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ENVIRONMENTAL IMPACTS (NEGATIVE AND POSITIVE) OF BREEDING IN COASTAL ENVIRONMENTS: EVALUATION FROM BIBLIOMETRIC ANALYSIS

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Abstract

Shrimp farming has shown high growth in the last decades. In Brazil, most of the shrimp farming projects take place in coastal environments, specifically in mangrove areas. It aims to identify the main environmental impacts that shrimp farming has on coastal environments and thereby discuss mitigation measures. Bibliographic research was used, scientific productions published in national and international scientific journals between the years 2015 to 2019 and which developed studies on the environmental impacts of shrimp farming in coastal environments were verified. The Google Scholar database was used as keywords for the Portuguese terms "shrimp farming", "environmental impact", "degradation". Initially, 504 academic productions. Twenty-one scientific articles were selected and published on the study proposal. The results indicate that the most frequent environmental impacts caused by the development of carciniculture are: deforestation and suppression of mangrove areas, contamination of water bodies, extinction of fishing species and other species of coastal fauna, intensification of the erosion process, among others. The main mitigating measures point to the implementation of environmental and business management and management strategies.

Keywords: Shrimp farming; Environmental Impacts; Mangroves.

IMPACTOS AMBIENTAIS (NEGATIVOS E POSITIVOS) DA CARCINICULTURA EM AMBIENTES COSTEIROS: AVALIAÇÃO A PARTIR DE ANÁLISE BIBLIOMÉTRICA

Resumo

A carcinicultura tem apresentado elevado crescimento nas últimas décadas. No Brasil a maioria dos empreendimentos de criação de camarão ocorre em ambientes costeiros. Apresenta como objetivo identificar os principais impactos ambientais que a carcinicultura tem causado aos ambientes costeiros e através disso discutir sobre possíveis medidas de mitigação. Fez-se uso da pesquisa bibliográfica, verificou-se as produções acadêmicas publicadas em revistas científicas nacionais e internacionais entre os anos de 2015 a 2019 e que desenvolveram estudos acerca dos impactos ambientais da atividade da carcinicultura em ambientes costeiros. Utilizou-se a base de dados *Google* Acadêmico, como palavras-chave os termos em português "carcinicultura", "impacto ambiental", "degradação". Inicialmente foram identificadas 504 produções acadêmicas. Destes foram selecionados e analisados 21 artigos científicos que versavam sobre a proposta do estudo. Os resultados apontam que os impactos ambientais mais frequentes causados pelo desenvolvimento da carcinicultura são: desmatamento e supressão das áreas de manguezais, contaminação de corpos hídricos, extinção de espécies pesqueiras e demais espécies da fauna costeira, intensificação do processo erosivo. As principais medidas mitigadoras apontam para a implantação de estratégias de manejo e gestão ambientais e empresariais.

Palavras-chave: Carcinicultura; Impactos Ambientais; Manguezais.

LOS IMPACTOS AMBIENTALES DE LA CARCINICULTURA EN AMBIENTES COSTEROS

Resumen

El cultivo de camarón ha aumentado en las últimas décadas. En Brasil, la mayoría de las empresas de cría de camarones se encuentran en entornos costeros, específicamente en áreas de manglares. Su objetivo es identificar los principales impactos ambientales que tiene el cultivo de camarón en los ambientes costeros y así discutir las medidas de mitigación. Se utilizó investigación bibliográfica, se verificaron producciones científicas publicadas en revistas científicas nacionales e internacionales entre los años 2015 a 2019 y que desarrollaron estudios sobre los impactos ambientales del cultivo de camarón en ambientes costeros. La base de datos de Google Scholar se utilizó como palabras clave para los términos portugueses "cultivo de camarón", "impacto ambiental", "degradación". Inicialmente, se identificaron 504 producciones académicas. Se seleccionaron y publicaron veintiún artículos científicos sobre la propuesta de estudio. Los resultados muestran que los impactos ambientales más frecuentes provocados por el desarrollo de la camaronicultura son: deforestación y supresión de manglares, contaminación de cuerpos de agua, extinción de especies pesqueras y otras especies de fauna costera, intensificación del proceso de erosión, entre otros. Las principales medidas de mitigación apuntan a la implementación de estrategias de gestión y gestión ambiental y empresarial.

