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An Approximation to Agribusiness Development in the Value Chain of the Bivalve Mollusk "Anadara Tuberculosa (Sowerby, 1833) (Arcidae)"

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ABSTRACT

The mollusk "Anadara tuberculosa (Sowerby, 1833) (Arcidae)", known in Ecuador with the common name of "Concha Prieta", in Mexico as the clam "Pata de Mula", in France with the name "Arche Noire" and in England as "Blood Cockle", is a mangrove bivalve exploited all along the Pacific coast. It is a species with great possibilities for fishing development. In its adult phase, it lives only in mangrove swamps, always associated with the red mangrove "Rhizophora mangle" in the intertidal zone, where it grows almost completely buried in the mud. In Colombia, where it is called "Piangua", it is one of the most exploited bivalve species on the Pacific coast. The artisanal activity which benefits the communities is usually performed by families that collect these mollusks for food or to commercialize them in the local market. Currently, the resource, besides being used for consumption and local commerce, is being exported from Colombia to Ecuador. In Ecuador, a constant extraction has been maintained during the period 2004-2008, with an estimated total landing of 55.3 million shells among all receiving ports. In the Province of El Oro, the extraction and commercialization of Anadara tuberculosa is an economic activity with low performance and absence of added value in the production chain. The objective of this research is to explore the problem of agribusiness in the value chain of the bivalve mollusk Anadara tuberculosa. Specifically, to establish its possible causes and consequences, as part of a broader research oriented towards the development of an agribusiness management model that promotes its sustainable exploitation and entry into international markets, in particular the European market, in which consumers of Latin American origin, represent a segment that could be interested in its intake, complying with the added value standards and quality required.

Keywords: Agribusiness management, Value chain, Bivalve mollusk, "Anadara tuberculosa (Sowerby, 1833) (Arcidae)"

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Introduction

At present, Ecuador has a tendency to diversify the production and commercialization of products with high added value. Some productive sectors such as fishing and aquaculture are constantly growing and contributing to the change of the productive matrix and the economy of the country through the development of mariculture and by-products of the sea. The fishing and aquaculture sector, including the seafood processing industry, contributes an average of 2.4% of the Gross Domestic Product and generates in exports more than $ 3.5 million in foreign currency a year to the Ecuadorian economy (National Chamber of Fishery, 2017).

In this sector of fishing and aquaculture, micro, small and medium enterprises (MSMEs), contribute significantly to their development and have the challenge of increasing their levels of efficiency and competitiveness through processes of continuous improvement of their business practices. In Ecuador, the development of agribusiness represents an opportunity for a balanced relationship between MSMEs and large companies of a national or transnational nature. However, the current situation is characterized by opportunistic and antagonistic relations between the different links in the agribusiness chain and between the people and companies that act in each one of them.

The production of bivalve mollusks in Ecuador, specifically of the Anadara tuberculosa (Sowerby, 1833) (Arcidae), commonly called "Concha Prieta", has been occurring in the coastal provinces of Esmeraldas, Manabí, Guayas and El Oro. This marine resource constitutes one of the ancestral fisheries of bivalve mollusks of great economic and social importance for users who live near the mangrove ecosystem, identified as the poorest and most disorganized.

The commercialization value of this resource, which is so important for the economy of the coastal communities, is generally low. On the other hand, the communities have not developed the capacity to add value to this fruit of the sea and to join the marketing chain under advantageous conditions with respect to the links dedicated to processing and marketing, which is where the highest profit margins and the real business are. On the other hand, we must also take into account the competition of the Colombian market from where a large amount of this product is marketed in Ecuador at lower prices and similar quality levels.

Approximately 15,000 people are dedicated to the extraction of “Concha Prieta” that is found in the roots of the mangrove swamp in Colombia and Ecuador, and every day the number of people dedicated to this activity increases, even though the population of the shell is decreasing gradually. On the other hand, these “concheros” do not receive training and awareness, they are not integrated into associations that represent them effectively and could help them to develop their own agribusiness, their own MSMEs, where they can start and improve their quality of life, increasing their income and valuing their effort when collecting the shell.

Given the fishing, economic, social and environmental importance of the production of the "Concha Prieta", Andara tuberculosa, it is essential to carry out a comprehensive study, with the aim of exploring the problem of agribusiness in the value chain of this bivalve mollusk, starting by establishing the possible causes and consequences of the situation. This research is part of a larger one oriented towards the development of an agribusiness management model for the product "Concha Prieta", Anadara tuberculosa, which serves as a reference, as an innovative contribution to boost its sustainable production and its insertion in international markets, in particular, in the European market, in which consumers of Ecuadorian and Latin American origin represent a market segment to develop, since they could be interested in its consumption, complying with the standards of added value and quality demanded in it.

