial value) from the shellfish of the *Anadara similis* species. This process also usually occurs on the islands or in the mangroves themselves, especially with that shellfish product used for national sale or in countries such as Colombia, Peru, or others. After being bought, cleaned, selected, and classified, the shellfish are sold alive and fresh to retailers, restaurants, or final consumers (Prado-Carpio *et al.*, 2020a).

The third link is that of restaurants, cevicherías, cocktail bars, picanterías, and the like, commercial establishments that buy live shellfish and offer it fresh to their customers. In these businesses, the shellfish are opened at the time of preparation and provided to their customers

in unique or mixed dishes. This link is where the most significant value is added to the product, with diverse preparations that include the shellfish (Prado-Carpio *et al.,* 2020a).

4.1.1 Classification Indicators

Prado-Carpio *et al.* (2020c) selected as classification indicators the geographical location, experience in the business, gender, age, level of education, and if it is associated with any organization related to the business of the *A. tuberculosa* (Table 1).

Table 1. Classification indicators of *A. tuberculosa* chain

Indicator	Description	Unit	Value
Island, commune or district	Machala	%	16.7
Years of experience in the business	13 to 23	%	42.5
Gender	Male	%	81.7
Age	Average	Years	42.5
Level of education	Complete primary education	%	48.6
Belonging to some association	Yes	%	63.2

In the province of El Oro, Ecuador, ten relevant sectors were identified for the *A. tuberculosa* production chain: Costa Rica, Las Casitas, Las Huascas, Pongalillo, Bella Vista, Arenillas, Santa Rosa, Huaquillas, Machala, and Pasaje. Machala (Puerto Bolívar) is the area with the highest volume of landings, reaching 16.7% of the total. These results are similar to those obtained by the National Institute of Fisheries of Ecuador - INP (2020), which indicates that in the province of El Oro, the main landing ports of the *A. tuberculosa* are Puerto Bolívar, Puerto Jelí, and Hualtaco. It was verified that there is a relationship between the links in the *A. tuberculosa* production chain and its geographical location (Prado-Carpio *et al.*, 2020 c).

Additionally, it was found that the workers and entrepreneurs involved in the productive activity have a great experience, with significant differences in the work experience according to the identified links.

Regarding the gender indicator of the sample of interviewees, it was obtained that the male gender is the majority within the production chain of the *A. tuberculosa*, with 81.7% of the interviewees for the province of El Oro (Prado-Carpio *et al.,* 2020a). However, they differ from those registered by Quiñonez-Cabeza *et al.* (2020) for the province of Esmeraldas, where it was recorded that 60% of the shellfish collectors were women, 30% men, and the remaining 10% minors.

In addition, it was determined that in the link of shellfish collectors, the male gender represents 96.3% of the sample. In comparison, for restaurants and traders, it only reaches the proportion of 44.4% and 63.3%, respectively (Prado-Carpio *et al.,* 2020a). However, for the shellfish collectors, this result contrasts with those reported in the province of Esmeraldas (Moreno-Cáceres, 2017) and in the Republic of Colombia, where most of the collectors are women (Lucero *et al.,* 2013; Cano- Otalvaro *et al.,* 2013).

Another element to highlight is that in the province of El Oro, the presence of children working in the capture work and the *A. tuberculosa* production chain was not observed, while in Nicaragua, it has been reported (Hernández *et al.,* 2011).

Regarding the age of the workers and entrepreneurs, it was determined that the average age of the interviewees was 42.5 ± 12.8%, the most frequent group being 28 to 39 years of age with 39.7% and second between 40 to 51 years of age with 25.7% (Prado-Carpio *et al.,* 2020a). These results differ from those found in Colombia, where the most representative age range was estimated to be 26 to 30 years (Zapata *et al.,* 2008). Likewise, it was verified that there are significant differences between age groups by links in relation to age.

Concerning the variable degree of education, the trend shows complete primary education with 48.2%, followed by unfinished primary education with 17.27%. It was determined that there is a dependence between the link and the degree of education. In the restaurant/cevicherias link, a higher educational level than that of shellfish collectors was found.

Regarding the variable association of individuals with some socio-productive organization linked to the business of the *A. tuberculosa*, it was determined that 63.2% are affiliated. This proportion is higher in the shellfish collector link (Prado-Carpio *et al.*, 2020a). Therefore, it is inferred that this link is the one with the highest levels of institutional organization, which favors the development of the shellfish extraction and conservation of the mangrove swamp.

4.1.2 Dimensions of the value chain performance construct

The results obtained in the competitiveness, productivity, and quality of life dimensions, subdimensions, and indicators of the performance construct of the value chain of *A. tuberculosa* are presented below.

In Prado-Carpio *et al.* (2020a), the performance index of the *A. tuberculosa* value chain was estimated at 75.1%, which means that the value chain has a moderate to good performance level, reaching the lower value in the quality of life dimension within this construct, which shows the need to improve it (Figure 2).

