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MONOGRAPH

"SHRIMP FARMING IN ECUADOR: HISTORY, ZONES OF PRODUCTION, IMPORTANCE IN NATIONAL ECONOMY"

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Gratitude

First, I would like to thank God for giving me the strength and energy to be able to complete this stage of my life and my parents who have given me the opportunity to study at the Javier School and who have accompanied me in this process and have been my driving force to keep going.

Summary

This monographic work contains the study of one of the most important aquaculture practices that exist in Ecuador as is the cultivation of shrimp, a practice that over the years has acquired great importance for the country at an economic level, because this product has a great demand worldwide, which has made this currently become one of the main export products that has our country and therefore generating large foreign exchange for himself.

This document in turn presents information on the history of the shrimp sector as is the areas that are used for this activity, as well as where most of the shrimp and laboratories are located in the country, since its inception with empirical techniques, the various adversities that have had to overcome, such as diseases in different farming systems, which generated a considerable drop in the export of the product to different world markets, thus generating millions of quantitative losses for the private sector and seriously threatening the continuity of the business, and technological advances that has over the years have been discovered and have facilitated in different areas the management and control of the business, making this practice a viable and sustainable business with a great projection into the future.

This monographic study can also be used to offer the reader an overview of the shrimp sector and to provide data to raise public awareness of the importance of this sector for the country, thus allowing them to have an educated and detailed knowledge of this practice. It should be noted that it also contains information on the different environmental spaces that have been used by different companies to carry out this activity, and the different cultivation systems that have been implemented over the years and have managed to increase production considerable.

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Introduction

This monographic work is a research on **shrimp production in Ecuador: History, production areas, importance for the national economy**, the same which aims not only to publicize the history of the shrimp sector, but also to analyze the importance that it has today for the economy of the country. The shrimp sector in Ecuador began in 1968 and since then it has become one of the most important businesses in Ecuador, surpassing even bananas in 2017 as the main non-oil export product.

The specific study of the subject is of great importance because shrimp production in Ecuador from its beginnings in 1968 to the present day has brought great profits to the country's economic sector. In addition, it is worth noting the importance it has had for the environment and for society, being a great source of work for people living near estuaries, specifically the mangrove swamp.

Several authors and institutions have dealt with this subject, such as Elizabeth Bravo in her thesis " Caso 2: La industria camaronera del Ecuador. Ponencia presentada en Globalización y Agricultura.", The Food and Agriculture Organization of the United Nations (FAO), among others. The existence of shrimp production in Ecuador dates to 1968 in the province of El Oro due to the work of a group of entrepreneurs and then thanks to the creation of various shrimp farms located mainly along the coastal profile have made this activity one of the most important in the country.

This monographic work consists of three chapters: The first will deal with the history of the shrimp sector, where its origin will be analyzed, the most widely used farming systems, among which we can find extensive, semi-extensive and intensive, diseases that seriously affected the Ecuadorian shrimp sector and advances; the second, production areas, including marine areas, inland cultivation and estuaries and geographical location; and the third, its importance for the national economy, exports, main export markets, marketing, world supply, world demand and marketing channels.

It is worth mentioning the great progress made by the shrimp sector from the white spot to the present day and it is expected that in 2018 the registered trademark will be surpassed in the previous year with a greater number of exports and therefore of income to the country, thus becoming a great support for the national economy.

Chapter I

History of shrimp farming production in Ecuador

1.1 Origin

The shrimp production of Ecuador is not recent because it has evolved for more than 40 years and has left great marks in the history of Ecuador. According to Food and Agriculture Organization of the United Nations (FAO) (2005), this began in 1986, in the province of "El Oro", due to a group of local businessmen dedicated to agriculture who began to carry out the activity when they observed that shrimp was growing in ponds near the estuaries.

1.2 Shrimp farming systems

For shrimp farming, there are five different types of culture, ranging from extensive to ultra-intensive, but the most commonly used in our country are three, among which are: extensive, semi-extensive and intensive.

1.2.1 Extensive.

This type of system, which started shrimp farming in our country, consists of using the natural food from the pools. The density of sowing used is between 30,000 and 50,000 juveniles per hectare. The size of the pools is normally greater than 10 ha. These

systems are managed with little water replacement and very little balanced feed for shrimp growth. This type of culture is used to obtain maximum profits using little investment of resources, the pools where the system is applied can yield from 50 to 500 kg of whole shrimp per hectare.

1.2.2 Semi-extensive.

It is the most widely used cultivation systems in our country, with planting densities ranging from 60,000 to 200,000 juveniles/ha. It uses water replacements that range from 5 to 10% per day and a higher consumption of balanced feed to cover the nutritional demand of the animals. The size of the pools has normally between 2 and 10 hectares and the facilities pumped systems and supply canals and drains. Production's ranges from 750 to 2500 kg/ha/cycle depending on the equipment or the technical level of the shrimp farm.