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Development

Worldwide production of bivalves

Mollusks, mainly bivalves, is the third most important group of marine organisms, after shrimp and fish (FAO, 2007). According to FAO (2017), more than 14 million tonnes of bivalves are produced each year in aquaculture. However, the proportion of bivalves entering the international trade is relatively small, since most of them are consumed in the country of production. This is especially true with the world's leading producer, China, which generates more than 80 percent of the world's bivalves, but consumes almost all of that production.

Less than 5% of the production of bivalve mollusks enters international trade, led by mussels, clams, scallops, and oysters, being one of the lowest proportions in the world trade of fishery products. This is due to the very nature of bivalves, which are highly perishable and potentially dangerous to human health if not handled properly. The European Union is one of the main markets for bivalves and captures more than a third of total trade, but only 13 non-EU countries are allowed to send live bivalves to the market, which shows the strict sanitary control of this type of fishery products.

According to the FAO (2016), 632,000 tonnes of bivalves were produced in Europe and the main producers in 2014 were Spain (223,000 tonnes), France (155,000 tonnes) and Italy (111,000 tonnes). The production of bivalves in China that same year was about 12 million tons, five times that of the rest of the world. Other important Asian bivalve producers are, for example, Japan (377,000 tonnes), the Republic of Korea (347,000 tonnes) and Thailand (210,000 tonnes). On the other hand, the main importers worldwide are Spain ($ 1.67 billion), Japan ($ 1.35 billion), Italy ($ 1.28 billion), Hong Kong ($ 1.1 billion) and the United States ($ 971 million) (Observatory of Economic Complexity, 2018).

In Latin America, the production of bivalve mollusks reached approximately 128,500 tonnes, which represents 1.07 percent of the world total of aquaculture production. Chile is the largest producer in the region followed by Brazil and Peru. The main species produced are the Chilean mussel and the Fan shell. In recent years, total exports of bivalves from Latin America and the Caribbean were 18,500 tonnes (FAO, 2007).

Currently, worldwide, most of the production of bivalve mollusks comes from natural populations, although the stocks are getting closer or have already surpassed, the maximum sustainable yield. The increase of stocks through fishing and the use of natural catch seed in both extensive and intensive crops are common practices throughout the world, but in the future, it will not always be possible to count on natural collection. Conflicts related to overexploitation and the use of coastal areas, for example, with tourism activities, are more pressing (Helm et al., 2006).

In this sense, a solution to satisfy the demand of seed of the industry of bivalves goes through the cultivation in a hatchery. Seed production through hatchery propagation currently accounts for a small percentage of total seed requirements and total product demand, but it is likely that these needs will increase as genetically selected varieties are adapted to specific conditions (Helm et al., 2006).

The bivalves are microalgae filtering animals and require a minimum of care, not needing more food than the algae present in their natural habitat. Its cultivation has been carried out for many centuries, however, technological advances have allowed increasing the levels of production significantly, which contributes to satisfying the growing demand, which is why the cultivation of this species is very attractive for investors. There are important opportunities for the development of this sector of food production, mainly focused on the native species present in Ecuador.

In the case of Cocha Prieta in Ecuador, availability has been reduced during the last two decades. From the provinces of Esmeraldas to El Oro, the mollusk represents the livelihood of thousands of families. Despite this, the “concheros” themselves warn that the resource is overexploited. A study by the National Fisheries Institute (INP) indicates that in 2004 more than 26 million hard shells were collected

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in San Lorenzo and Muisne (Esmeraldas), El Morro, in Guayas, and in the artisanal ports Jelí, Bolívar and Hualtaco (The Gold). However, 20 years ago, 34.4 million were collected, according to a study by the Maritime Research Center (Rendón Yllescas et al., 2009).

Therefore, it is necessary to explore in the agribusiness model of this productive chain, the option of producing Concha Prieta in captivity and not depend exclusively on the extraction of mollusks that reproduce naturally.

Concha Prieta "Anadara tuberculosa (Sowerby, 1833) (Arcidae)"

The black shell "Concha Prieta" is a bivalve mollusk, belonging to the species of Anadara spp. and the Pelecypoda or Bivalvia class (United States Agency for International Development, 2012). Anadara tuberculosa is the bivalve mollusk of major commercial importance at present (Mackenzie, 2001), reaching great possibilities for this economic sector (García et al., 2008). Its distribution occurs throughout the Pacific coast of America, from Laguna San Ignacio, Baja California Sur in Mexico, to Punta Telégrafo in Peru.

Anadara tuberculosa usually lives buried in the muddy sediments mainly between the roots of the red mangrove Rhizophora mangle. They are captured manually when the tide goes down by inserting the fingers into the mud. They are sold live, being able to remain alive out of the water between 5 to 8 days, depending on the environmental conditions (Felix, Ramírez, and Holguín, 2009).

Anadara tuberculosa has a very solid shell, with an oval contour and moderately elongated. It consists of a white colored surface, covered by a brown or black layer called the periostracum. They normally inhabit the mangrove swamps where they remain completely buried, from the intertidal zone to about 5 m deep. It reaches a maximum length of 8 cm and a maximum weight of 103.4 grams (Díaz, J.M. et al., 2014).