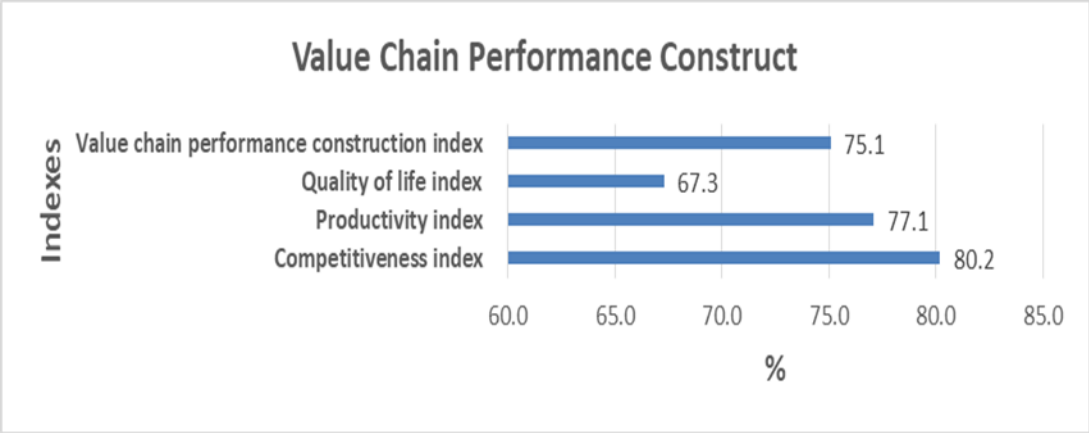

Figure 2. *A. tuberculosa* value chain performance indexes

4.1.2.1 Competitiveness dimensión indicators

It was established that the competitiveness dimension comprises the sub-dimensions: cost leadership, differentiated product, and market segment, with their indicators (Figure 3).

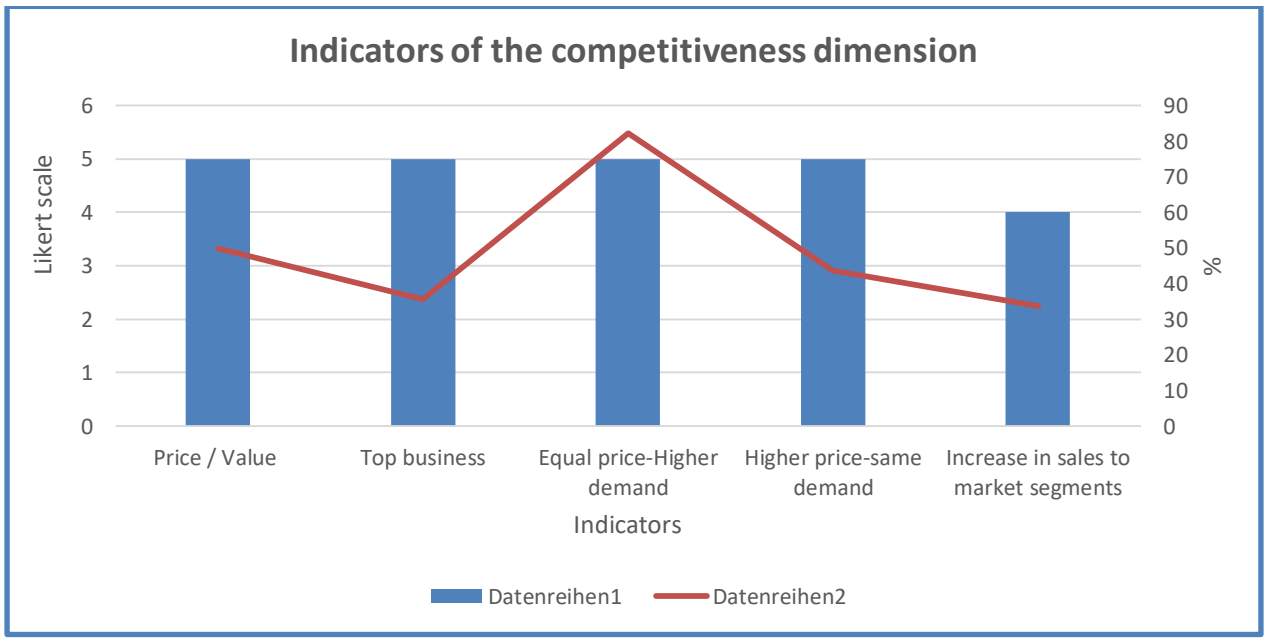

Figure 3. Indicators of the competitiveness dimension in the performance of the *A. tuberculosa* value chain.

- **Cost leadership subdimension**

The selected indicators are minimum costs and the standard quality-cost ratio. Regarding the latter, it was found that consumers of the *A. tuberculosa* prefer this food due to its positive quality and low-cost ratio (moderate proportion of 49.8%), which is indicative of a good price/value ratio (Prado Carpio *et al.,* 2020c).

On the other hand, a cost increase trend of 50.5% was estimated, which can be interpreted as that costs have remained at a similar level during recent years. The average daily operating expenses for each link are 7.6 USD per day for the shellfish collectors, 8.3 USD for the traders link, 53.2 USD for the restaurant link, and 6.8 USD for each shellfish managers group member (Prado-Carpio *et al.*, 2020a).

The operating expenses of each link are not comparable, as each link performs different procedures and activities. It should be noted that the operating costs of 7.6 USD per day for the shell link obtained in this investigation are higher than those obtained in the Esmeraldas area of 4.0 USD per day by Quiñónez-Cabeza *et al.* (2020), which can be interpreted as lower levels of competitiveness of the production of the *A. tuberculosa* in the province of El Oro, in relation to those of the province of Esmeraldas. However, to make a valid comparison from the point of view of competitiveness, these costs must be estimated based on the unit value. 67.7% of those who interact in the *A. tuberculosa* production chain consider that the way to reduce unit costs is to increase production.

- **Differentiated product subdimension**

Competition, demand-price, and distinction-price were selected as indicators. The results obtained reflect that the *A. tuberculosa* business is superior to that of other marine species

except for shrimp, with a moderate to low trend (35.6%), in a higher proportion in the shellfish link (40.6%).) and to a lesser extent in the traders' link (26.7%).

Similarly, in the demand-price indicator, it turned out that in the face of the possibility of the same price, the *A. tuberculosa* will always be more in demand than other species of bivalves (very high trend of 82.3%, to a lesser extent in the link of traders with a 55.5%).