1.2.3 Intensive.

In this system, the size of the pools is relatively small from 0.01 to 2 ha and the planting density used is higher compared to the others (up to 500,000 juveniles/ha). A system of phases is used that can go from 1 to 4, where the length and weight of the shrimp are used, sowing larger quantities in the first phases and decreasing as the shrimp grow.

In this type of system, between 5,000 and 10,000 kg/ha/year can be obtained and require a greater investment of capital that is used in specialized labor, aeration equipment, circulation and bioremediation to maintain a good water quality, automatic feeding for greater efficiency since shrimp depend absolutely on balanced feed for their normal development and ensure maximum production.

1.3 Shrimp diseases

The shrimp industry in Ecuador has suffered falls in production due to the different diseases that shrimp have gone through. Among the diseases that have caused the most damage to the shrimp industry are: Seagull's syndrome in 1989, Taura's syndrome in 1993 and the white spot in 1999, considered to date the disease that caused the most damage to the shrimp industry.

1.3.1 Seagull's syndrome.

This disease, which occurred in 1989, was one of the first diseases to affect shrimp production in our country. According to Ochoa (2002), due to the appearance of Seagull Syndrome, exports decreased by 17.69% and income by 15.20%.

1.3.2 Taura's syndrome.

The Taura's syndrome occurred in 1993, after the arrival of the El Niño's phenomenon and according to Cuellar-Anjel (2013), It was identified in shrimp farms in Ecuador, near the Taura River, in the province of Guayas, from where it spread throughout North and Central America on the Pacific and Atlantic coasts. Subsequently, it reached Asia (first China and then Thailand), generating high mortality and therefore substantial economic losses.

Among the main ways, it is transmitted from this disease are the cannibalism of shrimp that have contracted the disease, which is the fastest way and by replacement water that is infected

1.3.3 White spot.

The white spot (WSVV) occurred in 1999 and has been the disease that has done the most damage to the shrimp sector because due to this disease there was a considerable decrease in shrimp production in Ecuador.

According to Notarianni (2006), the WSVVV first appeared in the Province of Esmeraldas, expanding to Guayas, Manabí and El Oro, causing a closure of imports of

larvae, brood fish, Artemia biomass and causing the fall of the wild larvae industry, among many other things that put in crisis the continuity of the shrimp sector in the country.

1.4 Technological advances

The Ecuadorian shrimp industry is reaching a state of maturity and has focused on implementing technological improvements to be more efficient in the production process.

Among the main modifications we have improvements in the infrastructure (pool designs), new pumping systems, leaving behind the centrifugal pumps with which the activity started with high flow axial pumps, aeration equipment, among which the most used are the vane aerators, automatic feeding equipment, automatic harvesters, improvements in the transport of the product to the balers leaving behind the use of drawers by the use of bins or thermal tanks.

Advances in crop systems with the implementation of raceways and intensive pre-breeding and recirculation systems. Improvements at the genetic level with the domestication of the cultivated species, obtaining animals of greater growth and survival.

All this has contributed to the fact that aquaculture production has experienced exponential and sustained growth in recent years and has placed our country among the world's leading shrimp producers.

As an expectation for the future, supported by the new production matrix that the government is trying to implement, the objective is to change or migrate from the diesel engines that are currently used to electric motors and with the help of software and technology already on the market, to automate most of the shrimp farming processes.

Chapter II

Zones of production

2.1 Zones of production

According to Food and Agriculture Organization of the United Nations (FAO) (2005), "The development of shrimp culture has taken place mainly along the coastline region, where favourable natural conditions occur creating a propitious environment for the development of aquaculture". Among the most important production areas are: inland crops, marine areas and estuaries where the mangrove is found, which is the most used site for shrimp farming.

2.1.1 Inland crops.

Inland shrimp farming with low salinity waters has become popular in recent years in our country, although it is not a new crop since Thailand has had data on this type of farming since 1987. The initial idea was to take advantage of the existing infrastructure for the cultivation of other species that were not commercially successful, such as the Australian lobster, whose pools were small, and the water source came from deep wells, and many pools that were used for tilapia cultivation are now used for shrimp.

As mentioned by Marcillo (2010), inland shrimp farming has some advantages, which are: the diversification of land use for food production, the possibilities of causing environmental impacts are lower, there is a more efficient use of land and water, as production is more intensive and allows the creation of jobs in rural areas.

Among the main disadvantages of this system of cultivation at the beginning was the lack of openness to authorize the exercise of the activity in the face of complaints of salinization of agricultural lands. Nowadays there are improvements in the cultivation methodology that allows to regulate the lack of salts via balanced feed and this allowed to increase more areas dedicated to this activity.