Palabras-clave: Cultivo de camarón; Impactos ambientales; Manglares.

1. INTRODUCTION

Over time, coastal environments have been occupied by various productive activities. According to the National Coastal Management Plan (PNGC) there are several economic activities developed in the Brazilian coastal zone, among them Oil and Gas, Mining, Tourism, Fishing, Shrimp farming, among others. Allied to the development of economic activities, the intensive urbanization process in these areas in recent decades has contributed to the intensification of the environmental degradation process in these environments.

Marine aquaculture, specifically shrimp farming, has been the object of numerous discussions and studies that aim to identify and assess the impact that these productive activities have on these coastal environments. In Brazil, the activity is predominantly developed in the Northeast region, considered the cradle of Brazilian shrimp farming and which emerged in the mid-1970s in the state of Rio Grande do Norte (DE MELO SOARES et al. 2016). Today the Northeast region is responsible for approximately 90% of the national production.

The coastal areas close to mangroves and beehives are the places where the activity is usually performed. For De Paula (2019, p. 3), in the Northeast region, most shrimp farms "use a series of chemical products, which lead to the contamination of water bodies, resulting in the extinction of fishing species". Farias; Andrade (2010) state that the reduction of mangrove areas is mainly due to anthropic actions, as an example the practice of shrimp farming.

Given the relevance of coastal regions for biodiversity and countering this the intensification of anthropic action in this environment, either by the urbanization process or by the use in productive activities such as shrimp farming, the identification in the literature of the environmental impacts that Shrimp farming has caused to coastal environments, mainly mangroves.

For this, as a general objective this article carried out a survey of the state of the art through a bibliographic study identifying the main environmental impacts that shrimp farming has caused to coastal environments and through this to discuss possible mitigation measures for these impacts that maintain the competitiveness of the productive activity and that protects these environments, extremely important for the maintenance of the biodiversity of these places.

2. METHODOLOGY

This is a bibliographical research in which the Google Scholar database was used for the initial survey of articles related to the object of study. Thus, initially a search was carried out on the production of the most recent knowledge regarding the environmental impacts of shrimp farming in coastal environments, especially mangroves in the last 5 years (2015 to 2019).

As procedures, the selection was performed based on the analysis of titles, abstracts, objectives and conclusions, in order to verify if the criteria for inclusion of articles for the purposes of this research would be met and for a first selection of likely articles of interest.

As inclusion criteria, articles that addressed discussions on survey, identification and impacts of shrimp farming published in national and international journals were used. As filters, the survey of the texts was carried out using as keywords the terms "shrine farming", "environmental impact" and "degradation".

The choice of selection of articles published in journals is justified, as these works went through evaluation and review processes by scientific journals.

Thus, initially 504 results were found. At the end of the first selection stage, 20 articles were selected, analyzed, organized into files with a synthesis of each study, in order to apprehend the intended conceptions with the development of the research.

Table 1 presents the list of selected works, authors, year of publication and journal, used in the construction and development of the research.

Table 1 – Articles selected for the study. Source: Survey data (2020)