Regarding the distinction-price indicator, the result reveals that the different characteristics of the *A. tuberculosa* in relation to the competition allow it to be sold at a higher price (moderate to low proportion of 43.6%). These results are similar to those reported by Lazarich-Gener (2009) and the Instituto de Investigaciones Marinas y Costeras- INVEMAR (2010), which indicate that *A. tuberculosa* is a marine resource in demand in local markets on the Pacific coast of Colombia, Ecuador, Peru, Nicaragua, and other countries, but that to competitively enter formal markets at the international level requires raising their levels of safety and sanitary quality. In other words, in a local context, the *A. tuberculosa* is a differentiated product, with high levels of competitiveness in the informal markets where this study was carried out, but with low levels of competitiveness in the traditional international markets, as it does not comply with current health regulations. Therefore, the application of purification techniques is required (Hidalgo-Villon *et al.,* 2020).

- **Market segment subdimension**

The analysis showed that sales to specific market segments have almost always increased, for example, to the group of tourists attracted by the marine-coastal areas of Ecuador, in a moderate to a low proportion of 33.6%. Thus, it can be inferred that although the *A. tuberculosa* has specific and attractive commercial and nutritional attributes that allow it to achieve a better

price in the market, this quality is not being adequately managed from the point of view of market segmentation, especially in the link of shellfish collectors, a group where it was evidenced that in a proportion of 33.3% market segmentation has never been promoted.

It is inferred that the competitiveness dimension is characterized by moderate to high levels, mainly due to the qualities and characteristics of the *A. tuberculosa*, which make it a unique product, practically irreplaceable, with a national and international demand greater than supply and increasing, if it meets the minimum standards but whose prices have been increasing. This situation makes it less competitive and displaced by the complementary supply of other similar items, such as other types of shellfish (Prado-Carpio *et al.,* 2020a).

4.1.2.2 Productivity dimension indicators

The productivity dimension comprises physical productivity and economic productivity subdimension indicators.

- **Physical productivity subdimension**

It was investigated if the production satisfies the customers' demands. The results indicate that, almost always, but not always, demand is met in a moderate to low proportion of 41.8%, which is a sign of the need to increase production to satisfy the existing demand fully, as Prado-Carpio *et al.* (2020b) points out.

The researchers mentioned above also inquired about the average number of shellfish handled daily by each of the main groups participating in the *A. tuberculosa* production chain and its relationship with the planned quantity. In Table 2, it is observed that the highest value corresponds to the shellfish collectors associations, and the lowest compliance in the planned collection corresponds to managers.

Table 2. Number of shells handled daily by groups in the production line of *Anadara tuberculosa*

Link / Group	Unit	Planned quantity	Quantity achieved	Achievement (%)
Shellfish collectors	Shells /day	296	295	99.6
Restaurants	Shells /day	402	383	95.2
Traders	Shells /day	1294	1,861	143.8
Managers of shell collectors	Shells /day	6404	5,283	82.5

Source: Authors

On the other hand, the total of shells handled was estimated on an annual average per individual in each link: shellfish workers (85,271 shells), restaurants (110,703 shells), traders (538,563 shells), and 1,528,875 shells for shellfish associations and their managers (Prado-Carpio *et al.*, 2020b).

- **Economic productivity subdimension**

The exploration carried out by Prado-Carpio *et al.* (2020b) concluded that the participants in the *A. tuberculosa* production chain have always experienced moderate improvements in their income (35.4%), while 23.1% experienced that their income has hardly ever increased.

It was determined that the shellfish price is different depending on the size in the different groups of the production chain. It turned out that the sales of mixed size shells are somewhat higher (41.9%) than those of large size (40.5%), being lower for small shells (Table 3). It is noteworthy that at the market level, many shells were detected with a size below the legally established size, possibly because they are mixed with other more requested sizes.

Table 3. Size and price of *A. tuberculosa* shells for sale

Size of shells sold	% Marketed	Price of 100 shells (USD)	Price per unit (USD)
Only large	34.1	13.60	0.14

Only medium	2.9	11.81	0.12
Only small	0.7	7.33	0.07
Mixed sizes	50.7	12.12	0.12
Only large and medium	11.6	NA	NA
Total	**100**	**NA**	**NA**

NA: Not applicable Source: Authors

The *A. tuberculosa* sales prices are influenced by its size (Table 3). This investigation determined that large-sized shells representing 34.1% of the total traded are sold at 13.60 USD per hundred units at the shell level and those of small size at 7.33 USD per hundred units, which reached only 0.7% of the total traded. However, it should be noted that the highest proportion of *A. tuberculosa* sold is done in a mixed way, between large, médium, and small with 50.7% of the total, with a price of 12.12 USD per hundred units. This behavior explains the need for shellfish collectors to achieve higher income from their daily work by mixing large and small shells by size. However, this negatively affects production in the long term because they collect small specimens that have not reached their reproductive stage yet, affecting the size of the available population.

On the other hand, the marketing margins between the links from shellfish collectors to traders and restaurants were also determined, obtaining the link from traders 18.26% in relation to the value paid to the shellfish collectors, which was a weighted average of 13.29 USD per hundred units. The restaurants obtained a marketing margin of 167.16% in relation to the price paid to the traders, which was a weighted average of 15.71 USD per hundred shells. Restaurants have the highest marketing margin because they serve the processed and prepared shells to final consumers, and they are also accompanied by other inputs in dishes highly demanded by the population at a weighted average price of 41.98 USD per hundred shells.

These results differ from those obtained by Quiñónez-Cabeza *et al.* (2020) in San Lorenzo, Esmeraldas province, who point out that the price of the shell is influenced by the species and not the size since it is sold at 9 USD / 100 shells if they are female (*A. tuberculosa*) and 4 USD/100 shells if they are male (*A. similis*). Likewise, they indicate that the traders sell 100 units at 10 USD, a value substantially lower than the 15.71 USD percent of shells sold in the province of El Oro. These results allow us to infer that in this last province, the costs are higher, but also prices, equating marketing margins in both provinces.