2.1.2 Marine areas.

There are many shrimp farms located near the coastal profile of our country in sectors where there is little tourism development. Its source of supply is sea water, which, although it has a low nutrient content, is clean and inexhaustible, making it a fundamental source of good cultivation. Soils are usually sandy or silty-sandy and areas within the continent have good infrastructure in terms of roads and basic services. There are also islands such as the Puna's island, located in the province of Guayas, which make use of seawater and are very productive areas, although logistics increases their production costs.

In the coastal profile are located most of the larval laboratories, especially in the province of Santa Elena, where approximately 80% of Ecuadorian larvae are produced.

2.1.3 Estuaries.

The estuarine areas are the preferred areas for shrimp farming due to their water rich in nutrients and natural productivity. In the early days of the activity, when it depended exclusively on wild larvae for cultivation, this area supplied the entire industry with larvae. These areas are mostly mangrove areas, which are breeding and mating grounds for many species, and where large areas have been established for shrimp farming.

2.1.3.1 The mangrove swamps

The mangrove area has been the main place for shrimp production in our country, because it is an area rich in nutrients and natural food that allows shrimp to grow faster. In addition, these areas were abundant in wild larvae that from the beginning of the activity until the arrival of the White Spot was the main source of larvae for shrimp farms.

According to Yáñez, Twilley & Lara (1998), Mangroves are one of the most productive ecosystems in the world, due to the production of litter, debris and soluble

organic compounds and because all the nutrients from the rivers are concentrated there, which are trapped by the mangrove roots. These nutrients serve to feed the rich fauna that lives in the mangrove swamp. Wader roots are the substrate for the development of a rich fauna of great ecological and economic value. In turn, the debris from the leaves of mangrove trees will serve as food for the fish of the sea.

According to Bravo (2002), in June 1985, the government declared the conservation of mangrove forests to be in the public interest; and in September of the same year, the Undersecretary of Fisheries suspended any license to practice aquaculture in mangrove areas. In November 1986, the Government declared 362,742 hectares of mangrove ecosystems, including crabs and areas of vegetation such as mangroves, to be protective forests. The indefinite ban on the destruction of the mangrove forest was imposed in 1999.

Due to the exploitation of mangroves to establish multiple needs, these areas are currently considered protected areas and the felling of mangroves for the construction of swimming pools is prohibited, and rather through state laws and regulations established in 2008 by former President Rafael Correa with the process of regulating shrimp farming, which orders the reforestation of part of the mangrove territory, a percentage of the area that had been destined for this activity has been

recovered, since by not complying with this decree shrimp farms would lose their right to concession and would be evicted from the place where they are located.

2.2 Geographical location

The Ecuadorian shrimp industry has approximately 210,000 hectares dedicated to shrimp farming, distributed over 3000 farms located along the Ecuadorian coastal profile.

The province of Guayas has the largest infrastructure dedicated to shrimp farming and in this province is located approximately 60% of the total area followed by the province of El Oro with 15%, Santa Elena with 10%, Manabí with 10% and Esmeraldas with 5%.

As mentioned above, the larval laboratories are mostly located in the province of Santa Elena, although there are also important facilities in Manabí, Guayas and on a smaller scale in Esmeraldas and El Oro.

The largest shrimp exporters are in the province of Guayas and much lower in the provinces of Oro and Manabí.

With the recent incursion of inland cultivation, new projects have been initiated in the testing phase in the province of Los Ríos, opening new opportunities for the growth of the Ecuadorian shrimp farming sector.

Chapter III

Importance in national economy

3.1 Export

The objective of shrimp produced in our farms has always been export and this is what has made the shrimp business attractive for decades, with shrimp being the second largest non-oil export item in our country after bananas in recent years, even surpassing bananas in 2017 and becoming for the first time the main non-oil export item.

There are many export companies located in the province of Guayas, the clear majority and the main ones at the national level, this has allowed a healthy competition between them to offer attractive prices for the shrimp producer and not fall as in other businesses that becomes export monopolies, which leads to low prices for the producer.

The top five shrimp exporting companies in Ecuador in July 2018 were as follows: Santa Priscila Fishing Industry with an amount of 15,221,706 pounds exported, Omarsa SA with 13,032,173 pounds, Expalsa SA with 11,136,418 pounds, Promarisco SA with 7,657,766 pounds and Songa SA with 6,970,980. In total, 98 million pounds of shrimp were exported in July 2018, making it the best July in the history of shrimp production in our country.

3.1.1 Main export markets

From the beginning, the main destination for Ecuadorian shrimp exports was the United States, which became the destination for more than 50% of Ecuadorian shrimp production, mostly fresh-frozen shrimp tails. The second place was occupied by the European market with approximately 20% of our production and the required product was the whole shrimp with very interesting prices for the Ecuadorian producer. We managed to place 5% of our production in the Asian market.