Research carried out in Costa Rica determined the proximal composition of Anadara tuberculosa, resulting in protein levels of 61.6%, carbohydrates 21.6%; ash, 8.8%, lipids 7.9%, the caloric value was 5.2 kcal / g., characteristics that place it as a recommended product for human consumption, due to its low fat content and high protein content (Cruz, Fonseca and Chavarría, 2012). However, even when this fruit of the sea has excellent nutritional properties, the health risks that may result from the capture of contaminated organisms, as well as inadequate sanitary management have to be taken into consideration.

Bivalve mollusks can concentrate large quantities of pathogenic bacteria, viruses, toxins and non-food chemical elements. This is due to the contamination of the coasts by human action and to their way of feeding, which is by filtration. This is even more relevant when we take into account that many of them are consumed raw or undercooked, thus increasing the risk to food safety, which may be the cause of toxic infections in humans. Bivalves are largely consumed internationally. Therefore, like any other product for food consumption, they must comply with standards of quality and safety, among which the following stand out (Official Journal of the European Union, 2006):

1. Visual characteristics related to the living state and freshness, such as shells without dirt, an adequate response to percussion and normal amounts of intravalvular liquid.

2. Have less than 300 fecal coliforms, or less than 230 E. coli, per 100 g of meat and intravalvular liquid.

3. Do not contain Salmonella in 25 g of meat.

4. Do not contain toxic or objectionable compounds, both natural and environmental pollutants.

5. The upper limit for the content of radionuclides should not exceed the limits established by the European Union for foodstuffs.

6. In the edible parts of mollusks, the total paralytic shellfish toxin (PSP) content must not exceed 80 µ per 100 g.

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7. The usual biological test methods should not give a positive result to the presence of the shellfish diarrheal toxin (DSP) in the edible parts of the mollusks.

8. In the absence of routine virus testing procedures and virological reference values, sanitary controls should be based on counts of fecal bacteria.

Problems affecting the agribusiness chain of the Concha Prieta "Anadara tuberculosa"

The concept of agribusiness began to develop in the 1950s. Davis and Goldberg, supported by Leontief's Input-Output matrix, define agribusiness as "... the sum of the total operations involved in production, manufacturing, and distribution of agricultural-aquaculture items (Davis and Goldberg, 1957).

Through the study of agribusiness chains, we analyze products with market potential, in which actors that are linked to each other are involved to take the product from one state to another, from production to consumption. The structure and dynamics of this whole set of actors, actions, relationships, transformations, and products is what is known as the productive chain (Van der Heyden, 2004).

According to the Ministry of Production of Peru (2007), the productive chain is defined as a system that groups the economic actors interrelated by the market with participation articulated in activities that generate value around a good or service, which includes phases of supply of inputs, production, conservation, transformation, distribution, commercialization and consumption in both internal and external markets. The production chain can start from the production or extraction phase (Figure 1).

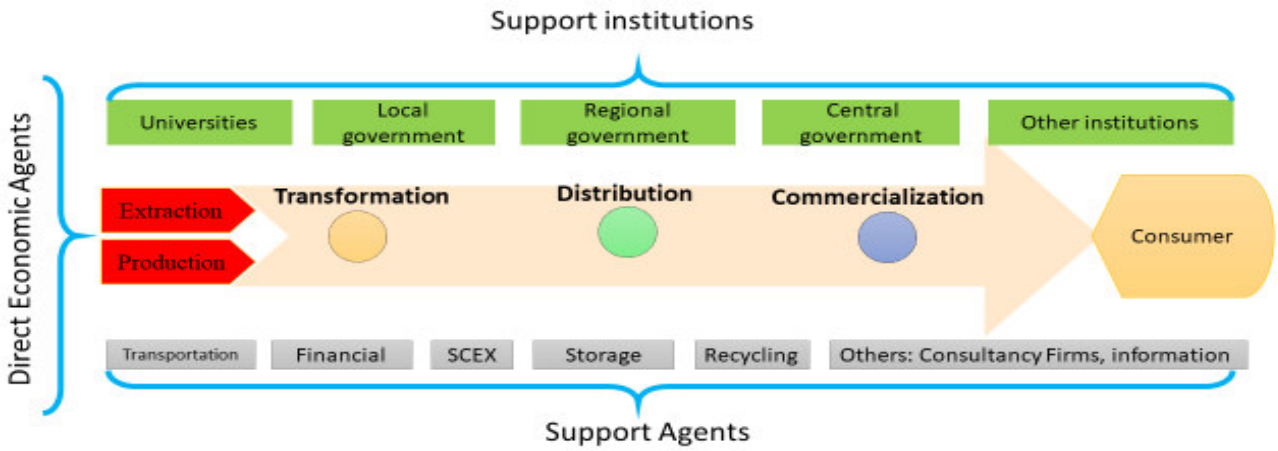

Figure 1. Components of a fishery-aquaculture production chain

Source: Ministry of Production of Peru (2007).

