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Degradation of Mangrove Ecosystems Due to Shrimp Farming Activities and Its Conflicts of Interest in the State of Bahia, Brazil

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Abstract: Shrimp farming is the branch of aquaculture dedicated to the farming of crustaceans during all their stages of development. The marine shrimp Litopenaeusvannamei is the main species in this activity. Shrimp farming uses brackish water from mangrove ecosystems as its main resource due to its ideal quality. However, this practice causes several environmental impacts such as the deforestation of mangrove forests for implementing ponds and also legal conflicts that currently favor this type of aquaculture activity in areas with environmental restrictions. Communities that live in the surrounding areas of shrimp farms are also impacted by the activity due to the difficulty they have in accessing the mangroves where they carry out traditional and artisanal shellfish gathering.

Key words: degradation, mangrove forests, shrimp farming, public conflicts

1. Introduction

Mangrove forests are a type of coastal ecosystem that represents the transition between terrestrial and marine environments, and is characteristic of tropical and subtropical areas that are subjected to tide regimes [1]. According to Fernandes (2012) [2], this ecosystem protects the coastal zone against floods and erosion; it is responsible for the absorption and neutralization of chemicals, including heavy metals and other pollutants; it comprises the base of the food web of coastal ecosystems; and represents a source of food and subsistence for human communities located near shrimp farms that are installed within these areas.

According to Fernandes (2012) [2], an estuary is defined as an environment in which marine water influences the continental mass. Seawater salinity can be either continuously or periodically diluted in a measurable way by the action of rivers, surface runoff or water table outcrops. Thus, salinity stretches from the adjacent coastal zone that receives the estuarine plume up to the point of maximum influence of spring tides.

Mangrove ecosystems dominate coastal areas in low latitudes, such as that of Brazil. Mangroves are characterized by the presence of facultative halophytes. This type of vegetation develops in the intertidal area of an estuary, where soil is unstable, saline, muddy, rich in organic matter, subjected to periodic flooding, and to which other components of the flora and fauna are associated with [2].

Mangrove forest preservation as a whole, including apicum zones, is also equally important socially because these areas are considered nurseries for various fishery resources, which sustain either directly or indirectly over 1 million people. Disorderly occupation along the Brazilian coast has been causing

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the loss and fragmentation of this habitat by converting these environments into shrimp farm areas, human settlements and into areas dedicated to tourism activities [3].

Mangrove forests in Brazil are distributed in estuaries, lagoons and bays, covering an area of approximately 25,000 km². Along the 7,408 km of coastline of the country, the state of Rio Grande do Sul is the only coastal state which does not present this ecosystem [2].

Mangrove forests in the state of Bahia cover an estimated area of approximately 1,000 km², distributed along 1,181 km of coastline [4]. Shrimp farming is one of the fastest growing activities in Brazil, especially in the northeastern portion of the country [5]. The exotic species Litopenaeusvannamei, after being introduced in Brazil, adapted to its new environment with better quality indicators, boosting the development of this sector and becoming the main farmed species in the aquaculture scenario of the country and of the state of Bahia.

The main factors that contribute to the development of this activity in these environments are: physicochemical water conditions, good location for product transportation, and local labor supply. The water from mangrove forests presents appropriate salinity for shrimp farming. Therefore, entrepreneurs seek out this type of ecosystem for building their enterprises, using this coastal environment for installing farming ponds, which involves water catchment and effluent discharge.

Shrimp farming in the municipality of Salinas da Margarida, which concentrates over 50% of this activity's revenue, has caused significant environmental impacts. For instance, mangrove forests have been reclaimed and filled with earth for building farming ponds and channels for water catchment and effluent discharge; river and estuary water flows have been altered due to the great volume of water used; and ecosystem mischaracterization and losses have been observed regarding the surrounding communities, because they have been prevented from performing shellfish gathering and family shrimp farming activities, which has culminated in the dislocation of these traditional communities to cities.

Shrimp farming enterprises can be found all over the state of Bahia, from the southernmost to the northernmost areas of the state. However, while all enterprises use environmental resources, the majority do not have an Environmental License to practice the activity, which would establish mitigation and/or compensation actions.

2. Objectives

The general objective of the present study was to demonstrate the current situation of mangrove ecosystem conservation in the state of Bahia, considering the conflicts and impacts of aquaculture activities regarding socio-environmental aspects.