Prado-Carpio *et al.* (2020c) point out that concerning the relative operational margin in the different participating groups of the *A. tuberculosa* production chain, the highest values are for the shellfish collectors (76.03%), a margin similar to that reported by Quiñónez-Cabeza *et al.* (2020) of 76.20%; and shellfish managers (69.53%). For traders, the operating margin (13.14%) was close to the value reported by the aforementioned researchers of 20% for the shellfish that comes from Colombia and 10% for the one that is extracted in Esmeraldas, Ecuador, which represent 48% and 52% of the total, respectively. Regarding the operational margin obtained in the link of the shellfish collectors, it should be noted that this estimate only considered the expenses for transportation, food, and consumables, but the value of labor was not added. For this reason, the operating margin gives high values, higher than 50%.

Regarding the income that the managers of the shellfish chain, traders, and restaurants obtain, the average daily value of 32.01 USD for each individual of the shellfish chain link was estimated, higher than the 13.33 USD received in the province de Esmeraldas (Quiñónez-Cabeza *et al.,* 2020).

In the province of El Oro, Ecuador, where the study was conducted, each individual in the chain of traders obtained a daily net profit of 34.51 USD/day, much lower than the gross profit of 2,750 USD/day, which is obtained on average by the 21 wholesale traders, in the province of Esmeraldas, Ecuador, (Quiñónez-Cabeza *et al.,* 2020), so it is inferred that in the province of Esmeraldas the market is monopolized by a few traders.

Based on these values that apply to the participants in the *A. tuberculosa* value chain, the monthly income of a shellfish collector is projected at 427 to 640 USD, a range below the basic family basket in Ecuador (712.11 USD).

The annual income for the shellfish collectors' link would be between 4,600 and 7,000 USD per year approximately, a value higher than that indicated by the Inter-American Development Bank (2018) of USD 4,000 / year per family of shellfish collectors.

In the same way, it was obtained that the owners of restaurants and picanterías obtain an average net income of 3,097 USD per month, equivalent to about 33,000 USD per year, inferring that this link is the one that obtains, on average, the highest income for the entrepreneurs who carry out this commercial activity within the production chain of the *A. tuberculosa.*

Additionally, the level of dependence of each link concerning the *A. tuberculosa* business was investigated, obtaining an average of 65.52% for the percentage of income represented by the production chain for each participating group. This means that their highest income comes from the *A. tuberculosa* business, mainly for shellfish collectors, with an average value of 78.5%, much higher than the 30.4% achieved by restaurants, which come from this activity.

Finally, it is noted that the performance of the value chain of *A. tuberculosa* is characterized by moderate to low productivity levels, fundamentally due to the situation of the mangrove forest, which supports the shellfish resource and other associated resources.

4.1.2.3 Quality of life dimension indicators

The sub-dimensions of quality of life, based on the indicator of unsatisfied basic needs (UBN), are presented in Table 4.

Table 4. Indicators of quality life dimension in the performance of *Anadara tuberculosa* value chain

Sub dimension	Indicator	Category	Unit	Value
Housing quality	Roof	Zinc	%	73.4
Overcrowding	Average	Spaces	Ambients	4.75
Overcrowding	Average	Resident	Persons	4.42
Overcrowding	Average	Residents/Spaces	Persons/Spaces	0.93
Potable wáter	Supply System	Water by pipe	%	94.5
Excreta	Sanitary Services	Sewers	%	41.7
Excreta	Sanitary Services	Cesspool	%	37.2
Schooling	Children aged 7-12 at home	Yes	%	50.2
Schooling	These children attend school	Yes	%	87.4
Income	Average	Age	Years	42.75
Income	Educational Level	Complete Primary Ed.	%	48.6

Source: Authors

The results reflect that 73.4% of those consulted have a zinc roof in their homes, indicating an intermediate quality of life in the rural centers evaluated. According to Feres and Mancero (2001), one of the most important indicators of quality of life is the level of habitability of the home, expressed through the predominant materials in the floor, walls, and ceiling or their state of conservation.

Likewise, in the overcrowding subdimension, it was obtained that in the homes, there are on average 4.75 spaces (kitchen, laundry room, living room, bathrooms, and bedrooms), calculating an overcrowding index of 0.93, which means that there are 0.93 inhabitants per room, an adequate and favorable result. In this sense, Feres and Mancero (2001) point out that in most

applications of the NBI method in Latin America and the Caribbean, a critical threshold of more than three people per room is used, which places the participants in the *A. tuberculosa* value chain outside the poverty thresholds for this indicator.

For the drinking water supply subdimension, the piped water category obtained 94.5%, indicative of excellent coverage of this service to the participants' homes in the *A. tuberculosa* production chain. The majority of the value chain participants are above the poverty line in this indicator.

In the excreta disposal system subdimension, 41.7% were obtained for the sewers and 37.2% for the cesspool or septic tank, which is indicative of the intermediate level of coverage reached by the sanitary services in the evaluated area.

In the case of the children's schooling subdimension, it turned out that 50.2% of households have school-age children, of which 87.4% attend school. Both indicators reached intermediate levels since the acceptable value is 95% and the ideal is 100%, in accordance with what is indicated by the National Institute of Statistics and Censuses of Ecuador-INEC (2015), which indicates that poverty is inversely associated with the number of years of study completed.

On the other hand, the income subdimension considers the level of education and the age of the participants who work as household heads in the *A. tuberculosa* production chain. The indicators reach values of 42.8 years and complete primary schooling in a proportion of 48.6%. According to Feres and Mancero (2001), these results indicate an approximation to the poverty threshold.