Order	Author and Year	Article title	Magazine
1	Maia *et al*. (2019)	Environmental impacts on mangroves in Ceará: causes and consequences	Conexões: Ciência e Tecnologia
2	Passos; Klock (2019)	Comparative analysis of the old and the New Forest Code: progress or setback?	Revista Direito Ambiental e Sociedade
3	Souza *et al*. (2019)	Mapping and identification of vectors responsible for mangrove suppression in the Bahia Southern Lowlands Coastal Zone, Brazil	Revista Brasileira de Geografia Física
4	De Paula (2019)	Artisanal fishing in Brazilian geography: impacts/conflicts, environments/territories	Revista Para Onde!?
5	Carvalho; Mello (2018)	Knowing Sergipe's Geodiversity: elements for valuation and geoconservation of the coast and sertão	Geographia Meridionalis
6	Cavalcante; Aloufa (2018)	Integrated Coastal Management in Brazil: A Qualitative Analysis of the National Coastal Management Plan	Revista Desenvolvimento Regional em Debate – DRd
7	Fernandes *et al*. (2018)	Impact of shrimp farming on the Conchas river mangrove, Porto do Mangue, Rio Grande do Norte	Revista Sociedade & Natureza
8	Ferreira; Costa; Pereira (2018)	Legal aspects of shrimp farming in the municipality of Curuçá: perspectives and realities for the activity	Revista Caribeña de Ciencias Sociales
9	De Jesus *et al*. (2018)	Environmental Education and Licensing: a look at the Environmental Impact Reports in the state of Sergipe	Revista de Ciências Ambientais – RCA
10	Gomes; Batista; Lima (2018)	Coverage, soil occupation and erosion around the Laguna Guaraíras/RN, Brazil	HOLOS
11	De Paula (2018)	Environmental impacts on Brazilian artisanal fishing: a geographic interpretation	Revista PerCursos
12	Oliveira (2017)	Environmental zoning and geographical territorial occupation of the Pontas de Pedra district in the municipality of Goiana on the north coast of Pernambuco – Brazil	Observatorium: Revista Eletrônica de Geografia
13	Abreu; Vasconcelos; Albuquerque (2017)	The diversity in the use and occupation of the coastal zone of Brazil: sustainability as a necessity	Conexões: Ciência e Tecnologia
14	Moreira; Júnior (2017)	Socioeconomic and environmental impacts of industrial development in the municipality of Goiana-Pernambuco, Brazil	Revista Contribuciones a las Ciencias Sociales
15	De Melo Soares *et al*. (2016)	Environmental Licensing as a Tool for Sustainability: Analysis of Shrimp Farming in the State of Rio Grande do Norte	Revista Interfaces da Saúde
16	Dos Santos; Da Silva (2016)	Environmental interactions and risks in the coastal plain of the municipality of Itaporanga D'Ajuda	Seminários Espaços Costeiros
17	Neto (2016)	Impact on the realization of economic and social rights of the traditional population of the Pina Basin	NEARI em Revista

18	Lopes; Lourenço; Reuss-Strenzel (2016)	Multicriteria analysis applied to the development of conservation unit zoning in the coastal zone of Bahia, Brazil	Revista Raega - O Espaço Geográfico em Análise
19	De Araújo; Nascimento; Oliveira (2016)	Water Resources and Human Health: industrial impacts and management strategies and environmental protection in the municipality of Goiana/PE	Revista Internacional Interdisciplinar INTERthesis
20	Santos *et al*. (2016)	Social and environmental conflicts in fishing communities in Grande Aracaju, Sergipe, Brazil	Revista Geografar

The following section presents the results of the analysis and discussion of selected articles on the topic and then the final considerations of the study.

3. RESULTS AND DISCUSSION

The development of the entrepreneurial activity of shrimp farming in the Brazilian territory is characterized by a large occurrence in areas close to mangrove vegetation. The area is of fundamental importance for the marine environment, being considered the cradle for the maintenance of the life of several species of coastal fauna and flora, in addition it is important for the maintenance and renewal of water quality, increasing sediment fixation and supply of primary production for the environment and maintenance of biodiversity (KRUG; LEÃO; AMARAL, 2007).

The Brazilian legislation through CONAMA resolution 303/2002 that delimits the permanent protection areas (APP) in the coastal strips (mangrove area and sandbank strips) and the forest code itself, give the mangrove areas the due legal protection, however in the In practice, this has not occurred (FERNANDES et al., 2017).

To Oliveira; Mattos (2007, p.184) the "indiscriminate construction of shrimp ponds and water supply channels represents a reduction in mangrove areas that can affect the regional ecosystem". Gomes; Baptist; Lima (2018), write that despite the shrimp farming activity having a significant economic and social importance not only for the study area, but at the national level, the activity is seen as one of the biggest responsible for the destruction and degradation of areas of mangroves. of Araújo; Birth; Oliveira (2016) writes about a shrimp farming venture built in an extractive reserve (Resex Acaú-Goiana), which ended up destroying local mangroves, damming the waters of the estuaries, harming its renewal and causing serious imbalances in this ecosystem.