The specific objectives were:

- To describe the importance of mangrove ecosystems;
- To list factors that contribute to the installation of shrimp farming in the state of Bahia;
- To report the main impacts of shrimp farming on mangrove forests;
- To address the main legal conflicts regarding shrimp farming;
- To identify existing social conflicts in communities located in the surroundings of shrimp farms; and
- To propose mitigation actions for minimizing shrimp farming impacts.

3. Methodology

In order to perform this study, secondary data was obtained from several sources, such as journals, scientific articles, quantitative data published in the Internet, newspaper articles, associations of shrimp farmers, as well as official websites of various Government (Secretariat of the Environment and Sustainable Development of the State of Bahia —

SEMA; Brazilian Ministry of the Environment — MMA, Brazilian Institute of the Environment and Renewable Natural Resources — IBAMA; Public Ministry of the State of Bahia — MPBA; Institute for the Environment and Water Resources of the State of Bahia — Inema; Secretariat of Agriculture, Livestock, Irrigation, Agrarian Reform, Fisheries and Aquaculture of the State of Bahia — Seagri; Center for Studies and Research for the Development of the Southernmost Region of the State of Bahia — Cepedes; National Environmental Council — CONAMA; Institute for Applied Economic Research — Ipea; and the Chico Mendes Institute for Biodiversity Conservation — ICMBio.

4. Results and Discussion

The mangrove ecosystem of the state of Bahia has been experiencing a significant reduction since 2002. Shrimp farming has been reported as one of the main causes of this ecosystem's degradation. One of the main problems caused by this type of activity, in addition to its implementation in areas that are protected by law, regards water catchment and effluent discharge. For water catchment, supply channels are opened across the mangrove by means of deforestation and water is then lead either by gravity or by periodic floods. Effluent discharge often occurs directly into the adjacent water body without any type of treatment as Figs. 1 and 2, since there is currently no legal instrument to regulate either seawater or estuary water catchment.

Fig. 1 Mangrove forest areas in shrimp farms in the Taperoa channel, municipality of Valença (BA).

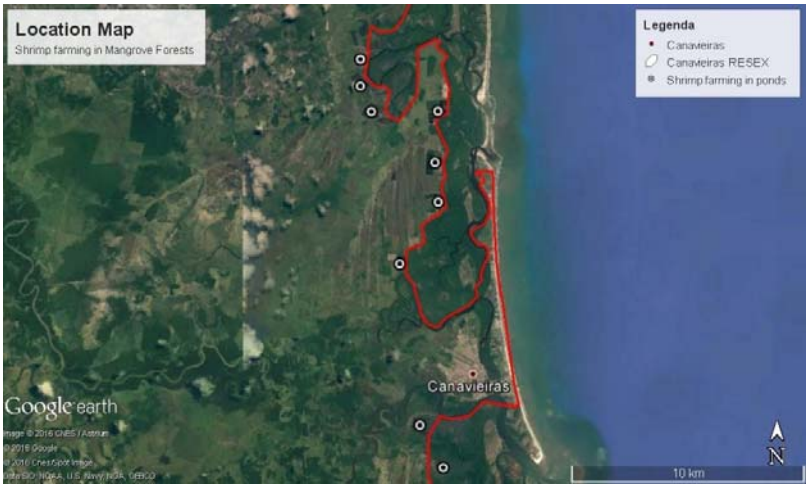

Fig. 2 Shrimp farming enterprises with water catchment and effluent discharge channels located either only partially or completely within the Canavieiras Extractive Reserve (RESEX).

The large water renewal that is needed for pond maintenance represents an expressive daily flow of effluent discharge. This residue presents high levels of organic matter, phosphorus, nitrogen, suspended solids, and others substances. By discharging this effluent without treatment, water quality is altered regarding the government standards imposed by CONAMA Resolution No. 357/2005 and by the complementary and updated CONAMA Resolution No. 430/2011. The full dimension of impacts to the mangrove ecosystem cannot yet be precisely measured due to the large load of organic matter present in the discharged fluid, which can saturate the environment and accelerate the process of eutrophication of the water body.

The construction of sedimentation ponds is an alternative for mitigating some of the effects of untreated effluent discharge. Sedimentation ponds act as an intermediate stage between circulation and either the outflow of waste water, as described in Article 14 of the CONAMA Resolution No. 312/2002, or, when necessary, the use of water in a recirculation system. Other possibilities for implementing this type of enterprise have been studied, but the most financially feasible option remains the construction of ponds in mangrove forest areas, despite its unsustainability shown in Figs. 3, 4 and 5.