With the data collected in the quality of life dimension, the global index was calculated for each of its links for the *A. tuberculosa* production chain. The data reflects that almost 90% of the

participants have quality of life levels that range from fair (39.2%) to good (49.5%). This occurs because some links, such as restaurants, have adequate income, but they also have a relatively good infrastructure for housing and public services, except for excreta disposal.

However, it should be noted that the majority of the shellfish collectors (49.3%) and managers of the shellfish associations (66.7%) are at a regular quality of life level. The majority of the participants in the traders (77.8%) and restaurants (73.3%) links have a good quality of life.

Likewise, when the results obtained in the quality of life dimension were integrated, an average value was obtained for the percentage index of 67.5%, similar to that reported by Prado-Carpio (2020a). If the following scale is taken into consideration: from 0 to 20% totally unsatisfied basic needs; 21 to 40% not very satisfied basic needs; 41 to 60% basic needs moderately satisfied; 61 to 80% basic needs quite satisfied, and 81 to 100% basic needs fully satisfied, the production chain of the black shell would be located in the category of quite satisfied basic needs.

5 Conclusions

After applying the proposed methodology and achieving the results that were previously analyzed, the following conclusions are reached regarding the diagnosis of the performance of the *A. tuberculosa* value chain in the three dimensions identified: productivity, competitiveness of the *A. tuberculosa* resource, and quality of life of the participants in each intervening link:

The *A. tuberculosa* value chain has a rudimentary structure, with few links and low levels of complexity. The extraction, commercialization, and restaurant-cevicherías links were identified.

This value chain is characterized by the predominance in El Oro province of male workers and entrepreneurs who have extensive experience in their work. However, the participants tend to be young, presenting high levels of associativity, particularly in the link of the shellfish

collectors, which is positive because it gives the value chain a collective sense. The production is scattered in different islets and ports of the study area.

The competitiveness dimension is the one that provides the greatest strength to the performance of the *A. tuberculosa* value chain since this item is characterized by a high preference and demand over the other species of shellfish offered in the market and also maintains a leadership before complementary items such as fish and shrimp produced in the area. The *A. tuberculosa* has unique characteristics that make it an exquisite ingredient and is highly appreciated by customers of restaurants and cevicherías. Its competitiveness is supported by focusing on quality and market segmentation, not cost leadership.

On the other hand, in the productivity dimension, it is concluded that the prevailing production systems based on the extraction of natural populations do not meet the existing demand. At the same time, there is a downward trend in these natural populations as the catch increases. Commercial and consumption of small specimens have not reached the legal and technically established size. They are mixed with the larger specimens in search of higher income. Additionally, the situation of deterioration and surface loss of the mangrove ecosystem sustenance of the shellfish resource must be added.

In the quality of life dimension of the participants in the *A. tuberculosa* production chain, it is concluded that those who participate in it do not achieve sufficient income to cover the basic food basket, especially in the chain of shellfish collectors. However, they have an infrastructure in their homes, which provides them with moderate comfort without overcrowding. Sewage dumped directly in many of the same mangroves from which the *A. tuberculosa* is extracted still is a severe management problem.

Finally, as an original contribution of this research, the performance index of the *A. tuberculosa* value chain was estimated. This performance can be diagnosed as moderate to good, mainly driven by the high levels of competitiveness of this resource, and to a lesser degree due to its limited production, with quality of life being the weakest aspect within the performance construct of the *A. tuberculosa* value chain.

Based on these conclusions, it is recommended to develop strategic lines that allow the production chain to be promoted in terms of competitiveness, productivity, and quality of life to expand and improve the supply of this bioresource in the Ecuadorian and international markets.

References

Azabache-Cobeña, J. (2016). Cadena productiva de *Anadara tuberculosa* (SOWERBY 1833) extraída en el santuario nacional los manglares de Tumbes. Available at http://www.met.igp.gob.pe/publicaciones/2016/10Tesis_Jose_Azabache.pdf (accessed on 1 September 2020).

Banco Interamericano de Desarrollo- BID. (2018). Ecuador: manglares gestionados a través de concesiones comunitarias. Available at https://ewsdata.rightsindevelopment.org/files/documents/70/IADB-EC-T1370.pdf (accessed on 12 December 2018).

Beitl, C., Rahimzadeh, P., Bravo, M., Ortega, D., Bird, K. (2018). Geoforum New valuation for defying degradation: Visualizing mangrove forest dynamics and local stewardship with remote sensing in coastal Ecuador. Geoforum (April) 1–10. Available at https://doi.org/10.1016/j.geoforum.2018.10.024 (accessed on 3 December 2020).

Bertolotti, M.I., Pagani, A., Gualdoni, P., Fosati, J. (2014) Cadena de producción del cultivo del mejillón en el año 2011 en la provincia de Tierra del Fuego, Antártida e islas del Atlántico Sur, Argentina. Revista Galega de Economía 23 (Extraordinary issue September 2014) pp: 33-50. Available at https://www.redalyc.org/pdf/391/39138004002.pdf. (accessed on 20 February 2020).

Cabanilla-Carpio, C. L. (2007). Plan de manejo de la pesquería de concha prieta *Anadara tuberculosa* en la localidad de Puerto Hualtaco, Provincia de EL ORO-ECUADOR. Available at https://www.researchgate.net/publication/304007853_PLAN_DE_MANEJO_DE_LA_PESQUERIA_DE_CONCHA_PRIETA_Anadara_tuberculosa_EN_LA_LOCALIDAD_DE_PUERTO_HUALTACO_PROVINCIA_DE_EL_ORO-ECUADOR (accessed on 20 October 2020). DOI: 10.13140/RG.2.1.2484.1846.