The productive chains in the fishery and/or aquaculture sector have been studied by different authors and organizations. Such is the case of the study carried out by Chirinos et al. (2009) on the industrialization and export of Pota derivatives. Pota is a giant squid that is available on the coast of Mexico, Costa Rica, Peru and northern Chile. In its production chain, stages are identified that start from the capture and storage, through the transformation and commercialization of the product. In addition, other activities that support the proper functioning of the sector are included, as shown in Figure 2.

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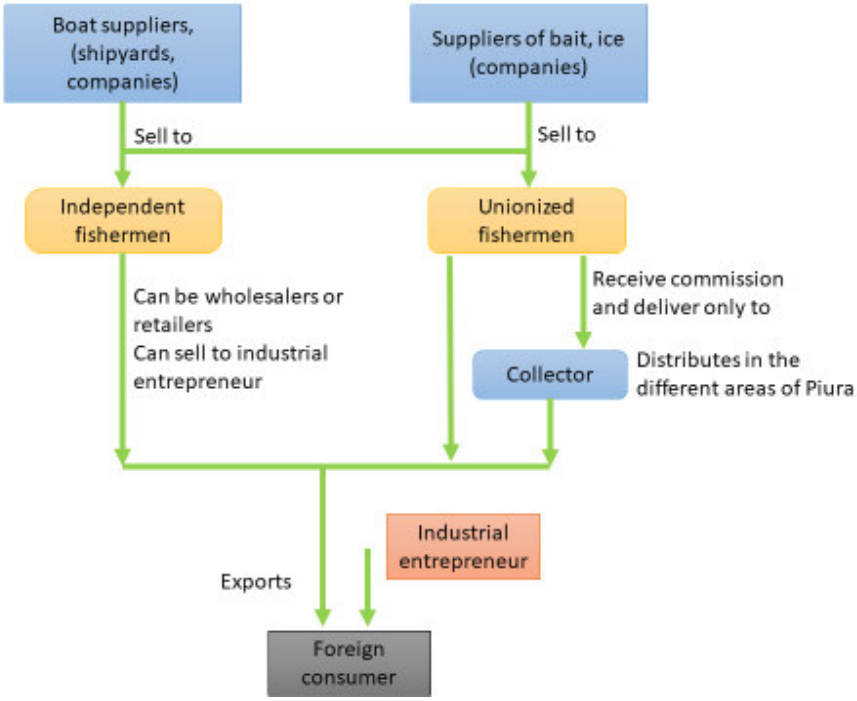

Figure 2. Productive chain of a fishery product

Source: Chirinos et al. (2009)

Also, in a market study of the Anadara tuberculosa and Anadara similis in Nicaragua by Lazarich, (2009), the phases of the commercialization chain and the ways in which Anadara tuberculosa and Anadara similis are commercialized were identified (Figure 3).

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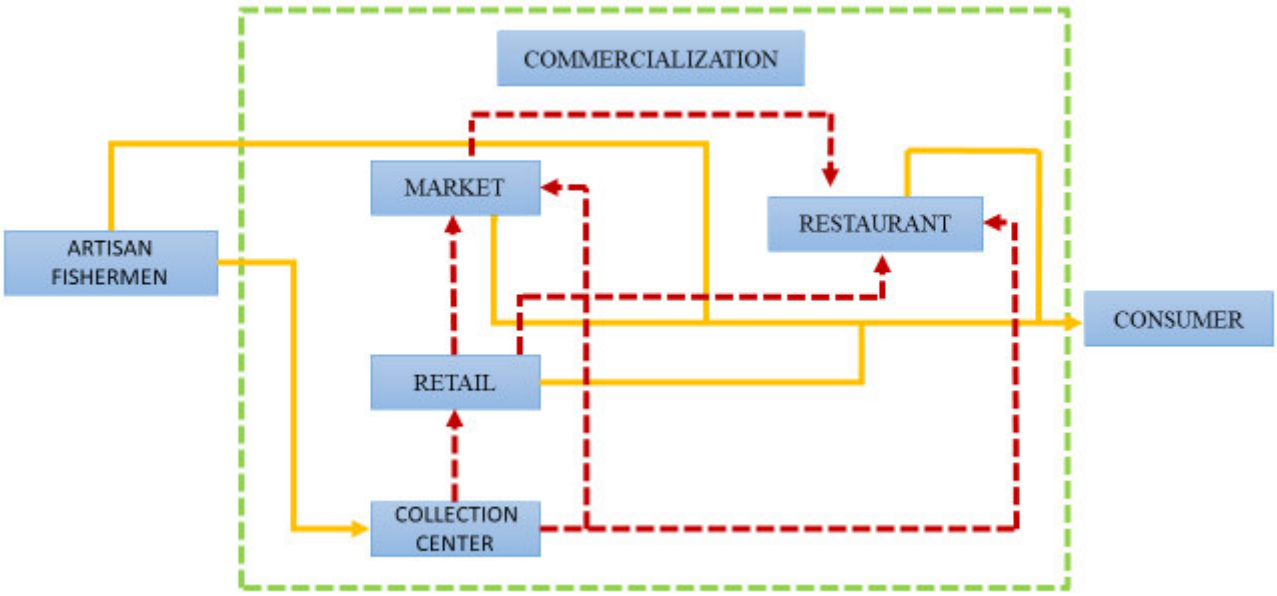