Fig. 3 Shrimp farm in the municipality of Salinas da Margarida (BA).

Fig. 4 Water catchment and effluent discharge channel in a shrimp farm, Salinas da Margarida (BA).

Fig. 5 Backhoe in a mangrove forest in Canavieiras.

The 2015/2016 Plano Safra established by Seagri encompasses shrimp farming and allows a wide growth potential within the plan. According to the president of Bahia Pesca, a company linked to Seagri, Dernival Oliveira Júnior, the state of Bahia presents a potential area of 100 thousand hectares that are suitable for shrimp farming. On the other hand, this activity is known to occupy areas that are legally prohibited for such.

The Brazilian Forest Code — Law No. 12,651 from 2012 states in Article 4 that "a Permanent Preservation Area, in both rural and urban zones, is considered for the effects of this Law: VII — mangrove forests, in all their extension". The Brazilian National Environment Council (CONAMA) in its resolution No. 312 from 2002 makes it clear in Article 2 that "shrimp farming in mangrove forests is prohibited".

However, in the state of Bahia, this type of activity in mangroves is still very common because the aforementioned Code also states in Article 61 that: "In Permanent Preservation Areas, the continuity of agrosilvopastoral, ecotourism and rural tourism activities consolidated until July 22nd 2008 are exclusively authorized in rural areas". Shrimp farming, according to State Decree No. 14,024/2012 and its alterations made in State Decree No. 15,682/2014, is classified as an agrosilvopastoral enterprise because it refers to animal farming.

In August 1st 2007 (Act No. 2007.8512-4 — Public Civil Action — 6th Federal Court) a lawsuit was filed against the state of Bahia, IBAMA and the Center for Environmental Natural Resources (current Inema), in order to determine the suspension of environmental licenses for implementing new shrimp farming projects in the Coastal Zone of the state of Bahia without previously performing an Environmental Impact Study and without the concurrent participation of IBAMA in the process. This would encompass all activities related to the functioning of new projects, including the construction of larvae laboratories and sellers and buyers of post-larvae shrimps that were produced in such projects. Moreover, the lawsuit was also intended to determine that the Federal Heritage Management must provisionally interrupt the edition of new acts regarding the permission for the use of goods involving shrimp farming projects in the Coastal Zone of the state of Bahia when projects do not present environmental licenses. However, due to the Sentence Execution Suspension Decision of September 1st 2015 issued by the Federal Regional Court of the First Region No. 0045899-31.2015.4.01.0000/BA, via summons by the 6th Federal Court of the 1st Instance, there was an alteration regarding the respective framework, and this activity was once more determined to be licensed following the State Decree in course.

Some shrimp farms were implemented reusing desalination ponds that were previously built using resources of either the Brazilian Development Bank (BNDS) or the Banco do Nordeste. These farms have been, in their majority, in operation for over two decades. Currently, such enterprises face difficulties regarding both the issue of Environmental Licensing due to changes in the current legislation, and also the decision made by law that an Environmental Impact Study must be presented regardless the size of the shrimp farm. With the obstacle of environmental licensing, associations and entrepreneurs complain about the difficulties in keeping their farms operational without the proper license. The last time licenses were granted for this activity was approximately 10 years ago, due to a court decision. This situation has directly affected the productive cycle and the employment chain of the area.

Mass employee dismissal and the fall of the productive cycle in either cities or small areas where shrimp farming was the base of the economy, as well as the greatest reported draught period in northeastern Brazil, have directly influenced rural exodus. Numerically, a study conducted by Cepedes in 2006 showed that 59.37% of farmers left the rural area in the state of Bahia.

5. Conclusion

The conflict between mangrove forest preservation and shrimp farming is evident. The greatest socio-environmental conflicts related to this activity can be inferred to be regarding the irregular occupation of Permanent Protection Areas (PPA), such as mangrove forests, the lack of control regarding water catchment and effluent discharge, and the divergences in both licensing and current legislation.

Therefore, joint and articulated action is necessary among the environmental agencies that are involved in the process of environmental licensing for shrimp farms. Moreover, the conditionings proposed in the Ordinance of these licenses must address mitigation and/or compensatory actions in order to avoid future socio-environmental problems. Thus, the reduction of the existing conflicts would be assured, enabling environmental resources to be used consciously in order to preserve local ecosystems, meeting the demands of Article 225 of the Federal Constitution from 1988, which regards environmental preservation for present and future generations as a duty of both the government and of society.

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