Cano-Otalvaro, J. L., Murrillo-García, O. E., Cantera-Kintz, J. R., Gil-Agudelo, D. L. (2012). Diferenciación morfológica de las especies de piangua *Anadara tuberculosa* y *Anadara similis* (Arcidae) en diferentes bosques de manglar a lo largo de la costa pacífica colombiana

mediante morfometría geométrica. INVEMAR, Boletín de Investigaciones Marinas y Costeras 41(1) pp: 47-60. ISSN 0122-9761.

Cruz, R. A., Fonseca Rodríguez, C., Chavarría-Solera, F. (2012). Comparación de la composición química proximal de la carne de *Anadara tuberculosa* y *A. similis* (Bivalvia: Arcidae) de Chomes, Puntarenas, Costa Rica. Revista Ciencias Marina y Costeras 4(1): 95–103. DOI: 10.15359/revmar.4.6.

FAO- Organización de las Naciones Unidas para la Alimentación y la Agricultura (2018). El estado mundial de la pesca y la acuicultura 2018. Cumplir los objetivos de desarrollo sostenible. Roma. Licencia: CC BY-NC-SA 3.0 IGO. Available at http://www.fao.org/publications/sofia/es/ (accessed on 1 July 2020).

FAO- Organización de las Naciones Unidas para la Alimentación y la Agricultura (2020). El estado mundial de la pesca y la acuicultura 2020. La sostenibilidad. Available at https://doi.org/10.4060/ca9231es (accessed on 19 January 2021).

FAO- Organización de las Naciones Unidas para la Alimentación y la Agricultura y CEPAL- Comisión Económica para América Latina y el Caribe (2020). Sistemas alimentarios y COVID-19 en América Latina y el Caribe: Hacia una pesca y acuicultura inclusiva, responsable y sostenible. Boletín N°15. Available at https://www.cepal.org/es/publicaciones/46106-sistemas-alimentarios-covid-19-america-latina-caribe-ndeg-15-pesca-acuicultura (accessed on 23 September 2020).

FAO- Organización de las Naciones Unidas para la Alimentación y la Agricultura (2007). Estado actual del cultivo y manejo de moluscos bivalvos y su proyección futura. Factores que afectan su sustentabilidad en América Latina. Taller Técnico Regional de la FAO 20-24 de agosto de 2007, Puerto Montt, Chile. Available at http://www.fao.org/3/a-i0444s.pdf (accessed on 4 January 2018). ISBN 978-92-5-306115-0.

Feres, J. X., Mancero, X. (2001). El método de las necesidades básicas insatisfechas (NBI) y sus aplicaciones en América Latina; Comisión Económica para América Latina y el Caribe-CEPAL, División de Estadística y Proyecciones Económicas, Serie Estudios Estadísticos y Prospectivos 7, Santiago de Chile. pp. 52. Available at https://www.cepal.org/es/ publicaciones/4784-metodo-necesidades -basicas-insatisfechas-nbi -sus-aplicaciones - america-latina (accessed on 30 May 2019). ISBN: 9213217919.

Flores-Aguilar, D., Romero-Córdova, M., Trujillo-Vázquez, V., González- González, A., Juela, O. (2020). Análisis multitemporal de la superficie ocupada por la cría de camarón (Litopenaeus vannamei) en los manglares del archipiélago de Jambelí, cantón Santa Rosa, Provincia de El Oro, Ecuador. Bosques Latitud Cero 10(2):146:160. Available at https://www.researchgate.net/publication/348937475_Analisis_multitemporal_de_la_superficie_ocupada_por_la_cria_de_camaron_Litopenaeus_vannamei_en_los_manglares_del_archipielago_de_Jambeli (accessed on 1 September 2019).

Hernández-Sampieri, R. (2004). Metodología de la investigación. Editorial Félix Varela. La Habana. 2004. Available at https://www.ecured.cu/Investigaci%C3%B3n_no_experimental (accessed on 21 January 2020).

Hernández, N., Saavedra Martínez, M. A., Maradiaga, J., Martínez, S., Hernández, C., Windevoxhel, N., Ponce, M. (2011) Diagnóstico sobre el estado de aprovechamiento del recurso conchas negras (*Anadara tuberculosa* y *Anadara similis*) en la costa pacífica de Nicaragua. Documentación. Programa Regional de USAID para el Manejo de Recursos Acuáticos y Alternativas Económicas, Managua. Available at http://repositorio.uca.edu.ni/39/ (accessed on 3 September 2020).

Hidalgo-Villón, A.P., Arévalo-Castro, O.R., Carreño-Rosario, H.N. (2020) Contaminación por Coliformes Totales y *Escherichia coli* en concha (*Anadara tuberculosa* y *Anadara similis*) en Jambelí, El Oro, Ecuador. Available at https://revistas.uees.edu.ec/index.php/IRR/article/download/399/430?inline=1 (accessed on 21 September 2020).

IVEMAR-Instituto de Investigaciones Marinas y Costeras José Benito Vives de Andréis (2010) Pianguando. Estrategias para el manejo de la piangua. Available at https://www.oceandocs.org/handle/1834/8253 (accessed on 21 September 2020).

Instituto Nacional de Estadística y Censos del Ecuador-INEC (2015). Instituto Nacional de Estadística y Censos (2015) Pobreza en ecuador perfiles y factores asociados 2006-2014. 26 p.

Instituto Nacional de Pesca del Ecuador-INP. (2020). Nota informativa del recurso concha (*Anadara tuberculosa* y *Anadara similis*) en la provincia de El Oro, febrero 2020. Available at http://www.institutopesca.gob.ec/concha/ (accessed on 2 September 2020).

Lazarich-Gener, R. (2009). Estudio de mercado de la concha negra (*Anadara similis* y *Anadara tuberculosa*) en Nicaragua. Comercialización con garantía de inocuidad. Available at http://repositorio.uca.edu.ni/2702/ (accessed on 7 January 2020).