Figure 3. Commercialization chain of Anadara similis and Anadara tuberculosa in Nicaragua

Source: Lazarich Gener, Rodolfo (2009)

In Nicaragua, the commercialization chain of these mollusks shows the characteristics of an uncompetitive product in high segments, with shortages of competitors and imperfect information. In this sense, Figure 3 shows the actors and the main product flows in the marketing chain, even though the informality of the market makes it possible to present relationships and alternative flows to those shown.

A third study conducted in Peru by Azabache-Cobeña (2016), on the black shell, indicates that it occurs in greater quantity in the Los Manglares de Tumbes National Sanctuary (SNLMT), through a productive chain integrated by three links: extraction, commercialization, and distribution (Figure 4). It must be said that given the informality in the great majority of the processes, alternative relations and flows could be presented to those shown.

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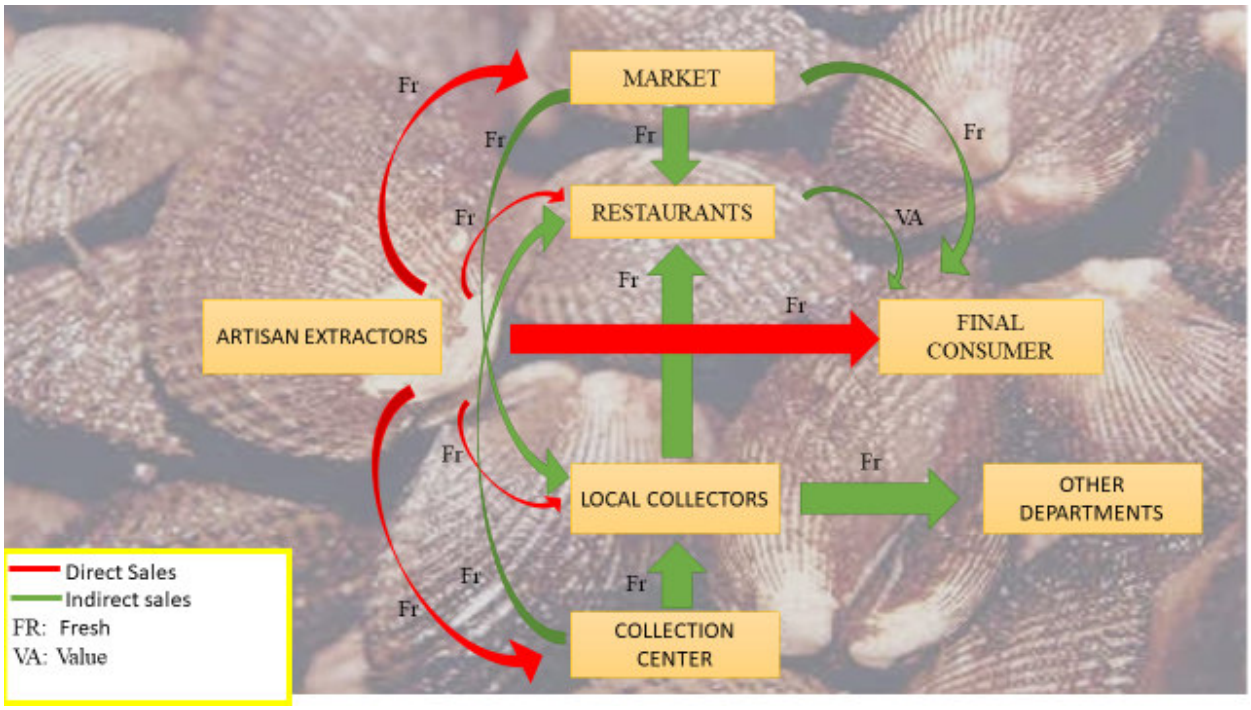

Figure 4. Scheme of the actors and flows of the product in the productive chain of the Anadara tuberculosa in Peru. **Source:** Azabache-Cobeña (2016)

The study concludes that the productive chain of the "Concha Prieta", exemplifies the qualities of a product that although it is true that it is quite in demand both locally and in the surrounding countries, it does not have a sustainable agribusiness model, due to the large imbalances observed in the economic, social and environmental aspects of exploitation. In Peru, the production chain of the black shell starts with the first link in the extraction of mollusks from the natural environment, although it also initiates controlled production in an incipient way. The majority of the Anadara tuberculosa resource, which is commercialized, is extracted mainly from the SNLMT.