Oliveira (2017, p. 31) cites that among the various activities developed in coastal areas, "the most harmful is shrimp farming due to the construction of fattening ponds in restinga, apicum and mangrove environments, with the consequences of destroying native vegetation" . Abreu; Vasconcelos; Albuquerque (2017) in his study on the diversity of land use and occupation activities in coastal zones, report that shrimp farming poses a risk (reduction of mangrove areas and water contamination) to the coastal zone from the moment of its implementation until the execution of the projects of the productive sector. De Melo Soares et al. (2016) write about the importance of the licensing process for this type of productive activity and the relevance of diagnosing the size of the enterprise, since the larger the enterprise's size, the greater the capacity or potential for negative impact on the coastal environment.

Souza et al. (2019) identify two vectors responsible for the suppression of mangrove areas in Bahia: the first one is due to the disorderly expansion of urban areas and the other vector is due to the advance of the clandestine shrimp farming activity that occurs without the proper licensing process environmental.

Birth; Pereira; Dória (2007) identified a loss of approximately 25% of Brazilian mangrove areas as a result of human activities, including shrimp farming. Fernandes et al. (2018) carried out a study on the evaluation of the impact of shrimp farming in mangroves, using the Conchas river, Porto do Mangue, in the state of Rio Grande do Norte as a study base. The authors identify, through remote sensing techniques, significant losses of mangrove vegetation between 1999 and 2007, a consequence of the inadequate disposal of effluents in water bodies and the lack of planning in the development of the shrimp farming productive activity.

Oak; Mello (2018, p. 213) cite the great potential for environmental impact that shrimp farming can cause "that in addition to suppressing vegetation, the use of certain types of antibiotics and artificial feeding, alter the quality of water released into the environment" . Godoy (2015) mentions that shrimp farming is one of the main factors in reducing mangrove areas in Ceará estuaries. Maia et al. (2019) in their study on the environmental impacts on mangroves in the state of Ceará, highlight that shrimp farming has mischaracterized mangrove areas, directly influencing the ecosystem. They also report in this study that 84.1% of shrimp farms in Ceará cause damage to apicuns or salty, mangrove features.

The results of the reduction of vegetation cover in areas such as mangroves, brings significant consequences to these environments, such as the reduction of the diversity and density of benthic fauna (MAIA et al., 2019; BOSIRE et al., 2004), characterized by creeping organisms and that they are home to several animal species. In addition, the reduction of vegetation cover limits and impacts the functioning of the entire biota and hinders the possibility of recovering these environments (MAIA, et al., 2019; PAULA; LIMA; MAIA, 2016; SILVA, 2017; SILVA; MAIA et al., 2018). For Dos Santos; Da Silva (2016, p. 3):

> "Because of the influence of fresh and salt water, the mangrove is rich in nutrients and has a great diversity of species of adapted fauna and flora. In this morphology,

> there is often deforestation for the introduction of dikes in order to build tanks for the implementation of shrimp farming. However, these changes in the environmental system cause the interruption of the interconnection between the flows of matter and energy, with a consequent change in the production of nutrients, reduction of areas used as refuge for fauna and feeding area for migratory birds, causing a reduction in biodiversity environmental and providing a threat to the food sovereignty of traditional communities and to productive activities such as tourism and community fishing".

As for the disposal of effluents generated in the activity of shrimp farming, the large amount of organic load present in these effluents causes the contamination of fauna and flora in these environments. De Paula (2018) states that in the Northeast region, aquaculture, especially shrimp farming, is one of the main causes of environmental impacts.

Saints; Silva (2016, p. 11) report that "the cleaning process of the nurseries causes the contamination of the watercourse, due to the dumping of chemical products in the estuary". Thus, the areas where the shrimp farming activity is developed must be constantly monitored, with the need for these projects to go through an environmental licensing process for the activity (DE PAULA, 2018; LOPES; LOURENÇO; REUSS-STRENZEL, 2016).