López-Rodríguez, F. (2021). Mangrove in Ecuador: Conservation and management strategies. IntechOpen By 03 March 2021. Open access peer-reviewed chapter. DOI: 10.5772/intechopen.95572 (accessed on 21 January 2021).

Lucero-Rincón, C. H., Cantera, J. R., Gil-Agudelo, D. L., Muñoz, O., Zapata, L. A., Cortes, N., Gualteros, W. O., Manjarres, A. (2013). Análisis espacio temporal de la biología reproductiva y el reclutamiento del molusco bivalvo *Anadara tuberculosa* en la costa del Pacífico colombiano. Revista de Biología Marina y Oceanografía 48(2): 321-334. Available at https://www.redalyc.org/pdf/479/47928716011.pdf. (accessed on 1 January 2021).

Martínez-Miguélez, M. (2005). El proceso de nuestro conocer postula un nuevo paradigma epistémico, Polis: Revista Latinoamericana Polis (8). ISSN 0717-6554, ISSN-e 0718-6568.

Martínez-Soto, M. E. (2011). Desarrollo de un modelo de gestión del conocimiento en la cadena de suministro de la industria agroalimentaria. Tesis Doctoral Universidad Politécnica de Madrid, Escuela Técnica Superior de Ingenieros Industriales, Madrid, España. 271 pp. Available at http://oa.upm.es/6199/1/MOISES_ENRIQUE_MARTINEZ_SOTO.pdf (accessed on 20 October 2021).

Mora, E., Flores, L., Moreno, J., Gilber, G. (2012). La pesquería de la concha (*Anadara tuberculosa)* en los principales puertos de desembarque de Ecuador. Boletín Científico y Técnico 22 (2): 11–16. Available at https://scholar.google.es/scholar?hl=es&as_sdt=0%2C5&q=Mora+E%2C+L.+Flores%2C+J.+Moreno+y+G.+Gilbert+%282012%29+La+pesquería+de+la+concha+%28Anadaratuberculosa+y+A.+similis%29+en+los+principales+puertos+de+desembarque+de+Ecuador+en+el+2011.+Bol.+Cient.+Te (accessed on 1 September 2019).

Moreno-Cáceres, J. (2017). Manejo basado en derecho importancia de la pesquería de concha prieta. Instituto Nacional de Pesca, Ecuador. 20 pp. Available at http://institutopesca.gob.ec/wp-content/uploads/2017/07/Documento-Concha-Manejo-Basado-en-Derecho.pdf (accessed on 20 October 2020).

Organización de Naciones Unidas- ONU (2015). Objetivos del desarrollo sostenible. Available at https://www.un.org/sustainabledevelopment/es/objetivos-de-desarrollo-sostenible/ (accessed on 19 January 2021).

Orquera, L. (1999). El Consumo de moluscos por los canoeros del extremo sur. Relaciones de la Sociedad Argentina de Antropología XXIV. Buenos Aires, 21 p. ISSN 0325-2221.

Prado-Carpio, E., Quezada-Abad, C., Martínez-Soto, M. E., Rodríguez-Monroy, C., Morris-Díaz, A. (2018). An approximation to agribusiness development in the value chain of the bivalve mollusk (*Anadara tuberculosa*) (Sowerby, 1833) (Arcidae). Proceedings in Food System Dynamics, pp. 382-393. Available at http://centmapress.ilb.uni-bonn.de/ojs/index.php/proceedings/article/view/1831 (accessed on 21 September 2019). DOI: 10.18461/pfsd.2018.1831.

Prado-Carpio, E., Castro-Armijos, C., Rentería-Minuche, P., Coronel-Reyes, J., Paladines-Amaiquema, J., Martínez-Soto, M. (2019). Agronegocio Conchero (Anadara tuberculosa): Aspectos socioeconómicos, Archipiélago de Jambelí. Revista Cumbres 5(9):79-88. DOI https://doi.org/10.48190/cumbres.v5n2a6.

Prado-Carpio, E. (2020a). Gestión de agronegocios y el desempeño de la cadena de valor de la concha prieta Anadara tuberculosa. Tesis Doctoral, Doctorado en Ciencias Agrarias, Universidad del Zulia, Venezuela. pp. 303. Available at https://www.researchgate.net/publication/353352826_Tesis_Doctoral_en_el_Doctorado_de_Ciencias_Agrarias (accessed on August 04, 2021). DOI: 10.13140/ RG. 2.2.20107.62242.

Prado-Carpio, E., Martínez-Soto, M.E., Morris-Díaz, A., Castro-Armijos, A., Renteria-Minuche, P., Coronel-Reyes, J., Rodríguez Monroy, C. (2020b). Importancia de la producción de la concha prieta (*Anadara tuberculosa*) en las costas ecuatorianas. Revista Espam Ciencia 11(1): 34-46. ISSN: 1390-8103.

Prado-Carpio, E., Martínez-Soto, M., Rodríguez-Monroy, C., Morris-Díaz, A. (2020c). Agribusiness management characterization and performance of the value chain in the production of the "concha prieta" (*Anadara tuberculosa*). Proceedings in System Dynamics and Innovation in Food Networks 2020. International Journal on Food System Dynamics 63-83. DOI: http://dx.doi.org/10.18461/pfsd.2020.2007.

Prado-Carpio, E., Martínez-Soto, M.E., Rodríguez-Monroy, C., Núñez-Guerrero, Y., Quiñonez-Cabeza, M., Nazareno-Veliz, I., Egas-Moreno, F., Castillo-Cabeza, N. (2020d). Description of the production chain of the concha prieta Bivalve Mollusc “Anadara tuberculosa”. EasyChair Preprint 3749: 1–10. Available online: https://www.researchgate.net/publication/342802503 (accessed on 13 February 2020).