Next, the second link of the distribution is presented, which can be to restaurants, collection centers or the local market. The distribution to the national market is done through intermediaries (local or Ecuadorian nationals) which need a reference guide to be able to distribute the product outside the region.

The third link of the chain is the commercialization which is done informally and without any control. In some cases, the merchant does not have a sales establishment and does the commercialization outdoors, and with no guarantee of equity and harmlessness.

Finally, the product is received by the consumer, who may be a local or a tourist since the final consumption is not only distributed among the housewives of the region but also among the diners in the different restaurants, which can be foreigners in some cases.

All these studies that have been outlined in the previous paragraphs allow us to infer that "Concha Prieta" is a product with great market development potential, but that it faces serious imperfections and threats in its business model, in the different links of its production chain, by virtue of the antagonistic and opportunistic relations between the different links, the low level of innovation in the processes, its risky toxicological and sanitary quality, and finally, the overexploitation of the natural environment, which includes the shellfish collectors and the fishermen.

According to Cabanilla (2010), in Ecuador the main ports where the shell is landed for commercialization are San Lorenzo and Muisne (Province of Esmeraldas), El Morro (Province of Guayas), Puerto Jelí, Puerto

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Bolívar and Puerto Hualtaco (Province of El Oro) while the neighboring country of Colombia this bivalve comes from ports such as La Tola, Imbiti, Tumaco, Mosquera and San Francisco.

The presentations for the sale of "Concha Prieta" are three: In bulk, in sacks and canned. The most important markets are in Guayaquil. The prices at the landing ports paid to shell producers during the 2004-2005 season ranged from 4 to 10 USD for one hundred units, while these values increased to $ 15 and 18 US dollars in 2010, and in 2018, according to data obtained by researchers in the local market, the hundred shells are being traded for 20 USD.

Despite the trend in the price increase of "Concha Prieta", the disorganized, distorted and unbalanced management of its agribusiness chain by the intermediaries that make the product reach the final consumer, ends up harming the shell collector, who has the lowest profit margin and always receives relatively low prices. This problem is compounded by the competition for low prices of the product of Colombian origin, which reduces the profit margin of the entire agribusiness chain. To the situation posed by unbalanced margins and low prices, we must add the problem of the low value that is added to the product in the agribusiness chain.

In this sense, based on the literature review and all that has been presented in this research, the main problem under study is the deficient performance in the agribusiness chain of the bivalve mollusk, Anadara tuberculosa, as a consequence of the imbalances in the profit margins and low added value in the products offered to the market.

This problem has some causes and consequences, which have been identified through the methodology of the tree of causes and consequences, by the authors of this study, indicating approximately the same results, as shown in Table 1 and Figure 5:

Table 1. Causes and consequences of the agribusiness problems of the Concha Prieta value chain

Causes	Consequences
1. Little knowledge of the potential of agribusiness in the technological, economic, quality and social responsibility aspects associated with the value chain	1.1. Low yields or productivity 1.2. Little innovation 1.3. Loss of national markets 1.4. No export programs 1.5. Unfair competition with producers from neighboring countries 1.6. Market disinterest due to low-quality products 1.7. Loss of prestige and image of the business 1.8. Low profitability
2. Disorganization in the links of the value chain made up of "concheros", collectors and marketers.	2.1. Poverty in the concheros (Instability and inequity in the chain) 2.2. Unstable production 2.3. Low income per capita 2.4. Opportunistic relations between the links of the chain 2.5. Little government help 2.6. Few relationships with financial sectors
3. Ignorance of the legal norms in force regarding the extraction, stockpiling and commercialization of bivalve mollusks	3.1. Non-compliance with legal regulations 3.2. Overexploitation of the mollusk 3.3. Loss of support capacity of the productive ecosystem (mangrove) 3.4. High levels of health and toxicological risks for consumers 3.5. High levels of risk in the extraction work 3.6. Impossibility to access global markets

Source: Authors

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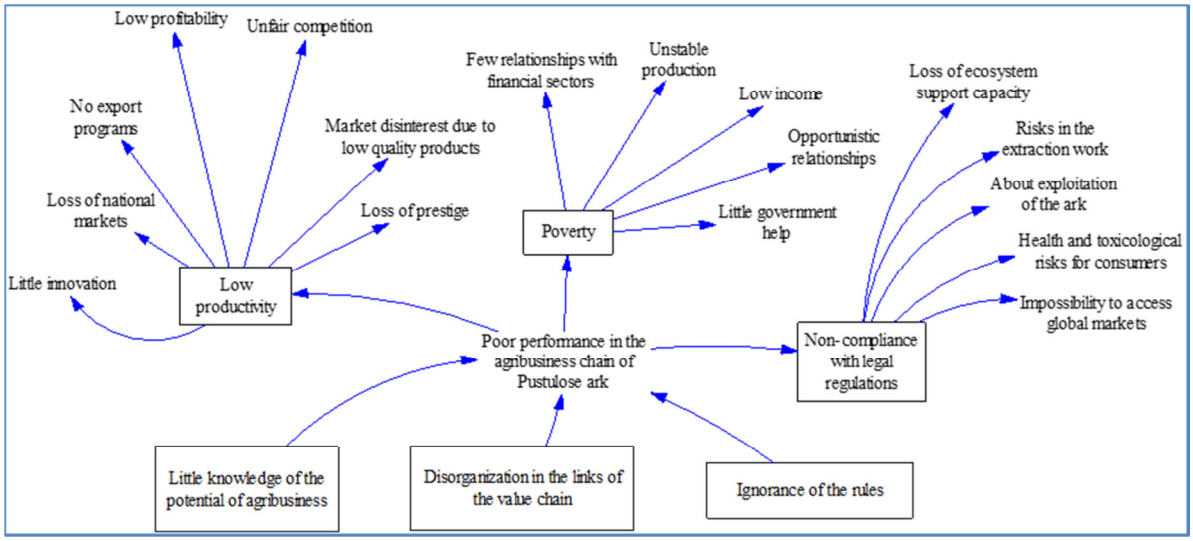