Cavalcante; Aloufa (2018) analyze the National Coastal Management Plan and in their considerations argue that the expansion of economic activities in coastal areas, including shrimp farming, also brings several negative environmental impacts to the coastal environment. They also claim that measures such as the expansion of control over the planning of the use of natural resources and the proper occupation of coastal spaces, in addition to the correct application of legal instruments for the use and occupation of these environments by productive activities can bring positive results to the management of coastal zones.

From Jesus et al. (2018) analyze Environmental Impact Reports (RIMA) from 10 municipalities in the state of Sergipe and point out the main negative impacts of shrimp farming, such as interference in water circulation patterns, landscape degradation, suppression of vegetation cover and interference in the activity local fishing. As a positive impact, the authors cite the increase in the number of jobs generated by the activity.

Silva (2002) states that the mangrove areas most affected by human activities are the most urbanized areas. This process of urbanization and occupation of mangrove areas, which in the Brazilian case occurs in a disorderly manner (SOUZA, 2009), makes the negative impact on this environment even more intense. Thus, mangrove areas close to urban centers have been the object of speculation in the real estate market over time and, as a result, these areas have gone through landfill processes, which end up impacting the existing ecosystem (NETO, 2016).

Moreira; Júnior (2017) describe that shrimp farming and urban expansion have caused the intensification of the erosive process on the coast of Goiás, which has brought imbalance to the ecosystem. Fernandes et al. (2018) in the field study identified erosive and backfilling processes of mangrove areas due to shrimp farming activity, the authors infer that the elevation of the terrain reduced or eliminated the ebb and flow of tides in the region under study, modifying the entire ecosystem of the region, with consequent drying of the roots and death of the mangrove vegetation.

In another study, Steps; Klock (2019) report that the reduction of mangrove areas in the last and decades is a reflection of the growth of shrimp farming and urban expansion. This directly reflects on fishing activities and directly affects the lives of the population that lives in this area. Santos et al. (2016, p. 12) writes that in shrimp farming:

> Deforestation of the mangrove is necessary, which contributes to the reduction of the habitat of species, such as crabs; from the shellfishing area, which leads fisherwomen to move to more distant places or even abandon the activity, thus causing an environmental and social impact.

When discussing the environmental impacts of shrimp farming, the economic and social importance of this activity for riverine families must be taken into account, as this is often the only subsistence activity for these families (NETO, 2016). In addition, the environmental impact of human activities on mangrove areas is the result not only of the development of activities related to aquaculture, such as shrimp farming, but also due to the process of intensification of urbanization in recent decades.

Gomes; Baptist; Lima (2018), point out several negative impacts that shrimp farming can cause in aquatic environments, such as the siltation process of water bodies, accumulation of sediments and tailings and organic load, which can cause an increase in the process of eutrophication of water and change in the ecosystem of these environments, change in the flow of water bodies, salinization of groundwater, destruction of mangroves and areas around them, introduction of exotic species and spread of epidemics. This highlights the close relationship between shrimp farming and negative impacts on the environment.

De Oliveira (2017, p. 46) lists the main environmental impacts caused by the development of shrimp farming based on data from the Commission for the Environment and Sustainable Development (CMADS) of the Chamber of Deputies in Brasília in 2005, among which are:

> "[...]modification of tidal flow; reduction and extinction of habitats of numerous species; extinction of shellfish fishing and crab capture areas; expelling fishermen from their places of work; prohibition of access to fishing areas; collecting crabs and shellfish; contamination of water intended for human consumption; spread of diseases among crustaceans; destruction of the landscape and land conflicts arising from the privatization of Union lands (marine lands and vacant lands), in addition to cumulative damage along the hydrographic basins where the farms are located"[...].

Of the Saints; Da Silva (2016) write that shrimp farming can cause morphological changes in coastal features due to the reduction of vegetation and destruction of the existing native cover for the implementation of nurseries. The vegetation in these

environments fixes the sand for the formation of dunes, and its removal impacts the deformation of the coastline, alters the flow of sediment transport, reduces the protection of groundwater, thus increasing the vulnerability of coastal environments.