Prado-Carpio, E., Echeverría-Espinoza, E., Olivo-Garrido, M. L., Martínez-Soto, M. E. Rodríguez-Monroy, C. (2021a). Agronegocio: cadena de valor de Anadara tuberculosa (concha prieta) en Ecuador. (2021a). Revista Espacios 42(22):66-83. DOI: 10.48082/espacios-a21v42n22p05.

Prado-Carpio, E., Martínez-Soto, M. E., Rodríguez-Monroy, C., Quiñonez-Cabeza, M., Olivo-Garrido, María L. (2021b). Biología, productividad y atributos comerciales del molusco bivalvo «concha prieta» (Anadara tuberculosa) Biology, productivity and commercial attributes of the «black ark Shell» bivalve mollusk (Anadara tuberculosa). Revista Espacios 42(22):12-32. DOI: 10.48082/espacios-a21v42n22p02.

Prado-Carpio, E., Olivo-Garrido, M.L., Quiñonez-Cabezas, M., Beitl, C.M, Martínez-Soto, M., Rodríguez-Monroy, C. (2021c). Performance and Challenges in the Value Chain of the Anadara tuberculosa Bivalve Mollusk in Ecuador. Sustainability 13(10863):1-20. DOI: 10.3390/su131910863.

Quiñonez- Cabeza, M. R., Nazareno-Veliz, I. T., Camacho-Marín, R. A., Cedeño-Coveña, M. V. (2020) Proceso de comercialización y extracción de productos de manglar, San Lorenzo-

Ecuador. Revista Venezolana de Gerencia 25(91): 885-899. DOI: https://doi.org/10.37960/rvg.v25i91.

Rendón, M., E. Suárez., Mejía, M. (2004). Manejo sustentable y comercialización de concha prieta en cautiverio, en Puerto El Morro (Provincia del Guayas), para su exportación hacia España. Facultad de Ciencias Humanísticas y Económicas. Guayaquil, Ecuador: ESPOL.

Rivero-Rodríguez, S. (2009). Diagnóstico del cultivo y extracción de moluscos en Centroamérica. Organización del Sector Pesquero y Acuícola del Istmo Centroamericano-OSPESCA. 87 pp.

SRP- Subsecretaría de Recursos Pesqueros del Ecuador (2013). Movilización de Recursos Pesqueros, San Lorenzo, Esmeraldas, Ecuador.

Tamayo-Tamayo M. (2014). El proceso de investigación científica. Mario Tamayo. Available at https://es.slideshare.net/sarathrusta/el-proceso-de-investigacion-cientifica-mario-tamayo-y-tamayo1 (accessed on 20 October 2020).

Zambrano, R., Flores, L., Mora E. (2017). Cambios espacio-temporales en los rendimientos de pesca de concha en el Archipiélago de Jambelí, Ecuador. La Técnica: Revista de las Agrociencias. DOI:10.33936/la_tecnica.v0i0.949. Available at http://revistas.utm.edu.ec/index.php/latecnica/article/view/949 (accessed on 1 July 2019).

Zapata, L. A., Caicedo, J. (2008) Importancia de la actividad pesquera sobre el recurso piangua (*Anadara tuberculosa*) en el parque nacional natural Sanquianga, Nariño, Colombia. Available at http://docplayer.es/55010461-Importancia-de-la-actividad-pesquera-sobre-el-recurso-piangua-anadara-tuberculosa-en-el-parque-nacional-natural-sanquianga-narino-colombia.html (accessed on 3 September 2020).

AUTHORS' CVs

Eveligh Pardo-Carpio

Degree in Business Administration and Commercial Engineer, Master in Business Administration from the Technical University of Machala, Ecuador. PhD in Agricultural Sciences from the University of Zulia-Venezuela (Honorable Mention). Advisor in public and private companies for 20 years, currently Professor at the Technical University of Machala for 23 years. Author of 18 articles published in national and international journals, participation in several international conferences.

Moisés Enrique Martínez- Soto

Agronomist and full professor at the University of Zulia, Venezuela. He completed his Ph.D. studies at the Technical University of Madrid (UPM). He has been accredited as a researcher nationally and internationally with more than 60 publications in journals and conference reports and as an advisor to several business organizations. He belongs to the scientific committee of LACCEI. His main line of research is agri-food value chains.

María de Lourdes Olivo-Garrido

Degree in Biology-Ecology and Master's Degree in Biological Sciences from the Universidad Simón Bolívar, Venezuela. Dr. in Humanities, Area of Geography by the Central University of Venezuela (UCV), Honorable Mention. Teaching Career in UCV School of Medicine. She began

her work in the Ministry of the Environment of Venezuela, later serving as an advisor in different public and private institutions. She is currently an independent Consultant in Socio-Environmental matters.

Manuel Quiñonez-Cabeza
Doctor in Economics, Universidad de Oriente, República de Cuba (2016), Magíster en Gerencia de Proyectos (2003), Especialista en Diseños de Proyectos (2002), Ingeniero Comercial (2000), Licenciado en Administración y Supervisión Educativa (2000), Licenciado en Administración de Empresas (1998), Vicerrector de Investigación, Innovación y Posgrado (2019) Director de Investigación y Postgrado Universidad Técnica "Luis Vargas Torres" de Esmeraldas, Ecuador.

Carlos Rodríguez-Monroy
Professor of International Business at King Juan Carlos University (URJC). He holds a Ph.D. degree in Industrial Management from Universidad Politécnica de Madrid (UPM) and degrees in Economics, Sociology, and Law from Universidad Complutense de Madrid. He is visiting scholar at IMT Atlantique in Nantes, France. He heads the Food Quality Engineering research group at UPM and is a member of the OPENINNOVA research group at URJC.