Figure 5. Tree of causes and consequences of the problems in the agribusiness development of the "Concha Prieta" value chain. (Source: Authors)

In this approach, it can be identified that the main problem is related to the poor performance of the agribusiness chain. This is due to an unstructured, chaotic, rudimentary, dysfunctional and incipient management model, which has its root cause in the ignorance of the business development potential, disorganization in the participants of the links of the value chain and ignorance of national and international standards of a technical and legal nature.

This analysis of the situation generates as possible main consequences low productivity, poverty and non-compliance with regulations, according to what Table 1 and Figure 5 indicate, which represent a first approach to the problem and the study of its solution proposals. This results in market losses, overexploitation of the resource and high risks in the operations and processes of the production chain.

Conclusions and recommendations

It can be concluded that the main problem of the productive chain of the Concha Prieta is related to the agribusiness model, which has developed spontaneously over the years, causing threats to its economic, social and environmental sustainability. The technical aspects related to the production in the natural environment or in captivity, the processing and added value of the "Concha Prieta" have been solved in the field of scientific research, but its application is not viable in the midst of the chaos that prevails in the system.

The development of agribusiness model for the "Cocha Prieta" should try in the first place to satisfy the growing national demand of Ecuador. But simultaneously, it must lay the foundations to stimulate its export to neighboring countries, as well as to the United States, Europe, and China, in alliance with other chains of businesses with exporting experience, such as those related to shrimp.

For the export of this product to Europe, and in particular to Spain as an importer of mollusks and for its representative population of Ecuadorians, technical and legal aspects related to the safety of the product must be explored, in order to comply with the demanding EU regulations. In the commercial aspects, it is necessary to inquire into the conditions offered by the Ecuador-European Union Trade Agreement, which includes mollusks within the tariff elimination schedule of the European Union for goods originating in Ecuador.

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It is recommended to deepen this study with the purpose of designing, validating and proposing an agribusiness model that contributes to the satisfaction of local markets and the export of products with high added value.

References

Azabache Cobeña, José Manuel Felipe. 2016. CADENA PRODUCTIVA DE Anadara tuberculosa (SOWERBY 1833) EXTRAÍDA EN EL SANTUARIO NACIONAL LOS MANGLARES DE TUMBES, 2015. .visible en: http://www.met.igp.gob.pe/publicaciones/2016/10Tesis_Jose_Azabache.pdf. (Accessed 04/01/2018).

Cabanilla, C. 2010. "Comercialización de La Concha Prieta (Anadara Tuberculosa Y A. Símilis) En Los Principales Puertos de La Costa Ecuatoriana." Boletín Científico y Técnico 20: 50–64. http://oceandocs.net/handle/1834/4796. (Accessed 04/01/2018).

Cámara Nacional de Pesquería. 2017. Sector pesquero y acuícola cuentan con su propio Ministerio. Visible en: https://camaradepesqueria.com/sector-pesquero-acuicola-cuentan-propio-ministerio/. (Accessed 04/01/2018).

CHIRINOS, Octavio; ADACHI, Leonardo; DE LA TORRE, Chris, ORTEGA, Alland; RAMÍREZ, Pilar. 2009. Industrialización y exportación de derivados de la pota. Lima: Universidad. ESAN, – 134 p. – (Serie Gerencia Global; 15). Visible en: https://www.esan.edu.pe/publicaciones/Descargue%20el%20documento%20completo__pdf.pdf. (Accessed 04/01/2018).

Cruz, Rafael, Cristian Fonseca y Fabian Chavarría. 2012. "Comparación de La Composición Química Proximal de La Carne de Anadara Tuberculosa Y A. Similis (Bivalvia: Arcidae) de Chomes, Puntarenas, Costa Rica Comparison." Revista de Ciencias Marinas y Costeras 4: 95–103. Visible en: www.revistas.una.ac.cr/index.php/revmar/article/download/4801/4622. (Accessed 04/01/2018).