Table 2 presents a summary of the environmental impacts generated by shrimp farming in coastal environments identified in the articles selected in the study.

Table 2 – Negative Environmental Impacts of Shrimp Farming on Coastal Environments. Source: Survey data (2020

Item	Impact	Authors
1	Occupation, degradation and suppression of mangrove areas and their surroundings (apicuns) and deforestation or reduction of forest cover	Maia *et al*. (2019); Souza *et al*. (2019); Cavalcante; Aloufa (2018); Fernandes *et* al. (2018); Gomes; Batista; Lima (2018); Jesus *et al*. (2018); Abreu; Vasconcelos; Albuquerque (2017); De Oliveira (2017); Moreira; Júnior (2017); Neto (2016); Santos *et al*. (2016); De Melo Soares *et al*. (2016); Dos Santos; Da Silva (2016)
2	Contamination of water bodies, degradation of water quality	De Paula (2019); Maia *et al*. (2019); Carvalho; Mello (2018); De Paula (2018); Jesus *et al*. (2018); Abreu; Vasconcelos; Albuquerque (2017); Lopes; Lourenço; Reuss-Strezel (2016); Dos Santos; Da Silva (2016)
3	Extinction of fishing species and other species of coastal fauna, loss of biodiversity	De Paula (2019); De Paula (2018); Jesus *et al*. (2018); De Araújo; Nascimento; Oliveira (2016); Santos *et al*. (2016); Dos Santos; Da Silva (2016)
4	Intensification of erosive processes	Fernandes *et al*. (2018); Gomes; Batista; Lima (2018); Moreira; Júnior (2017); Dos Santos; Da Silva (2016)
5	Modification of the flow of water bodies in estuaries or interference with water circulation patterns in estuaries, modification of tidal flows	Maia *et al*. (2019); Gomes; Batista; Lima (2018); Jesus *et al*. (2018); De Oliveira (2017); Dos Santos; Da Silva (2016)
6	Inadequate disposal of solid waste; accumulation of sediment, garbage, debris and other tailings in the aquatic environment	Maia *et al*. (2019); Fernandes *et al*. (2018); Gomes; Batista; Lima (2018); De Oliveira (2017)
7	Silting and grounding	Gomes; Batista; Lima (2018); Dos Santos; Da Silva (2016)
8	Eutrophication of the aquatic environment	Gomes; Batista; Lima (2018)
9	Salinization of groundwater and fresh water	Gomes; Batista; Lima (2018); Abreu; Vasconcelos; Albuquerque (2017)
10	Risk of introducing exotic species and spreading epidemics with the spread of diseases among crustaceans	Gomes; Batista; Lima (2018); De Oliveira (2017)
11	Reduction and extinction of habitats for numerous species	De Oliveira (2017)
12	Extinction of shellfishing, fishing and crab capture areas; expelling fishermen from their places of work; prohibition of access to fishing areas; of crab and shellfish collection	De Oliveira (2017)

13	Contamination of water intended for human consumption	De Oliveira (2017)
14	Modification or destruction of the natural landscape	De Oliveira (2017); Dos Santos; Da Silva (2016)
15	Cumulative damage along the watersheds where the farms are located	De Oliveira (2017); Dos Santos; Da Silva (2016)
16	Changes in the morphology of coastal environments and dune fields	Dos Santos; Da Silva (2016)

Ferreira et al. (2018) in their study that assesses the legal aspects applied to shrimp farming management, state that the environmental impacts caused by shrimp farming have a close relationship with the producer, who despite knowing the legislation that regulates the farming activity, often this still lacks sensitivity to the environmental issue. Added to this is the search for greater economic gains by producers and the omission of environmental inspection agencies at both the federal, state and municipal levels.

