



Brazil welcomes the opportunity to contribute to the Sharm el-Sheikh online portal under the Sharm el-Sheikh joint work on implementation of climate action on agriculture and food security, recognizing its important role in sharing information on projects, initiatives and policies for increasing opportunities for implementation of climate action to address issues related to agriculture and food security.

Carciniculture in salt-affected lands: reducing pressure on coastal ecosystems and providing family farmers with the means to adapt

I. Introduction

This submission portrays inland shrimp farming (carciniculture) in semi-arid interior regions of Northeastern Brazil as an example of an adaptive strategy centered on the use of salt-affected lands for food production. Historically, Brazilian carciniculture was intrinsically linked to coastal zones, affecting the mangroves and estuarine ecosystems and exacerbating competition with other land uses. However, the last two decades have witnessed a rapid, transformative "carciniculture interiorization", a movement redrawing the national aquaculture map, with the co-benefit of alleviating pressure on mangrove and other coastal ecosystems.

Aquaculture is often viewed as an adaptation strategy for fisheries declines, thereby alleviating food security from losses of other climate change impacts. Many adaptations are specific to regions, countries or sectors, such as Pacific Islands freshwater aquaculture, Bangladesh cropaquaculture systems or Viet Nam rice–fish cultivations. Cultivations of brackish species (shrimp, crabs) during dry seasons in Thailand and conversion of inundated rice paddies into aquaculture in Viet Nam, rotating shrimp, rice culture, and other salt-tolerant plants, are examples of adaptive strategies presented by the Intergovernmental Panel on Climate Change. In Brazil, integrated multi-trophic aquaculture and croplivestock-forest-aquaculture integration systems are widely practiced, presenting advantages and

environmental impacts specific to each region and biome.

Likewise, "Carciniculture interiorization" is a nature-based adaptation strategy to regions characterized by natural brackish water aquifers, potentially replicable in countries with areas unsuitable for agriculture due to saline-water intrusion and desertification. The Ministry of Fisheries and Aquaculture intends to receive cooperation and offer support to countries interested in replicating such adaptation technology in salt-affected lands.

The shift from coastal to in-land carciniculture in Northeastern Brazil was spurred not only by the existence of brackish water aquifers. The adaptability of the *Litopenaeus vannamei* shrimp species to diverse salinities and considerably lower inland land acquisition costs were also determinant to create a new economic frontier in a region with historically limited, low-profit agricultural alternatives.

The alleviation of carciniculture's pressure on coastal ecosystems, particularly mangroves, has been an unintended but desirable co-benefit of this interiorization process. Mangroves are among the most effective carbon sinks on the planet, as they capture and store carbon at a rate up to ten times greater per hectare than a mature tropical rainforest. Mangroves are also the first and best line of defense for coastal communities against the immediate physical impacts of climate change.

As in other parts of the world, many mangroves in Brazil have long been characterized by land use conflicts, involving real estate speculation, environmental degradation, pollution and effluent discharge, and frictions between environmentalist organizations, traditional communities, and government agencies.

In contrast, semi-arid interior regions in Northeastern Brazil have extensive underutilized areas, where carciniculture can prosper without major socio-environmental conflicts or constraints. As a result, while coastal carciniculture stagnates, inland carciniculture is rapidly expanding, with its backbone being smallholders migrating from subsistence livestock and other traditional agriculture toward carciniculture's higher profitability. An estimated 85% of shrimp farms in Northeastern Brazil are classified as micro and small (under 10 hectares).

In this context, if investments are provided to family farmers to produce *Litopenaeus vannamei* and other shrimp species in salt-affected lands in semi-arid areas of Northeastern Brazil, and if regular funds are applied in development and implementation of technologies that ensure the sustainability of shrimp production, then family farmers would be more prepared to adapt to the effects of climate change, leading to more income, less inequality and stronger food security, while alleviating the carciniculture's pressure on mangrove and other coastal ecosystems.