Davis, J.; Goldberg, R. 1957. A concept of agribusiness. American Journal of Agricultural Economics, Volume 39, Issue 4, 1 November 1957, Pages 1042–1045, https://doi.org/10.2307/1234228. (Accessed 04/01/2018).

Diario Oficial de la Unión Europea. 2006. REGLAMENTO (CE) No 1881/2006 DE LA COMISIÓN. Visible en: http://eur-lex.europa.eu/legal-content/ES/TXT/PDF/?uri=CELEX:32006R1881&from=ES. (Accessed 04/01/2018).

Díaz, J.M., G. Melo, J.M. Posada, A. Piedra y E. Ross. 2014. Guía de identificación: Invertebrados marinos de importancia comercial en la costa Pacífica de Colombia. Fundación MarViva. San José, Costa Rica. 102 pp. Visible en: http://marviva.net/sites/default/files/documentos/guiaespeciescolombia_7x10in_baja.pdf. (Accessed 04/01/2018).

FAO. 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. ISBN 978-92-5-306115-0. Visible en: http://www.fao.org/3/a-i0444s.pdf. (Accessed 04/01/2018).

FAO. 2016. El estado mundial de la pesca y la acuicultura. Contribución a la seguridad alimentaria y la nutrición para todos. Roma. 224 pp. ISBN 978-92-5-309185-0. Visible en: http://www.fao.org/3/a-i5555s.pdf. (Accessed 04/01/2018).

FAO. 2017. Comercio limitado de bivalvos. GLOBEFISH - Análisis e información comercial en pesquerías. Visible en: http://www.fao.org/in-action/globefish/marketreports/resource-detail/es/c/522565/. (Accessed 04/01/2018).

Félix, Esteban, Mauricio Ramírez, and Oscar Holguín. 2009. "Growth and Fisheries of the Black Ark Anadara Tuberculosa, a Bivalve Mollusk, in Bahía Magdalena, Baja California Sur, Mexico." North American Journal of Fisheries Management 29(1): 231–36.

García-Domínguez, Federico A, De Haro-Hernández, Alejandro, García-Cuellar, Ángel, Villalejo-Fuerte, Marcial, & Rodríguez-Astudillo, Sonia. 2008. Ciclo reproductivo de Anadara tuberculosa

DOI: http://dx.doi.org/10.18461/pfsd.2018.1831

(Sowerby, 1833) (Arcidae) en Bahía Magdalena, México. Revista de biología marina y oceanografía, 43(1), 143-152. https://dx.doi.org/10.4067/S0718-19572008000100015. (Accessed 04/01/2018).

Helm, M.M.; Bourne, N.; Lovatelli, A. (comp./ed.). Cultivo de bivalvos en criadero. Un manual práctico. FAO Documento Técnico de Pesca. No. 471. Roma, FAO. 2006. 182 pp. Visible en: http://www.fao.org/tempref/docrep/fao/009/y5720s/y5720s00.pdf. (Accessed 04/01/2018).

Lazarich Gener, Rodolfo 2009, Estudio de mercado de la concha negra (Anadara similis y Anadara tuberculosa) en Nicaragua. Comercialización con garantía de inocuidad visible en: http://www.bvsde.org.ni/Web_textos/GOLFONSECA/CIDEA/0002/2009%20Estudio%20mercado%20final%20de%20mouscos.pdf. (Accessed 04/01/2018).

Mackenzie, Clyde L. 2001. "The Fisheries for Mangrove Cockles, Anadara Spp., from Mexico to Peru, with Descriptions of Their Habitats and Biology, the Fishermen's Lives, and the Effects of Shrimp Farming." Marine Fisheries Review 63(1): 1–39.

Ministerio de la Producción del Perú 2007. Cadenas productivas de la acuicultura peruana. Despacho Viceministerial de Pesquería, Dirección General de Acuicultura. Perú. Visible en: http://www2.produce.gob.pe/RepositorioAPS/3/jer/ACUISUBMENU4/boletines/CADENAS%20PRODUCTIVAS.pdf). (Accessed 04/01/2018).

Observatorio de la Complejidad Económica. 2018. Productos. Moluscos. Visible en: https://atlas.media.mit.edu/es/profile/hs92/0307/. (Accessed 04/01/2018).

Rendón Yllescas, Mayra; Suárez Gómez, Elizabeth Vanessa; Mejía Coronel, Marco Tulio. 2009. 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. Visible en: https://www.dspace.espol.edu.ec/bitstream/123456789/1426/1/2789.pdf. (Accessed 04/01/2018).

Van Der Heyden, D. 2004. Guía metodológica para el análisis de cadenas productivas. 2da edición. Quito, Ecuador: Editorial Ruralter. Visible en: https://www.avsf.org/public/posts/554/gui-a-metodologica-para-el-analisis-de-cadenas-productivas.pdf . (Accessed 04/01/2018).

DOI: http://dx.doi.org/10.18461/pfsd.2018.1831