As mitigating measures that provide for the reduction of these impacts, it is necessary to implement actions for planning the correct use and management of the coastal environment in an integrated manner, with the participation of government and inspection bodies, entrepreneurs and the local community who live in these environments. Also as measures to mitigate the impacts of the activity in coastal areas, companies can use technological means in the management of their activities, such as the use of probiotics to reduce effluent contamination, use of waste decantation basins, analysis and monitoring the water and water bodies that supply the farms and the effluents generated by the activity; non-use of permanent protection areas (APP) for the installation of nurseries; licensing of farms, among other mitigating measures.

International studies corroborate the results found in this research. Thus, several recent studies can be observed (HARGAN et al. 2020; JASMIN et al. 2020; LE et al. 2020; MORSHED et al. 2020; NGUYEN et al. 2020; PHAM et al. 2020; PIMENTEL; AMADO; THEM, 2020; SWARNOKAR; ASHIK-UR-RAHMAN; MOU, 2020; ZHAO et al. 2020) published in international journals identify negative impacts related to the execution of shrimp activity in captivity such as increased salinity of water and soil, reduction or depletion of natural resources, impacts on biodiversity, reduction in agricultural production; reduction in fish production or food security, reduction of wild or natural stocks, inadequate use of environmental resources, water pollution, outbreak of diseases and pathogens, reduction and negative impacts on mangroves, apicums and flooded areas, eutrophication, high discharge of effluents and organic matter, among others.

In these studies, in addition to the identification of impacts, it is possible to verify proposals that aim to propose improvements in the environmental performance of the activity, making them more sustainable as Joffre et al. (2020) who state that the increased use of technologies in shrimp farming and the formation of groups of producers that provide exchange of information and greater interaction can contribute to the adoption of sustainable practices. Hargan et al. (2020) relate technological practices such as the introduction of closed systems and better food efficiency, in addition to supporting local aquaculture, which can help reduce organic matter discharges into coastal ecosystems and contribute to a more sustainable practice.

4. FINAL CONSIDERATIONS

Based on the literature analyzed in this study, it is inferred that the production activity of shrimp farming can, when not developed in a planned manner and with proper management, bring negative impacts to the coastal environment, especially mangrove vegetation and water bodies that function as driving tool for the operation of the activity.

As for the objective of the research, which was to identify and evaluate the impact that the production activity of shrimp farming causes to coastal environments, and based on bibliometric analysis, several impacts that may be caused by the activity or that are directly or intimately linked to shrimp farming: occupation, degradation and the suppression of the customs of the mangrove areas and their surroundings (apicuns); deforestation or decrease in forest cover; contamination of water bodies and degradation of water quality; extinction of fishing species and other species of coastal fauna, in addition to the loss of biodiversity; intensification of erosive processes; modification of the flow of water bodies in estuaries or interference with water circulation patterns in estuaries, modification of tidal flows; inadequate disposal of solid waste; accumulation of sediments, garbage, debris and other tailings in the aquatic environment; siltation and filling of water bodies; increase in the eutrophication process of the aquatic environment; salinization of groundwater and fresh water, such as lakes and lagoons; risk of introducing exotic species and spreading epidemics with the spread of diseases among crustaceans; reduction and extinction of habitats of numerous species; extinction of shellfishing, fishing and crab capture areas; contamination of water intended for human and animal consumption; modification or destruction of the natural landscape; cumulative damage along the watersheds where the farms are located and changes in the morphology of coastal environments and dune fields.

The solutions for mitigating environmental impacts indicate that entrepreneurs should seek to adapt the production process for a better management of the activity, including the use of technologies. It also highlights the need for greater inspection by government agencies and greater involvement of the local community.

Although the works do not present in their discussions mitigation measures that promote a greater inclusion of sustainable practices that meet the new demands of the consumer market, the activity can, for example, promote the application of

environmental certification as a positive and innovative alternative in shrimp farming.

On the other hand, it was identified that shrimp farming causes positive impacts, such as the socioeconomic role it plays in coastal communities, often being the only source of income for these populations. As a suggestion for future research, the database can be expanded using other databases such as Scielo and Web of Science to identify not only the impacts associated with the development of shrimp farming in coastal environments, but also the verification of the management of these projects, use of technologies and measures to mitigate the environmental impacts caused by the activity.

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