II. The project

The project primarily target is expanding the number of micro and small rural properties in semi-arid Northeastern Brazil transitioning into inland carciniculture. This is achieved by providing smallholders with capacity building in shrimp production and farm management, as well as access to repayable credit (loans) and non-repayable funds (grants) designated for installation and the adoption of standardized technology packages.

Farm installation costs are relatively consistent (homogeneous) across units, enabling the use of clear indicators to assess the initiative's implementation progress. Set-up costs are related i.a. to administrative and environmental licensing; pond excavations; production, packaging, refrigeration, and transport equipment; standardized technology packages for water management (extraction, recirculation, monitoring, and purification systems); biofloc; and effluent and sludge (waste) management systems.

The project will be implemented by academics and technical experts specializing in aquaculture, hydrology, and biotechnology, specifically focusing on water management and nutrition, administered by the Ministry of Fisheries and Aquaculture. Implementation will also involve partnerships with the productive sector (feed and post-larvae suppliers) and local cooperatives. Priority will be given to family farmers adapting existing rural properties, particularly those transitioning from traditional subsistence farming.

The partner entities possess infrastructure for research, systems development, and stakeholder training. They will be responsible for the

development and implementation of specific technologies that ensure the sustainability of shrimp production, focusing on the proper disposal of waste and effluents; avoiding the contamination and eutrophication of freshwater sources; ensuring electrical infrastructure capacity and access to low-cost electricity, including the use of solar and wind energy; and establishing mechanisms for rapid disease diagnosis and response to sanitary crises. They will also promote the diversification of produced species, including technology packages to cultivate native species of shrimps, aquaponics, and integrated multi-trophic aquaculture.

This integrated approach ensures the project responds to territorial realities, managing the specific technical challenges of the semi-arid climate. Success depends on the rigorous management of water quality, as *L. vannamei* thrives at temperatures (26°C–33°C) predominant in the Northeast, but parameters like pH, dissolved oxygen, ammonia, and nitrite fluctuate rapidly in high-density systems. The project will address the specific ionic composition of inland brackish water, which differs from seawater and may require correction.

Project ownership will be guaranteed through capacity building in sustainable technologies. Environmental sustainability and drought resilience require minimizing effluent discharge. The project will focus on adopting recirculation systems that treat and reuse water, ranging from simple sedimentation basins—which, though effective, increase implementation costs—to Biofloc Technology (BFT), which represents the most advanced form of in situ treatment and reuse.

The project is currently in the preparation phase, being complementary to existing policies led by the Ministry of Fisheries and Aquaculture to support family farmers and supply locally produced shrimp to public elementary schools.

Implementation will start immediately after regular funding is granted, covering an initial four-year period. It will encompass the development and adaptation of technology packages; building capacities in the local communities to produce, process and trade production; and a multiphase ecological risk assessment.

This submission seeks to secure funding for the project (US\$ 5 million). Partnerships with international research institutions, donors and

investors will also contribute to expand carciniculture in micro and small properties in Northeastern Brazil, offering smallholders better conditions to remain in their farms and adapt to climate change.

III. Scientific evidence

There is extensive technical literature validating the core inputs and risks of the production chain. The entire sector is dependent on two essential inputs: a constant supply of healthy, pathogen-free post-larvae (PLs) from specialized laboratories; and nutrition. Feed is the single largest operational expense, often representing over half the costs of a productive cycle, and its quality directly influences both shrimp growth and the water quality of the pond.

Evidence confirms the industry is vulnerable to viral and bacterial disease outbreaks, which can cause mass mortality and total production loss. Technical risk assessments identify clear mitigation measures based on verified data.

Indicators will be based on well-established production and biosecurity protocols.

IV. Conclusion

Northeastern Brazil accounts for over 99% of national shrimp production. "Carciniculture interiorization" has been a transformative process in this sector, providing family farmers a viable means to adapt beyond historically low-profit agriculture, while reducing pressure on coastal disputed areas, particularly mangroves.

V. References

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