Today the picture has changed dramatically to the point where the main buyer of shrimp is Asia, maintaining a demand share of at least 55% of our production. In recent years this proportion has gradually increased, making the market in Asia the largest importer of our shrimp, other major consumers of our shrimp are Europe with 24% and the United States with 16%.

3.2 Marketing

The commercialization of shrimp is one of the main economic incomes not only for our country but also for other countries such as India, Indonesia, Vietnam, China, Thailand, among others. Some of the points to consider in the marketing of shrimp are: world demand, where it should be analyzed because shrimp has become one of the main export products, world supply and different marketing channels that can be used to market the product.

3.2.1 Worldwide demand

According to García (2003), the main characteristic of shrimp as a consumer good is that it is a luxury good: its high quality and price influence that most of the world demand for this product is restricted to developed economies with high purchasing power. For this reason, world demand is closely linked to the economic cycles of the main developed countries, that it to say, the United States, the European Community and Japan.

Currently, even though China is the world's leading shrimp producer, its production does not meet local demand due to its large population and high per capita shrimp consumption, making it one of the main importers of shrimp.

There are other producers such as Brazil whose production is barely enough to meet local demand and countries such as India whose population is growing rapidly. These are examples of what happens in the world, with the rapid increase in population, aquaculture becomes a necessity to meet the demand for animal protein worldwide.

3.2.2 World supply

The world supply of shrimp is measured based on exports although China is the world's largest producer with 800,000 metric tons, most of which is for its own consumption, so it ranks sixth, exporting only 205,300 metric tons.

The five largest global shrimp exporters were: firstly, India with 438,500 metric tons of shrimp, secondly, Vietnam with 425,000 metric tons, thirdly, Ecuador, the only non-Asian country among the six largest exporters in the world with 372,600 metric tons, fourthly, Indonesia with 220,000 metric tons and, fifthly, Thailand with 209,400 metric tons.

3.2.3 Marketing channels

The main export channels are mainly three: the direct relationship between the producer and the buyer, the direct relationship between the exporter and the international consumer, and electronic sales via the Internet.

According to García (2003), the most widely used channel is the relationship between exporters and buyers, because the industry is more than 40 years old and there are close commercial relationships that have been forged over the years. Another important point in this regard is that shrimp being a ‘luxury' product in many countries,

the quality of this is paramount, so a close and direct relationship generates greater reliability from the buyer who knows his supplier. This is the way in which most of the production in Ecuador is traded.

In recent years, with the entry of new producers, international quality requirements and controls, and the incorporation of new technologies, Internet commerce has increased considerably, since, as mentioned by García (2003), Internet commerce is gaining ground by leaps and bounds. The countries that use it most are the largest Asian producers, although its use is gaining ground in all exporting countries, due to the lower cost and faster time for the two parties to transactions, bidders and claimants to meet. They are managed by advertisements of suppliers and demanders through the Internet on shrimp marketing pages, presenting payment availability and proposed prices respectively, as well as volumes that can be covered by exporters.

Conclusions

At the end of this monographic work it is concluded that:

- The shrimp industry since its inception in the province of "El Oro" until today, has gone through various changes that have allowed the creation of new methods that have facilitated work and increased production, so this practice has become a viable business and brings large amounts of money to the country.
- Shrimp farming is of great importance for the country's economy, as in recent years became one of the main export products, however, had a period of crisis, this due to the fall in exports in 1999 by the disease known as the white spot, which generated a large amount of losses to the private sector.
- Shrimp production has spread throughout the Costa region through permits granted with the respective government regulations for the construction of shrimp farms, especially in mangrove zones, as well as laboratories that help sustain the activity.
- Our society has benefited from this practice, because since its inception it has become an important source of jobs and foreign exchange earnings for the country.
- Different spaces have been assigned to shrimp production, such as marine areas, inland cultivation and estuaries, in the latter we can find the mangrove zone, which is the main area for shrimp production because of the rich nutrients it possesses, but this exaggerated use has caused the ecosystem to be affected and measures have been put in place to ensure its conservation.

Recommendations

At the end of this work it is recommended that:

- In view of the important future projection of the shrimp industry, there is an urgent need to train students, parents and teachers on this business and its characteristics. Above all, the importance that this industry has for the national economy and its great contributions to the private sector.
- Giving information about this practice is a way of training people. If a good training is achieved, it will allow people to have a clear idea about this topic and would allow them to know why shrimp production is a viable business since it can become a good option to start a university career with a view to professional development. Therefore, the school could bring aquaculture engineers, biologists or experts on the subject to give talks on how the shrimp sector operates and how much income it earns monthly.
- Society in general should be informed about this business and the multiple benefits it has brought over the years in the country, not only economically but also socially.

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